TIME, SPEED AND DISTANCE
10

INTRODUCTION

The chapter of Time, Speed and Distance (tsd) is amongst the most important for the purpose of the Quantitative Aptitude section in aptitude exams. This chapter can be divided into two parts – Time, Speed and Distance & Applications of Time, Speed and Distance (comprising of questions from various situational-based problem types that include: Boats and Streams; Clocks, Races and Games of Skill, Trains, Circular Motion, etc.). Besides, the basic concepts of TSD are used in solving questions based on motion in a straight line, relative motion and circular motion.

Due to this diversity in the possibilities for question setting, this chapter is very important for CAT aspirants. Besides, all other exams based on aptitude - XAT, IIFT, NMAT, SNAP, CMAT, MAHCET, CMAT and Banking, Clerical/SSC, UPSC-CSAT and all other aptitude exams regularly ask questions on Time, Speed and Distance.

Rarely do you come across a year, when questions from this chapter are missing in any of these exams. Hence, my advice to all students using this book to prepare for any of these aptitude exams including CAT - closely understand the concepts contained in this chapter to be comfortable with the problems related to this topic in the examination.

THEORY OF TSD

Concept of Motion and MathematicalRepresentation of Motion

Motion/movement occurs when a body of any shape or size changes its position with respect to any external stationary point. Thus, when a person travels from

city *A* to city *B*, we say that he has moved from city *A* to city *B*. In general, whenever a body moves with respect to a stationary point, we say that the body has undergone a displacement/motion with respect to the starting point. Thus, for motion to have occurred there must have been some displacement with respect to a stationary point on the ground.

The mathematical model that describes motion has three variables, namely: Speed, Time and Distance. The interrelationship between these three is also the formula on which this whole chapter hinges, namely:

1. Speed × Time = Distance (equation for the description of one motion of one body). Of course, this equation has three forms, namely:
2. Distance/Time = Speed and
3. Distance/Speed = Time.

In the equations above, *speed* can be defined as the rate at which distance is covered during the motion. It is measured in terms of *distance* per unit time and may have any combination of units of distance and time in the numerator and the denominator respectively (m/s, km/hour, m/min, km/min, km/day, etc.).

When we say that the speed of a body is *S* km/h, we mean to say that the body moves with S km/h towards or away from a stationary point (as the case may be).

Time (*t*) is the time duration over which the movement/motion occurs/has occurred. The unit used for measuring time is synchronous with the denominator of the unit used for measuring speed. Thus, if the speed is measured in terms of km/h, then time is measured in hours.

Distance (*d*) is the displacement of the body during the motion.

The need for maintaining consistency in the units used: The most common units used for speed are km/h or meters /second. The most common units used

for measuring time are hours or seconds, while the most common units used for measuring distance are kilometers and meters. One of the basic things that you need to get correct while using this formula is to use units for the three variables such that they are in sync with each other. Thus, if speed is measured in km/h then time should be in hours and distance in kilometers.

Likewise, if the speed is measured in meters/second, then naturally we should use distance in meters and time in seconds. These conversions need to be done, in questions where non-synced units are provided for the three variables. So, for instance, in some cases speed might be provided in km/h, while time and distance might be provided in seconds and meters. In such cases, one has to convert km/h to meters/second.

The following rules apply for these conversions:

Conversion from km/h to m/s → Use a multiplying factor of 5/18. For instance, 18 km/h = $18 \times \frac{5}{18}$ = 5 m/s

Conversion from m/s to km/h → Multiply by 18/5. Thus, 10 m/s = $10 \times \frac{18}{5}$ = 36 km/h.

Conversion between meters and kilometers → 1 meter = 1/1000 kilometers, 1 kilometer = 1000 meters

Conversion between seconds and hours → 1 hour = 3600 seconds, 1 second = 1/3600 hours

Converting minutes to hours: The normal process to convert a number in minutes to hours is to use a multiplier of 1/60. Thus, 1 minute = 1/60 hours; 2 minutes = 2/60 hours and so on. This conversion also has an interesting decimal implication. Consider the following:

1 minute = 0.01666 hours, 2 minutes = 0.03333 hours, 3 minutes = 0.05 hours, 4 minutes = 0.0666 hours, 5 minutes = 0.08333 hours, 6 minutes = 0.1 hours. 7 minutes = 0.11666 hours, 8 minutes = 0.1333 hours and so on. The stu-

dent is advised to master these decimal values so that he/she has enabled two-way conversions in the mind. Thus, 47 minutes = 42 +5 = 0.7 + 0.0833 hours = 0.78333 hours. Conversely, 0.7833 hours would be converted to minutes as follows: 0.7 hours = 7 × 6 = 42 minutes + 0.0833 hours = 5 minutes.

Hence, 0.7833 hours = 42 + 5 = 47 minutes.

Basic Uses of the Time, Speed and Distance Equation:

The first three reactions that you should organise in your mind, with respect to this chapter are the reactions that involve being given two of these in order to help finding the third. Thus, these three reactions play out as follows:

(1) 'A car travels at 100 km/h for 3 hours: Reaction: $S \times t$ = distance → 100 × 3 = 300 km/s

(2) A man travels from Delhi to Jaipur a distance of 250 km in 5 hours: Reaction: Distance/time = Speed → 250/5 = 50 km/h.

(3) A bus covers a distance of 200 km from Mumbai to Pune at a speed of 40 km/h: Reaction: Distance/Speed = time → 200/40 = 5 hours.

The above relationships are the mathematical descriptions of the movement of a body and as can be seen, are essentially the relationships between the three variables. This is the only formula on which the whole chapter of time, speed and distance, as well as the applications of this chapter hinge. Yet, in spite of the whole chapter being dependent on only one formula, some of the toughest and most complex questions in Arithmetic come from this chapter! This would be contrary to what one would expect from a chapter with only one formula. So, how are these complications created? A little bit of analysis will show you that an individual time-speed-distance question is normally a mix of multiple motions- and the formula needs to be applied multiple times in order to solve an individual question. This is one of the main reasons that I see students struggling with solving questions based on time, speed and distance.

Hence, one of your first focuses of trying to get a grip of this chapter has to be centred on improving your ability to identify the number of motions that are happening and described in an individual question. The moment, you improve that ability, your ability to create equations and hence solve them to solve complex questions in time, speed and distance would improve drastically.

Proportionalities Implicit in the Time-Speed-Distance Equation:

The above equation has three implicit proportionality dimensions each of which has its own critical bearing on the solving of time, speed and distance problems.

1. Direct proportionality between time and distance (when the speed is constant); time ∝ distance:

> ***Note:*** Speed is constant here means that - between two motions described either explicitly or implicitly in the problem, the speed should be the same.

Illustration

A car moves for two hours at a speed of 25 km/h and another car moves for three hours at the same speed. Find the ratio of distances covered by the two cars.

Solution: Since, the speed is constant, we can directly conclude that time ∝ distance.

Hence, $\frac{t_A}{t_B} = \frac{d_A}{d_B}$

Since, the times of travel are two and three hours, respectively, the ratio of distances covered is also 2/3.

> ***Note:*** This proportionality is basic common sense. However, if you were to work on questions of this chapter, you would find that this is the least important of the three proportionalities in this chapter. The other two proportionalities are much more important, hence let's take a look at those now.

2. Direct proportionality between speed and distance (when the time is constant); speed $\propto$ distance:

Note: This proportionality is one of the important proportionalities of this chapter and is usable when the time of travel in two motions is the same. The same time of travel can be indicated to you through multiple ways - both explicit and implicit. Consider the following cases, where you should be able to sport time constancy and hence, be able to use this proportionality.

Explicit ways in which time constancy is communicated:

(a) *A body travels at S_2 km/h for the first two hours and then travels at S_1 km/h for the next two hours.* Here two motions of one body are being described and between these two motions, the time is constant hence, speed will be proportional to the distance travelled.

(b) *A car travels for half the time @ 30 km/h and the other half of the time @ 50 km/h.* (Here, since time is divided into two halves, you should be able to identify that there are two journeys described here, whose times are constant).

Implicit ways of communicating time constancy:

(a) *Two cars start simultaneously from A and B respectively towards each other with speeds of S_1 km/h and S_2 km/h. They meet at a point C.* You should be able to see that in this situation, even though they have not explicitly mentioned that the time is same, it is implied as a part of the situation – since, the two cars have started together and they are meeting at a point

(obviously again the time is the same). Thus, the time of the two movements, are the same.

(b) Often in situations involving to-and-fro motions, moving bodies start at the same time and meet at a point and after the meeting; they keep travelling to-and-fro between the same points, turning back when they hit the ends. Questions based on such situations are very common in this chapter. In such situations, the bodies meet multiple times and time constancy is implied when we consider the movement of two bodies between one meeting point and another.

Example: Two people travel to-and-fro between Calcutta and Kharagpur, starting from opposite ends and reversing directions when they reach their destinations. They keep doing so and hence, meet multiple times. Define M_1 as their first meeting point, M_2 as the second, and $M3$ as the third and so on.

In such a case, the movement of the first person between M_1 and M_2, and the movement of the second person between M_1 and M_2, would involve the same time. Likewise, their movements between M_2 and M_3 would also involve a time constancy situation.

(c) A similar situation occurs when two or more people run multiple times around a circle (either in same or in opposite direction). In such a situation, these people would be meeting multiple times and these meeting points can again be defined as M_1, M_2, and M_3 and so on.

The analysis in this case would be similar to the one discussed in the to-and-fro situation above. The movement of the first person between M_1 and M_2, and the movement of the second person between M_1 and M_2, would involve the same time. Likewise, their movements between M_2 and M_3 would also involve a time constancy situation.

When time is constant, the following ratios and thought-processes are valid: Assume that there are two motions M_1 and M_2. Let M_1, S_2 and d_1, d_2 be the speeds and distances of the two motions, respectively.

Thought 1: $S_1/S_2 = d_1/d_2$. (This can also be thought of as the direct transfer of the speed ratio to the distance ratio and vice versa.)

Thought 2: If speed from S_1 to S_2 grows by 20% percent, then the distance d_2, would also be larger than d_1 by 20%. (The same percentage change in distance as in speed and vice versa)

Thought 3: If the speed is multiplied by 6/5, going from S_1 to S_2, then the distance would also be multiplied by 6/5 going from d_1 to d_2. (The same multiplication ratio is to be used in distance as in speed and vice versa.)

Thought 4: If the speed increases by 1/5, going from S_1 to S_2, then the distance would also increase by 1/5, going from d_1 to d_2. (The same fractional change is to be used in distance as in speed and vice versa.)

Thought 2: If speed from S_1 to S_2 grows by 20% percent, then the distance d_2, would also be larger than d_1 by 20%. (The same percentage change in distance as in speed and vice versa)

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Illustration

(i) A car travels at 30 km/h for the first two hours of a journey and then travels at 40 km/h for the next two hours of the journey. Find the ratio of the distances travelled at the two speeds.

Solution: Since time is constant between the two motions described, we can use the proportionality between speed and distance.

Hence, $d1/d2 = s1/s2 = 3/4$

Alternatively, you can also think in terms of percentage: d_2 will be 33.33% higher than d_1 since S_2 is 33.33% higher than S_1 and time is constant. You could also have thought of it as since speed is getting multiplied by 4/3, distance would also get multiplied by 4/3.

(ii) Two cars leave simultaneously from points A and B on a straight line towards each other. The distance between A and B is 100 km. They meet at a point 40 km from A. Find the ratio of their speeds.

Solution: Since time is the same for both the motions described, we have ratio of speed = ratio of distance.

$$SA/SB = dA/db = 40/60 = 2/3$$

(iii) Two cars move simultaneously from points A and B towards each other. The speeds of the two cars are 20 m/s and 25 m/s respectively. Find the meeting point if the distance between them is 900 km.

Solution: For the bodies to meet, the time of travel is constant (since the two cars have started to move simultaneously).

Hence, speed ratio = distance ratio

→ 4/5 = distance ratio

Hence, the meeting point will be 400 km from A and 500 km from B.

3. Inverse proportionality between speed and time (when the distance is

constant) ;speed ∝ 1/time

Note: This proportionality is also seen in a lot of questions and hence, quite important for you to understand. Between two motions described, if the distance covered is the same, then the speed would be inversely proportional to time. This situation too can be described in explicit and implicit ways. Some of the common descriptions you would see in the questions are provided below.

Explicit ways of communicating distance constancy in problems:

(a) *A body travels at S_1 km/h for the first half of the journey and then travels at S_2 km/h for the second half of the journey.*

(b) *A car travels at 50 km/h for 100 km and 80 km/h for the next 100 km.*

(c) Two people Ram and Shyam cover the same distance at speeds of 6 km/h and 7.5 km/h, respectively.

In each of the above cases, the situation described should show you two things – i) That there are two motions described. ii) Between the two motions, the distance travelled is constant – hence the speeds of the two motions would be inversely proportional to time travelled for in the two motions.

Implicit ways of communicating distance constancy in problems:

(a) Two cars start simultaneously from A and B, respectively towards each other at speeds of S_1 and S_2 km/h, respectively. They meet at a point C and reach their respective destinations B and A in $t1$and $t2$ hours, respectively.

(b) A man goes to office and comes back. (Any motion describing going and coming back over the same distance is actually a description of two motions).

(c) A man walks at 3/4th of his normal speed and is late to reach office by twelve minutes. (This situation is again describing two motions of the man – going to his office at different speeds on different days).

(d) Travelling at 12 km/h, a man is ten minutes late in reaching his office. The next day, he travels at 15 km/h and is now late by only four minutes. (Two motions are described over the same distance).

(e) Rohit covers the distance from Delhi to Jaipur at 80km/h, while his friend Sushil covers the same journey at 100 km/h.

(f) Two runners *A* and *B* are running around a circle. A can cover the circle in twelve minutes, while *B* covers the circle in fifteen minutes. (In this case, since the movements are described with respect to the covering of the entire circumference of the circle for both the people, we should be able to see that the distance is constant in both cases).

In each of the above cases, there are two motions described such that their distances are same. Hence, speed is inversely proportional to time. The following reactions are valid in such a situation:

1. Inverse transfer of the speed ratio to the time ratio and vice versa. Mathematically, this means that if there are two motions M_1 and M_2 with their distances being the same, and respective speeds and times as S_1, S_2 and t_1, t_2 respectively, then

   $S_1/S_2 = t_2/t_1$, i.e. if the speed ratio between motion 1 and 2 is 2:3, the time ratio between the two motions would be 3:2.

2. Inverse proportionality between speed and time also means that the product of speed and time is constant. This means that all the percentage increase-decrease pairs that we have studied in the percentage chapter would apply in such situations. Thus, for two motions, if you can spot that the distance is constant, and if the speed goes up by 25%, the time would come down by 20%. (It is advisable to revise all the pairs provided in the product constancy table of the percentage chapter in this book.

3. The situation can also be dealt with by thinking about fractional increase-decrease situation. Thus, for instance, if the speed increases by 1/4th, time would decrease by 1/5th; if the speed increased by 3/13, time would decrease by 3/16 and so on.

4. Using a multiplier also works in such cases: if speed is getting multiplied by 16/13, time would get multiplied by 13/16.

Illustration

(i) This is best looked at through this CAT 2017 example.

A man travels at 12 km/h and reaches the railway station ten minutes after the train has gone. The next day, he travels at 15 km/h and reaches the railway station ten minutes before the train leaves. What is the distance to the railway station?

Solution: Our normal solution that we had thought about in school for this was: If we assume the distance as d, then we have:

$$\frac{d}{12}-\frac{d}{15}=\frac{20}{60}\rightarrow d=20$$

However, there are many more ways to solve this using the inverse proportionality of speed and time. Let us look at multiple ways in which this question can be thought about using inverse proportionality.

1. In this situation, since two journeys are described over the same distance, the distance is constant. Here, S_1 is 12 km/h and S_2 is 15 km/h, which means that there is a 25% increase in the speed. This means that the time would be dropping by 20%. Also, from the problem we can see that the time has dropped by 20 minutes (from 10 minutes late to 10 minutes early). This means that the original time (at a speed of 12 km/h) must have been 100 minutes. Hence, the distance = $12 \times \frac{100}{60}$ 12km.

2. An increase of speed from 12 to 15 means a 1/4th increase in speed. Time would come down by 1/5th. Since, the time is coming down by 20 minutes it means that 1/5th of the original time (for the first motion) would be 20 minutes. Hence, the original time = 100 minutes. Hence, the distance = $12 \times \frac{100}{60}$ 12km.

3. Alternately, since speed is getting multiplied by 5/4 ($(12 \times \frac{5}{4} = 15)$). Hence, $t_1 \times \frac{4}{5} = t_2$. Also, since $t1 - t2 = 20$, we get $t1 = 100$.

4. The ratio of speeds S_1/S_2 is 4/5. Hence, the ratio of times t_1/t_2 = 5/4 (inverted transfer of the speed ratio to the time ratio). Also, since $t_1 - t_2 = 20$, we get $t_1 = 100$.

5. A train meets with an accident and moves at 3/4 its original speed. Due to this, it is twenty minutes late. Find the original time for the journey beyond the point of accident.

Solution: Speed becomes 3/4 (time becomes 4/3)

Extra time = 1/3 of normal time = 20 minutes

Normal time = 60 minutes

Alternatively, from the table on product constancy in the chapter of percentages, we get that a 25% reduction in speed leads to a 33.33% increase in time.

But, 33.33% increase in time is equal to 20 minutes increase in time.

Hence, total time (original) = 60 minutes.

(ii) A body travels half the journey at 20 km/h and the other half at 30 km/h. Find the average speed.

Solution: Since the distance is constant, the time ratio is 3:2 (inverse of the speed ratio). Using alligation, then we can get that the average speed is 24 km/h. (Good time to revise the Alligation chapter, if you did not get that!)

Relative Speed: Same Direction and Opposite Direction

Normally, when we talk about the movement of a body, we mean the movement of the body with respect to a stationary point. However, there are times when we need to determine the movement and its relationships with respect to a moving point/body. In such instances, we have to take into account the movement of the body/point with respect to which we are trying to determine relative motion.

Relative movement, therefore, can be viewed as the movement of one body relative to another moving body.

The following formulae apply for the relative speed of two independent bodies with respect to each other:

Case 1: Two bodies are moving in opposite directions at speeds S_1 and S_2 respectively.

The relative speed is defined as $S_1 + S_2$.

Case 2: Two bodies are moving in the same direction.

The relative speed is defined as:

(a) $S_1 - S_2$ when S_1 is greater than S_2.

(b) $S_2 - S_1$ when S_1 is lesser than S_2.

In other words, the relative speed can also be defined as the positive value of the difference between the two speeds, that is, $|S_1 - S_2|$.

Motion in a Straight Line

Problems on situations of motion in a straight line are one of the most commonly asked questions in the CAT and other aptitude exams. Hence a proper understanding of the following concepts and their application to problem solving will be extremely important for the student.

Motion in a straight line is governed by the rules of relative speed enumerated above.

***A.* Two or more bodies starting from the same point and moving in the same direction: Their relative speed is $S_1 - S_2$.**

(a) *In the case of the bodies moving to-and-fro between two points A and B:* The faster body will reach the end first and will meet the second body on its way back. The relative speed $S_1 - S_2$ will apply till the point of reversal of the faster body and after that the two bodies will start to move in the opposite directions at a relative speed of $S_1 + S_2$. The relative speed governing the movement of the two bodies will alternate between $S_1 - S_2$ and $S_1 + S_2$ every time any one of the bodies reverses directions. However, if both the bodies reverse their direction at the same instant, there will be no change in the relative speed equation.

In this case, the description of the motion of the two bodies between two consecutive meetings will also be governed by the proportionality between speed and distance (since the time of movement between any two meetings will be constant).

Distances covered in this case: For every meeting, the total distance

covered by the two bodies will be $2D$ (where D is the distance between the extreme points). However, notice that the value of $2D$ would be applicable only if both the bodies reverse the direction between two meetings. In case only one body has reversed direction, the total distance would need to be calculated on a case-by-case basis. The respective coverage of the distance is in the ratio of the individual speeds.

Thus, for the ninth meeting (if both bodies have reversed direction between every two meetings), the total distance covered will be $9 \times 2D = 18D$.

This will be useful for solving problems that require the calculation of a meeting point.

(b) *In the case of the bodies continuing to move in the same direction without coming to an end point and reversing directions:* The faster body will take a lead and will keep increasing the lead and the movement of the two bodies will be governed by the relative speed equation: $S_1 - S_2$.

Here again, if the two bodies start simultaneously, their movement will be governed by the direct proportionality between speed and distance (as the time would be constant).

***B.* Moving in the opposite direction: Their relative speed will be initially given by S_1+S_2.**

(a)*In the case of the bodies moving to-and-fro between two points A and B starting from opposite ends of the path:* The two bodies will move towards each other, meet at a point in between A and B, then move apart away from each other. The faster body will reach its extreme point first,

followed by the slower body reaching its extreme point next. Relative speed will change every time; one of the bodies reverses the direction.

The position of the meeting point will be determined by the ratio of the speeds of the bodies (since the two movements can be described as having the time constant between them).

Distances covered in the above case: For the first meeting, the total distance covered by the two bodies will be D (the distance between the extreme points). The coverage of the distance is in the ratio of the individual speeds.

Thereafter, as the bodies separate and start coming together, the combined distance to be covered is $2D$. (**Note:** If only one body is reversing direction between two meetings, this would not be the case and you will have to work it out.

Thus, for the tenth meeting (if both bodies have reverse direction between every two meetings), the total distance covered will be $D + 9 \times 2D = 19D$.

This will be useful for solving the problems that require the calculation of a meeting point.

Illustration

(i) Two bodies A and B start from opposite ends P and Q of a straight road. They meet at a point $0.6D$ from P. Find the point of their fourth meeting.

Solution: Since time is constant, we have ratio of speeds as 3 : 2.

Also, total distance to be covered by the two together for the fourth meeting

is $7D$. This distance is divided in a ratio of 3: 2 and thus, we have that A will cover $4.2D$ and B will cover $2.8D$.

The fourth meeting point can then be found out by tracking either A or B's movement. A, having moved a distance of $4.2D$, will be at a point $0.2D$ from P. This is the required answer.

(ii) A starts walking from a place at a uniform speed of 2 km/h in a particular direction. After half an hour, B starts from the same place and walks in the same direction as A at a uniform speed and overtakes A after 1 hour 48 minutes. Calculate the speed of B.

Solution: Start solving as you read the question. From the first two sentences, you see that A is 1 km ahead of B when B starts moving.

This distance of 1 km is covered by B in 9/5 hours [1 hour 48 minutes = 1(4/5) = 9/5 hours].

The equation operational here $(SB - SA) \times T$ = initial distance

$$(SB - 2) \times 9/5 = 1$$

Solving, we get $SB = 23/9$ km/h.

(b) *In the case of the bodies continuing to move in the same direction without coming to an end-point and reversing directions:* The bodies will meet and following their meeting they will start separating and going away from each other. The relative speed will be given by $S_1 + S_2$ initially while approaching each other and, thereafter, it will be $S_1 + S_2$ while moving away from each other.

Important: The student is advised to take a closer look and get a closer understanding of these concepts by taking a few examples with absolute values of speed, time and distance. Try to visualise how two bodies separate and then come together. Also, clearly understand the three proportionalities in the equation $s \times t = d$, since these are very important tools for problem solving.

Concept of Acceleration

Acceleration is defined as the rate of change of speed.

Acceleration can be positive (speed increases) or negative (speed decreases → also known as deceleration).

The unit of acceleration is speed per unit time (e.g. m/s^2).

For instance, if a body has an initial speed of 5 m/s and a deceleration of 0.1 m/s^2, it will take 50 seconds to come to rest.

Final speed = Initial speed + Acceleration ×Time

Some more examples:

(i) Water flows into a cylindrical beaker at a constant rate. The base area of the beaker is 24 cm^2. The water level rises by 10 cm every second. How quickly will the water level rise in a beaker with a base area of 30 cm^2?

Solution: The flow of water in the beaker is 24 cm^2 × 10 cm/s = 240 cm^3/s.

If the base area is 30 cm^2, then the rate of water level rise will be 240/30 = 8 cm/s.

Note: In case of confusion, in such questions, the student is advised to use dimensional analysis to understand what to multiply and what to divide.

(ii) A two-kilowatt heater can boil a given amount of water in ten minutes. How long will it take for

(a) A less powerful heater of 1.2 kilowatts to boil the same amount of water? A less powerful heater of 1.2 kilowatts to boil the same amount of water? A less powerful heater of 1.2 kilowatts to boil the same amount of water? A less powerful heater of 1.2 kilowatts to boil the same amount of water? A less powerful heater of 1.2 kilowatts to boil the same amount of water?

(b) A less powerful heater of 1.2 kilowatts to boil double the amount of water?

Solution:

(a) The heating required to boil the amount of water is 2 × 10 = 20 kilowatt minutes. At the rate of 1.2 kilowatt, this heat will be generated in 20/1.2 minutes = 16.66 minutes.

(b) When the water is doubled, the heating required is also doubled. Hence, heating required = 40 kilowatt minutes. At the rate of 1.2 kilowatt, this heat will be generated in 40/1.2 = 33.33 minutes.

APPLICATION OF ALLIGATION IN TIME, SPEED AND DISTANCE

Consider the following situation:

Suppose a car goes from A to B at an average speed of S_1 and then comes back from B to A at an average speed of S_2. If you had to find out the average speed of the whole journey, what would you do?

The normal short-cut given for this situation gives the average speed as:

$$\frac{2S_1S_2}{S_1+S_2}$$

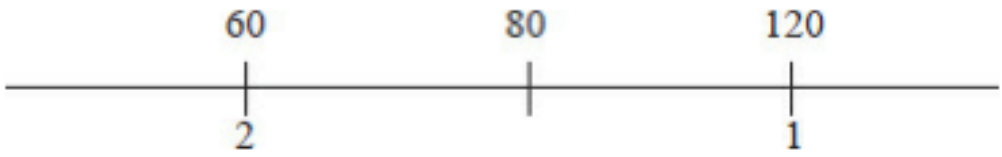
However, this situation can be solved very conveniently using the process of alligation as explained below:

Since, the two speeds are known to us, we will also know their ratio. The ratio of times for the two parts of the journey will then be the inverse ratio of the ratio of speeds since the distance for the two journeys are equal). The answer will be the weighted average of the two speeds (weighted on the basis of the time travelled at each speed).

The process will become clear through an example:

A car travels at 60 km/h from Mumbai to Pune and at 120 km/h from Pune to Mumbai. What is the average speed of the car for the entire journey?

Solution:



The process of alligation will be used here to give the answer as 80. (**Note**: For the process of alligation, refer to the chapter of Alligations.)

Note here, that since the speed ratio is 1:2, the value of the time ratio used for calculating the weighted average will be 2:1.

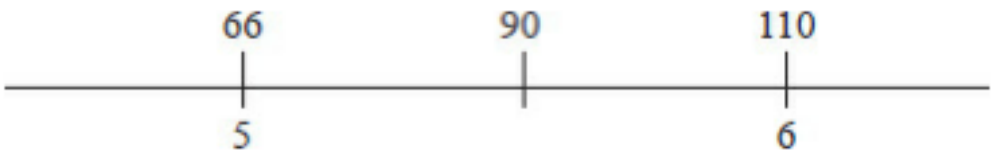
What will happen in case the distances are not constant?

For instance, if the car goes 100 km at a speed of 66km/h and 200 km at a speed of 110 km/h, what will be the average speed?

In this case, the speed ratio being 6:10, i.e. 3:5; the inverse of the speed ratio will be 5:3. This would have been the ratio to be used for the time ratio in case the distances were the same (for both the speeds). But since the distances are

different, we cannot use this ratio in this form. The problem is overcome by multiplying this ratio (5:3) by the distance ratio (in this case it is 1:2) to get a value of 5:6. This is the ratio which has to be applied for the respective weights. Hence, the alligation will look like:

Solution:



Thus, the required answer is 90 km/h. (The student is advised to check this value through normal mathematical processes.)

APPLICATIONS OF TIME, SPEEDAND DISTANCE

Trains

Trains are a special case in questions related to time, speed and distance because they have their own theory and distinct situations.

The basic relation for trains' problems is the same: Speed × Time = Distance.

The following things need to be kept in mind before solving questions on trains:

(a) When the train is crossing a moving object, the speed has to be taken as the **relative speed** of the train with respect to the object. All the rules for relative speed will apply for calculating the relative speed.

(b) The distance to be covered when crossing an object whenever a train crosses an object will be equal to: **Length of train + Length of object**.

Thus, the following cases will yield separate equations, which will govern the crossing of the object by the train:

For each of the following situations, the following notations have been used:

S_T = Speed of train S_O = Speed of object t = time

S_T = Length of train L_O= Length of object

Case 1: Train crossing a stationary object without length:

$$S_T \times t = L_T$$

Case 2: Train crossing a stationary object with length:

$S_T \times t = (L_T + L_O)$

Case 3: Train crossing a moving object without length:

- In opposite direction: $(ST + S_O) \times t = L_T$
- In same direction: $(S_T - S_O) \times t = L_T$

Case 4: Train crossing a moving object with length:

- In opposite direction: $(S_T + S_O) \times t = (L_T + L_O)$
- In same direction: $(S_T - S_O) \times t = (L_T + L_O)$

Note: In order for a train to completely cross a stationary point on the ground, the train has to traverse a distance that is equal to its entire length.
This can be visualised by remembering yourself stationary on a railway platform and being crossed by a train. You would say that the train starts crossing you when the engine of the train comes in line with you. Also, you would say that you have been crossed by the train when the end of the guard's compartment comes in line with you. Thus, the train would have travelled its length in crossing you].

Illustrations

(i) A train crosses a pole in eight seconds. If the length of the train is 200 meters, find the speed of the train.

Solution: In this case, it is evident that the situation is one of the train crossing a stationary object without length. Hence, Case I is applicable here.

Thus, ST = 200/8 = 25 m/s → $\frac{18}{5}$ = 90 km/h.

(ii) A train crosses a man travelling in another train in the opposite direction in eight seconds. However, the train requires 25 seconds to cross the same man if the trains are travelling in the same direction. If the length of the first train is 200 meters and that of the train in which the man is sitting is 160 meters, find the speed of the first train.

Solution: Here, the student should understand that the situation is one of the train crossing a moving object without length. Thus, the length of the man's train is useless or redundant data.

Then applying the relevant formulae after considering the directions of the movements, we get the equations:

$$S_T + S_M = 200/8 = 25 \text{ m/s}$$

$$S_T - S_M = 200/25 = 8 \text{ m/s}$$

Thus, $S_T = \frac{33}{2} = \frac{33 \times 18}{2 \times 5} = 59.4$ km/h

Boats and Streams

The problems of boats and streams are also dependent on the basic equation of time, speed and distance: Speed × Time = Distance.

However, as in the case of trains, the adjustments to be made for solving questions on boats and streams are:

The boat has a speed of its own, which is also called the *speed of the boat in still water* (S_B).

Another variable that is used in boats and streams' problems is the *speed of the stream* (S_S).

The speed of the movement of the boat is dependent on whether the boat is moving.

(a) In still water, the speed of movement is given by $\rightarrow S_B$.

(b) While moving upstream (or against the flow of the water), the speed of movement is given by $\rightarrow S_U = S_B - S_S$.

(c) While moving downstream (or with the flow of the water), the speed of movement is given by $\rightarrow S_D = S_B + S_S$.

The time of movement and the distance to be covered are to be judged by the content of the problem.

Circular motion: A special case of movement is when two or more bodies are moving around a circular track.

The relative speed of two bodies moving around a circle in the same direction is taken as $S_1 - S_2$.

Also, *when two bodies are moving around a circle in the opposite direction, the speed of the two bodies is taken to be* $S_1 + S_2$.

The peculiarity inherent in moving around a circle in the same direction is that when the faster body overtakes the slower body, it goes ahead of it. And for every unit time that elapses, the faster body keeps increasing the distance by which the slower body is behind the faster body. However, when the distance by which the faster body is in front of the slower body becomes equal to the circum-

ference of the circle around which the two bodies are moving, the faster body again comes in line with the slower body. This event is called as overlapping or lapping of the slower body by the faster body. We say that the slower body has been lapped or overlapped by the faster body.

First meeting: Three or more bodies start moving simultaneously from the same point on the circumference of the circle, in the same direction around the circle. They will first meet again in the LCM of the times that the fastest runner takes in totally overlapping each of the slower runners.

For instance, if A, B, C and D start clockwise from a point X on the circle such that A is the fastest runner, then we can define T_{AB} as the time in which A completely overlaps B, T_{AC} as the time in which A completely overlaps C and T_{AD} as the time in which A completely overlaps D. Then the *LCM* of T_{AB}, T_{AC} and T_{AD} will be the time in which A, B, C and D will be together again for the first time.

First meeting at starting point: Three or more bodies start moving simultaneously from the same point on the circumference of a circle, in the same direction around the circle. Their first meeting at the starting point will occur after a time that is obtained by the *LCM* of the times that each of the bodies takes to complete one full round.

For instance, if A, B and C start from a point X on the circle such that T_A, T_B and T_C are the times in which A, B and C respectively cover one complete round around the circle, then they will all meet together at the starting point in the *LCM* of T_A, T_B and T_C.

Clocks

Problems on clocks are based on the movement of the minute hand and that of the hour hand as well as on the relative movement between the two. In my opinion, it is best to solve problems on clocks by considering a clock to be a circular track having a circumference of 60 km and each kilometer being represented by

one minute on the dial of the clock. Then, we can look at the minute hand as a runner running at the speed of 60 km/h while we can also look at the hour hand as a runner running at an average speed of 5 km/h.

Since, the minute hand and the hour hand are both moving in the same direction, the relative speed of the minute hand with respect to the hour hand is 55 km/h, that is, for every hour elapsed, the minute hand goes 55 km (minute) more than the hour hand.

(Beyond this slight adjustment, the problems of clocks require a good understanding of unitary method. This will be well illustrated through the solved example below.)

Important Information

Number of right angles formed by a clock: A clock makes two right angles between any two hours. Thus, for instance, there are two right angles formed between 12 – 1 or between 1 and 2 or between 2 and 3 or between 3 and 4 and so on.

However, contrary to expectations, the clock does not make 48 right angles in a day. This happens because whenever the clock passes between the time periods 2 – 4 or 8 – 10, there are not four but only three right angles.

This happens because the second right angle between 2 – 3 (or 8 – 9) and the first right angle between 3 – 4 (or 9 – 10) are one and the same, occurring at 3 or 9.

Right angles are formed when the distance between the minute-hand and the hour-hand is equal to 15 minutes.

Exactly, the same situation holds true for the formation of straight lines. There are two straight lines in every hour. However, the second straight line between 5–6 (or 11–12) and the first straight line between 6–7 (or 12–1) coincide with each other and are represented by the straight line formed at 6 (or 12).

Straight lines are formed when the distance between the minute-hand and the hour-hand is equal to either 0 minutes or 30 minutes.

Illustration

At what time between 2–3 PM, is the first right angle in that time formed by the hands of the clock?

Solution: At 2 PM, the minute-hand can be visualised as being 10 kilometers behind the hour hand (considering the clock dial to be a race track of circumference 60 km such that each minute represents a kilometer).

Also, the first right angle between 2–3 is formed when the minute-hand is 15 kilometers ahead of the hour-hand.

Thus, the minute-hand has to cover 25 kilometers over the hour-hand.

This can be written using the unitary method:

Distance covered by the minute-hand over the hour -hand

55 kilometers in 1 hour

25 kilometers in what time

→ 5/11 of an hour

Thus, the first right angle between 2–3 is formed at 5/11 hours past 2 o'clock.

This can be converted into minutes and seconds using unitary method again as:

1 hour 60 minutes

5/11 hours ? minutes

→ 300/11 minutes = 27 (3/11) minutes

1 minute 60 seconds

3/11 minutes ? seconds → 180/11 seconds = 16.3636 seconds.

Hence, the required answer is: **2: 27 : 16.36 seconds**.

LEVEL OF DIFFICULTY (I)

1. The Calcutta Mail left Mumbai at 9 PM sharp. Two hours later, the Geetanjali Express started from Mumbai in the same direction. The Geetanjali

Express overtook the Calcutta Mail at 5 AM on the next morning. Find the average speed of the two trains over this journey, if the sum of their average speeds is 140 km/h.

(a) 68.57 km/h

(b) 70 km/h

(c) 75 km/h

(d) 6km/h

2. Two trains, Calcutta Mail and Bombay Mail, start at the same time from stations Kolkata and Mumbai respectively towards each other. After passing each other, they take 12 hours and 3 hours to reach Mumbai and Kolkata respectively. If the Calcutta Mail is moving at the speed of 48 km/h, the speed of the Bombay Mail is

   (a) 24 km/h

   (b) 22 km/h

   (c) 21 km/h

   (d) 96 km/h

3. Bharat walks to a viewpoint and returns to the starting point by his car and thus, takes a total time of 8 hours 45 minutes. He would have gained 2 hours by driving both ways. How long would it have taken for him to walk both ways?

   (a) 10 h 45 min

   (b) 7 h 45 min

(c) 5 h 45 min

(d) 6 h 45 min

4. A train is running at 7/11 of its speed and reached a place in 22 h. How much time could be saved, if the train runs at its speed?

   (a) 7 h

   (b) 8 h

   (c) 14 h

   (d) 16 h

5. Rajdhani Express travels 650 km in 5 h and another 940 km in 10 h. What is the average speed of train?

   (a) 1590 km/h

   (b) 168 km/h

   (c) 106 km/h

   (d) 126 km/h

6. Vandana goes to office at a speed of 6 km/h and returns to her home at a speed of 4 km/h. If she takes ten hours in all, what is the distance between her office and her home?

   (a) 24 km

   (b) 12 km

   (c) 10 km

   (d) 30 km

7. A railway passenger counts the telegraph poles on the rail-road as he passes them. The telegraph poles are at a distance of 50 meters. What will be his count in 4 hours, if the speed of the train is 45 km per hour?

   (a) 600

   (b) 2500

   (c) 3600

   (d) 5000

8. Harsh and Vijay move towards Hosur starting from IIM, Bangalore, at a speed of 40 km/h and 60 km/h, respectively. If Vijay reaches Hosur 200 minutes earlier then Harsh, what is the distance between IIM, Bangalore, and Hosur?

   (a) 600 km

   (b) 400 km

   (c) 900 km

   (d) 200 km

9. A man cycles with a speed of 10 km/h and reaches his office at 1 PM. However, when he cycles with a speed of 15 km/h, he reaches his office at 11 AM. At what speed should he cycle so that he reaches his office at 12 noon?

   (a) 12 km/h

   (b) 12.5 km/h

   (c) 18 km/h

   (d) None of these

10. A man moves from *A* to *B* at the rate of 4 km/h. Had he moved at the rate of 11/3 km/h, he would have taken 3 hours more to reach the destination. What is the distance between A and *B*?

    (a) 66 km

    (b) 132 km

    (c) 27 km

    (d) None of these

11. A plane left half-an-hour later than the scheduled time and in order to reach its destination 1500 kilometers away in time, it had to increase its speed by 50% over its usual speed. Find its increased speed.

    (a) 500 km/h

    (b) 1000 km/h

    (c) 750 km/h

    (d) 1500 km/h

12. A car travels 1/3 of the distance on a straight road with a speed of 10 km/h, the next 1/3 with a speed of 20 km/h and the last 1/3 with a speed of 60 km/h. What is the average speed of the car for the whole journey?

    (a) 18 km/h

    (b) 10 km/h

    (c) 20 km/h

    (d) 15 km/h

13. Ajay covers 910 km by car, bike and cycle in the ratio 4:3:6 respectively.

The speeds at which the journey was covered by Ajay were in the ratio 4:3:6 respectively. The total time taken to cover entire distance was 89 hours. Find the ratio between time taken by Ajay while travelling by car, bike and cycle.

(a) 3:4:2

(b) 1:1:1

(c) 6:3:4

(d) 4:3:6

14. Two trains for Patna leave Delhi at 6 AM and 6:45 AM and travel at 98 km/h and 136 km/h, respectively. How many kilometers from Delhi (approximately) will the two trains meet?

(a) 263.05 km

(b) 260 km

(c) 200 km

(d) None of these

15. Rahul travels 600 km to his home partly by bus and partly by car. He takes eight hours if he travels 120 km by bus and the rest by car. He takes twenty minutes more if he travels 200 km by bus and the rest by car. Find the speed of the bus in km/h.

(a) 45

(b) 60

(c) 75

(d) None of these

16. Walking at 3/4 of his normal speed, Abhishek is 60 minutes late in reaching his office. The usual time taken by him to cover the distance between his home and his office is

    (a) 180 minutes

    (b) 120 minutes

    (c) 150 minutes

    (d) 144 minutes

17. Shyam's house, his office and his gym are all equidistant from each other. The distance between any two of them is 4 km. Shyam starts walking from his gym in a direction parallel to the road connecting his office and his house and stops when he reaches a point directly East of his office. He then reverses direction and walks till he reaches a point directly South of his office. The total distance walked by Shyam is

    (a) 6 km

    (b) 9 km

    (c) 16 km

    (d) 12 km

18. A starts from a point that is on the circumference of a circle, moves 600 meter in the North direction and then again moves 800 meter East and reaches a point diametrically opposite the starting point. Find the diameter of the circle.

    (a) 1000 m

(b) 500 m

(c) 800 m

(d) 900 m

19. *Ramesh* and *Barkat* travel the same distance at the rates of 16 kilometers and 20 kilometers an hour respectively. If Ramesh takes thirty minutes longer than Barkat, the distance travelled by Barkat is

    (a) 12 km

    (b) 20 km

    (c) 32 km

    (d) 40 km

20. Two cars started simultaneously toward each other from town *A* and *B*, which are 480 km apart. It took eight hours by the first car in travelling from *A* to *B* to cover the distance and twelve hours by the second car in travelling from *B* to *A*. Determine at what distance from A the two cars meet.

    (a) 288 km

    (b) 200 km

    (c) 300 km

    (d) 196 km

21. Two cars start at the same time from *A* and *B* and proceed towards *B* and *A* at 36 km/h and 42 km/h respectively. When they meet, it is found that one car has moved 48 km more than the other. What is the distance between *A* and *B* (in km)?

(a) 624

(b) 636

(c) 544

(d) 460

22. A train moves at a constant speed of 120 km/h for one kilometer and at 40 km/h for the next one kilometer. What is the average speed of the train?

(a) 48 km/h

(b) 50 km/h

(c) 80 km/h

(d) 60 km/h

23. A journey of 192 km takes two hours less by a fast train than by a slow train. If the average speed of the slow train be 16 km/h less than that of fast train, what is the average speed of the faster train?

(a) 32 km/h

(b) 16 km/h

(c) 12 km/h

(d) 48 km/h

24. Two trains *A* and *B* start simultaneously in the opposite direction from two points *A* and *B* and arrive at their destinations nine and four hours, respectively after their meeting each other. At what rate does the second train *B* travel if the first train travels at 80 km per hour?

(a) 48 km/h

(b) 50 km/h

(c) 80 km/h

(d) 60 km/h

23. A journey of 192 km takes two hours less by a fast train than by a slow train. If the average speed of the slow train be 16 km/h less than that of fast train, what is the average speed of the faster train?

(a) 32 km/h

(b) 16 km/h

(c) 12 km/h

(d) 48 km/h

24. Two trains *A* and *B* start simultaneously in the opposite direction from two points *A* and *B* and arrive at their destinations nine and four hours, respectively after their meeting each other. At what rate does the second train *B* travel if the first train travels at 80 km per hour?

(a) 60 km/h

(b) 100 km/h

(c) 120 km/h

(d) 80 km/h

25. A motor car does a journey in 17.5 hours, covering the first half at 30 km/h and the second half at 40 km/h. Find the distance of the journey.

(a) 684 km

(b) 600 km

(c) 120 km

(d) 540 km

26. A man walked 12 km at a certain rate, and then 6 km farther at a rate of 1/2 km/h faster. If he had walked the whole distance at the faster rate, his time would have been 20 minutes less. How long did it really take him to walk the distance of 18 km?

(a) 4h

(b) 4.33h

(c) 4.66h

(d) 5h

27. Anish, during his journey, travels for 20 minutes at a speed of 30 km/h, another 30 minutes at a speed of 50 km/h, and 1 hour at a speed of 50 km/h and 1 hour at a speed of 60 km/h. What is the average speed?

(a) 51.18 km/h

(b) 63 km/h

(c) 39 km/h

(d) 48 km/h

28. Sambhu beats Kalu by 30 meters or 10 seconds. How much time was taken by Sambhu to complete a race 1200 meters?

(a) 6 min 30 s

(b) 3 min 15 s

(c) 12 min 10 s

(d) 2 min 5 s

29. Shaurya's new Mercedes travelling at 70 km/h uses 30% more diesel to travel a certain distance than it does when it travels at a speed of 50 km/h. If the car can travel 19.5 km/L of diesel at 50 km/h, how far can the car travel on 10 litres of diesel at a speed of 70 km/h?

    (a) 130 km

    (b) 140km

    (c) 150 km

    (d) 175 km

30. Ram and Bharat travel the same distance at the rate of 6 km per hour and 10 km per hour respectively. If Ram takes 30 minutes longer than Bharat, the distance travelled by each is

    (a) 6 km

    (b) 10 km

    (c) 7.5 km

    (d) 20 km

31. Lonavala and Khandala are two stations 600 km apart. A train starts from Lonavala and moves towards Khandala at the rate of 25 km/h. After two hours, another train starts from Khandala at the rate of 35 km/h. How far from Lonavala will they cross each other?

(a) 250 km

(b) 300 km

(c) 279.166 km

(d) 475 km

32. What is the time taken by Chandu to cover a distance of 360 km by a motorcycle moving at a speed of 10 m/s?

(a) 10 h

(b) 5 h

(c) 8 h

(d) 6 h

33. A car travels from *A* to *B* at V_1 km/h, travels back from *B* to *A* at V_2 km/h and again goes back from *A* to *B* at V_2 km/h. The average speed of the car is

(a) $\frac{2V_1V_2}{V_1+2V_2}$

(b) $\frac{2V_1V_2}{V_2+2V_1}$

(c) $\frac{3V_1V_2}{V_2+2V_1}$

(d) $\frac{3V_1V_2}{V_1+2V_2}$

34. It takes four hours to go from Kolkata to Kharagpur. A truck of Durga Transport leaves Kolkata for Kharagpur every thirty minutes starting at

6:00 AM. If you start from Kharagpur for Kolkata at 10:30 AM and travel at the speed of the trucks, how many such trucks would you meet till you reach Kolkata?

(a) 8

(b) 9

(c) 16

(d) 17

35. Arjit covers a distance in 120 minutes if he drives at a speed of 90 kilometers per hour on an average. Find the speed at which he must drive at to reduce the time of the journey by 25%.

(a) 100 km/h

(b) 105 km/h

(c) 150 km/h

(d) 120 km/h

36. Vinay fires two bullets from the same place at an interval of 12 minutes but Raju sitting in a train approaching the place hears the second report 11 minutes 30 seconds after the first. What is the approximate speed of train (if sound travels at the speed of 330 meter per second)?

(a) 660/23 m/s

(b) 220/7 m/s

(c) 330/23 m/s

(d) 110/23 m/s

37. A passenger train takes two hours less for a journey of 300 kilometers if its speed is increased by 5 km/h over its usual speed. Find the usual speed.

(a) 10 km/h

(b) 12 km/h

(c) 20 km/h

(d) 25 km/h

38. A cyclist moving on a circular track of radius 400 meters completes one revolution in four minutes. What is the average speed of cyclist (approximately)?

(a) 314 m/minute

(b) 200 m/minute

(c) 300 m/minute

(d) 900 m/minute

39. A man leaves office daily at 7 PM. A driver with car comes from his home to pick him from office and bring back home. One day he gets free at 5:30 PM and instead of waiting for driver he starts walking towards home. On the way, he meets the car and returns home on car. He reaches home 20 minutes earlier than usual. In how much time does the man reach home usually?

(a) 1h 20min

(b) 1 h

(c) 2 h 10 min

(d) Cannot be determined

40. *X* and *Y* are two stations 600 km apart. A train starts from *X* and moves towards *Y* at the rate of 25 km/h. Another train starts from *Y* at the rate of 35 km/h. How far from *X* they will cross each other?

    (a) 250 km

    (b) 300 km

    (c) 450 km

    (d) 475 km

41. A person travelled a distance of 200 kilometers between Lucknow and Allahabad by a car covering the first quarter of the journey at a constant speed of 40 km/h and the remaining three quarters at a constant speed of *x* km/h. If the average speed of the person for the entire journey was 53.33 km/h, what is the value of *x*?

    (a) 55 km/h

    (b) 60 km/h

    (c) 70 km/h

    (d) 80 km/h

42. If Arun had walked 1 km/h faster, he would have taken 10 minutes less to walk 2 kilometers. What is Arun's speed of walking?

    (a) 1 km/h

    (b) 2 km/h

    (c) 3 km/h

(d) 6 km/h

43. A car driver, driving in a fog, passes a pedestrian who was walking at the rate of 2 km/h in the same direction. The pedestrian could see the car for six minutes and it was visible to him up to a distance of 0.6 km. What was the speed of the car?

    (a) 30 km/h

    (b) 15 km/h

    (c) 20 km/h

    (d) 8 km/h

44. Manish travels a certain distance by car at the rate of 12 km/h and walks back at the rate of 3 km/h. The whole journey took five hours. What is the distance he covered on the car?

    (a) 12 km

    (b) 30 km

    (c) 15 km

    (d) 6 km

45. Two trains for Mumbai leave Delhi at 6: 00 AM and 6: 45 AM and travel at 100 km/h and 136 km/h respectively. How many kilometers from Delhi will the two trains be together?

    (a) 262.4 km

    (b) 260 km

    (c) 283.33 km

    (d) 275 km

46. Ishan left his home by car at 7:00 AM for Durgapur. At 7:30 AM, he overtook a truck also travelling towards Durgapur. He reached Durgapur and started his journey back home after two hours. One hour after leaving Durgapur he crossed the same truck. Find the ratio of speed of Ishan's car and the truck, if he crossed the truck for the second time at 1:00 PM (assume truck did not halt during the journey and both the car and truck travelled with constant speeds).

    (a) 9:4

    (b) 11:3

    (c) 13:7

    (d) 5:3

47. Walking at 3/4 of his normal speed, a man takes 2(1/2) hours more than the normal time. Find the normal time.

    (a) 7.5 h

    (b) 6 h

    (c) 8 h

    (d) 12 h

48. Without stoppage, a train travels a certain distance with an average speed of 60 km/h, and with stoppage, it covers the same distance with an average speed of 40 km/h. On an average, how many minutes per hour does the train stop during the journey?

    (a) 20 min/h

    (b) 15 min/h

(c) 10 min/h

(d) 10 min/h

49. Narayan Murthy walking at a speed of 20 km/h reaches his college ten minutes late. Next time he increases his speed by 5 km/h, but finds that he is still late by four minutes. What is the distance of his college from his house?

(a) 20 km

(b) 6 km

(c) 12 km

(d) None of these

50. Two trains start at same time, one from Chandigarh and second from Delhi running in opposite directions towards each other with uniform speed. They can complete their journey in 42 minutes and 56 minutes respectively. They will meet after

(a) 21min

(b) 22min

(c) 24min

(d) 28 min

51. A train requires 9 seconds to pass a pole while it requires 27 seconds to cross a stationary train which is 198 meters long. Find the speed of the train.

(a) 39.6 km/h

(b) 38.4 km/h

(c) 76.2 km/h

(d) 44.6 km/h

52. A boat sails downstream from point A to point B, which is 10 km away from A, and then returns to A. If the actual speed of the boat (in still water) is 3 km/h, the trip from A to B takes 8 hours less than that from B to A. What must the actual speed of the boat for the trip from A to B to take exactly 75 minutes?

(a) 7 km/h

(b) 4 km/h

(c) 5 km/h

(d) 6 km/h

53. A boat goes 80 km upstream in 8 h and a distance of 98 km downstream in 7 h. The speed of the boat in still water is

(a) 12 km/h

(b) 14 km/h

(c) 8.5 km/h

(d) 8 km/h

54. Two trains are running on parallel lines in the same direction at speeds of 50 km/h and 30 km/h, respectively. The faster train crosses a man in the second train in 36 seconds. The length of the faster train is

(a) 200 meters

(b) 185 meters

(c) 225 meters

(d) 210 meters

55. Ram and Shyam run a race of 2000 meters. First, Ram gives Shyam a start of 200 meters and beats him by 30 s.Next, Ram gives Shyam a start of 3 minutes and is beaten by 1000 meters. Find the time in minutes in which Ram and Shyam can run the race separately.

    (a) 8, 10

    (b) 4, 5

    (c) 5, 9

    (d) 6, 9

56. A motorboat went downstream for 28 km and immediately returned. It took the boat twice as long to make the return trip. If the speed of the river flow was twice as high, the trip downstream and back would take 672 minutes. Find the speed of the boat in still water and the speed of the river flow.

    (a) 9 km/h, 3 km/h

    (b) 12 km/h, 4 km/h

    (c) 15 km/h, 5 km/h

    (d) 6 km/h, 2 km/h

57. In a stream, *B* lies in between *A* and *C* such that it is equidistant from both *A* and *C*. A boat can go from *A* to *B* and back in 7 h 30 minutes while it goes from *A* to *C* in 10 h. How long would it take to go from *C* to *A*?

(a) 3.75 h

(b) 4 h

(c) 4.25 h

(d) 5 h

58. Two trains pass each other on parallel lines. Each train is 100 meters long. When they are going in the same direction, the faster one takes 60 seconds to pass the other completely. If they are going in opposite directions, they pass each other completely in 10 seconds. Find the speed of the slower train in km/h.

(a) 30 km/h

(b) 42 km/h

(c) 48 km/h

(d) 60 km/h

59. A boat sails down the river for 10 km and then up the river for 6 km. The speed of the river flow is 1 km/h. What should be the minimum speed of the boat for the trip to take a maximum of 4 hours?

(a) 2 km/h

(b) 3 km/h

(c) 4 km/h

(d) 5 km/h

60. A man rows 6 km/h in still water. If the river is running at 3 km/h, it takes him 45 minutes to row to a place and back. How far is the place?

(a) 1.12 km

(b) 1.25 km

(c) 1.6875 km

(d) 2.5 km

61. At noon, ship Chanakya starts from a point *P* towards a point *Q* and at 1.00 PM ship Rajendra starts from *Q* towards *P*. If ship Chanakya is expected to complete the voyage in six hours and ship Rajendra is moving at a speed 2/3 of that of ship Chanakya, at what time are the two ships expected to meet?

(a) 4 PM

(b) 4.30 PM

(c) 3 PM

(d) 2.30 PM

62. In a game of billiards, *A* can give *B* 15 points in 60 and *A* can give *C* 20 points in 60. How many points can *B* give *C* in a game of 90?

(a) 11

(b) 13

(c) 10

(d) 14

63. In a 500 meters race, the ratio of speed of two runners Rohit and Moni is 3: 4. If Rohit has a start of 170 meters, then he wins the race by

(a) 30 m

(b) 40 m

(c) 60 m

(d) 80 m

64. The speed of the boat in still water is 12 km/h and the speed of the stream is 2 km/h. A distance of 8 km, going upstream, is covered in

(a) 1 h

(b) 1 h 15 min

(c) 1 h 12 min

(d) None of these

65. A boat goes 15 km upstream in 80 minutes. The speed of the stream is 5 km/h. The speed of the boat in still water is

(a) 16.25 km/h

(b) 16 km/h

(c) 15 km/h

(d) 17 km/h

66. Vinay runs 100 meters in 20 seconds and Ajay runs the same distance in 25 seconds. By what distance will Vinay beat Ajay in a hundred meter race?

(a) 10 m

(b) 20 m

(c) 25 m

(d) 12 m

67. In a 100 meters race, Shyam runs at 1.66 m/s. If Shyam gives Sujit a start of 4 meters and still beats him by 12 seconds, what is Sujit's speed?

(a) 1.11 m/s

(b) 0.75 m/s

(c) 1.33 m/s

(d) 1 km/h

68. Two trains for Howrah leave Muzaffarpur at 8:30 AM and 9:00 AM, respectively and travel at 60 km/h and 70 km/h, respectively. How many kilometers from Muzaffarpur will the two trains meet?

(a) 210 km

(b) 180 km

(c) 150 km

(d) 120 km

69. Without stoppage, a train travels at an average speed of 75 km/h and with stoppages it covers the same distance at an average speed of 60 km/h. How many minutes per hour does the train stop?

(a) 10 minutes

(b) 12 minutes

(c) 14 minutes

(d) 18 minutes

70. Subbu can row 6 km/h in still water. When the river is running at 1.2 km/h, it takes him 1 hour to row to a place and back. How far in the place?

(a) 2.88 km

(b) 2.00 km

(c) 3.12 km

(d) 2.76 km

71. A dog is passed by a train in eight seconds. Find the length of the train if its speed is 36 km/h.

(a) 70 m

(b) 80 m

(c) 85 m

(d) 90 m

72. A motorboat whose speed in still water is 10 km/h went 91 km downstream and then returned to its starting point. Calculate the speed of the river flow if the round trip took a total of 20 hours.

(a) 3 km/h

(b) 4 km/h

(c) 6 km/h

(d) 8 km/h

73. In a race of 600 meters, Ajay beats Vijay by 60 meters and in a race of 500 meters Vijay beats Anjay by 25 meters. By how many meters will Ajay beat Anjay in a 400 meters race?

(a) 48 m

(b) 52 m

(c) 56 m

(d) 58 m

74. In a stream that is running at 2 km/h, a man goes 10 km upstream and comes back to the starting point in 55 minutes. Find the speed of the man in still water.

(a) 20 km/h

(b) 22 km/h

(c) 24 km/h

(d) 28 km/h

75. A man goes downstream at x km/h and upstream at y km/h. The speed of the boat in still water is

(a) $0.5\ (x + y)$

(b) $0.5\ (x - y)$

(c) $x + y$

(d) $x - y$

76. At what time are the hands of clock together between 2 and 3 PM ?

(a) 2/11 hours past 2 PM.

(b) 2/9 hours past 2 PM.

(c) 2:10 PM

(d) None of these

77. A motorboat went down the river for 14 km and then up the river for 9 km. It took a total of five hours for the entire journey. Find the speed of the river flow if the speed of the boat in still water is 5 km/h.

(a) 1 km/h

(b) 1.5 km/h

(c) 2 km/h

(d) 3 km/h

78. How many seconds will a caravan 120 meters-long running at the rate 10 m/s take to pass a standing boy?

(a) 10 seconds

(b) 12 seconds

(c) 11 seconds

(d) 14 seconds

79. Two trains are travelling in the same direction at 50 km/h and 30 km/h respectively. The faster train crosses a man in the slower train in 18 seconds. Find the length of the faster train.

(a) 0.1 km

(b) 1 km

(c) 1.5 km

(d) 1.4 km

80. A boat rows 16 km up the stream and 30 km downstream taking 5 hours each time. The velocity of the current is

(a) 1.1 km/h

(b) 1.2 km/h

(c) 1.4 km/h

(d) 1.5 km/h

81. Vijay can row a certain distance downstream in 6 hours and return the same distance in 9 hours. If the stream flows at the rate of 3 km/h, find the speed of Vijay in still water.

(a) 12 km/h

(b) 13 km/h

(c) 14 km/h

(d) 15 km/h

82. A lazy man can row upstream at 16 km/h and downstream at 22 km/h. Find the man's rate in still water (in km/h).

(a) 19

(b) 14

(c) 17

(d) 18

83. A man can row 30 km upstream and 44 km downstream in 10 hours. It is also known that he can row 40 km upstream and 55 km downstream in 13 hours. Find the speed of the man in still water.

(a) 4 km/h

(b) 6 km/h

(c) 8 km/h

(d) 12 km/h

84. The length of the minutes-hand of a clock is 8 cm. Find the distance travelled by its outer end in 15 minutes.

(a) 4π cm

(b) 8π cm

(c) 12π cm

(d) 16π cm

85. Between 5 AM and 5 PM of a particular day, for how many times are the minute and the hour-hands together?

(a) 11

(b) 22

(c) 33

(d) 44

86. A motorboat whose speed in still water is 15 km/h goes 30 km downstream and comes back in a total 4 hours 30 min. Determine the speed of the stream.

(a) 2 km/h

(b) 3 km/h

(c) 4 km/h

(d) 5 km/h

87. In a 100 meters race, *X* can give *Y* a 10 meters start and in a 18 km race, *Y* can give *Z* a 2 km start. If the speed of *X* is 20 m/s, then find the speed of *Z* (in m/s).

88. In a 5 km race, Mohan wins by 500 meters over Sohan, while Sohan can give a start of 200 meters to Chotan in a 1 km race. In a 5 km race, how much start (in meters) can Mohan give Chotan, so that both reach the destination simultaneously?

89. If the ratio of speeds of *A* and *B* is 5: 4, then what start can *A* give to *B* so that in a 1 km race, such that *B* must cover 10% less distance than *A*?

90. If the ratio of speeds of *X* and *Y* is 4: 5 and *X* loses the race by 250 meters, then what is the length of the race track (in km)?

Directions for Questions 91 and 92:

Three persons *X*, *Y*, *Z* run on a circular track of length 1 kilometer at speeds of 20 m/s, 40 m/s and 60 m/s respectively in the same direction.

91. If they start running simultaneously, after how much time (in seconds) will they meet again?

92. After how much time will they meet at the starting point?

93. *X*, *Y*, *Z* run on a circular track at speeds of 10 m/s, 20 m/s, 25 m/s respectively. If they start from the same point in the same direction at the same time and *X* covers 1 km when they meet again for the first time at the starting point, then find the total distance covered by *Y* (in km).

Directions for Questions 94 and 95:

John's office is 80 km from his house. One day he started from home, an hour later than his usual time of leaving for his office. In order to cover up the delay, he increased his speed by 4 km/h and thus, reached the office on time. Now answer the following questions:

94. What is the final speed of John?

95. What is the percentage increase in John's speed?

96. The distance between two cities *A* and *B* is 100 km and the speed of Ram and Rahim are 50 km/h and 30 km/h respectively. Initially Ram is at *A* and Rahim is at *B*. If they move between *A* and *B* to-and-fro, then find the distance (in km) covered by Ram by the time they meet for the third time.

LEVEL OF DIFFICULTY (II)

1. Two swimmers started simultaneously from the beach, one to the North and the other to the East. Two hours later, the distance between them turned out to be 100 km. Find the speed of the faster swimmer, knowing that the speed of one of them was 75% of the speed of the other.

   (a) 30 km/h

   (b) 40 km/h

   (c) 45 km/h

   (d) 60 km/h

2. A motorcyclist rode the first half of his way at a constant speed. Then he was delayed for five minutes and, therefore, to make up for the lost time he increased his speed by 10 km/h. Find the initial speed of the motorcyclist, if the total path covered by him is equal to 50 km.

   (a) 36 km/h

   (b) 48 km/h

   (c) 50 km/h

   (d) 62 km/h

Directions for Questions 3 to 5: Read the following and answer the question that follow.

A naughty bird is sitting on top of a car. It sees another car approaching it at a distance of 12 km. The speed of the two cars is 60 km/h each. The bird starts flying from the first car and moves towards the second car, reaches the second car and comes back to the first car and so on. If the speed at which the bird flies is 120 km/h, then answer the following questions (assume that the two cars have a crash).

3. The total distance travelled by the bird before the crash is

   (a) 6 km

   (b) 12 km

   (c) 18 km

   (d) None of these

4. The total distance travelled by the bird before it reaches the second car for the second time is

   (a) 10.55 km

   (b) 11.55 km

   (c) 12.33 km

   (d) None of these

5. The total number of times that the bird reaches the bonnet of the second car is (theoretically)

   (a) 12 times

   (b) 18 times

(c) Infinite times

(d) Cannot be determined

6. Ajay and Vijay start running simultaneously from the same point on a circular track in the same direction. If Ajay is running with a uniform speed of 'a' km/h and Vijay is running with 'b' km/h, they meet for the first time when Ajay is in his fourth round and Vijay is in his third round. Which of the following can be the value of a: b (If $a > b$)?

(a) 1.4

(b) 1.46

(c) 1.35

(d) Type (1) If only one option is correct

Type (2) If two options are correct

Type (3) If all the options are correct

Type (4) If no option is correct

7. The Sabarmati Express left Ahmedabad for Mumbai. Having travelled 300 km, which constitutes 66.666 per cent of the distance between Ahmedabad and Mumbai, the train was stopped by a red signal. Half an hour later, the track was cleared and the engine-driver, having increased the speed by 15 km per hour, arrived at Mumbai on time. Find the initial speed of the Sabarmati Express.

(a) 50 km/h

(b) 60 km/h

(c) 75 km/h

(d) 40 km/h

Directions for Questions 8 to 12: Read the following data and answer the questions that follow.

Three brothers, Ram, Shyam and Mohan, travelled by road. They all left the college at the same time- 12 noon. The description of their motions are detailed below:

Name	*Ram*	*Shyam*	*Mohan*
Phase I	Bus for 2 hours @ 10 mph	Bike for @ 1 hours 30 mph	Foot for 3 hours @ 3.33 mph
Phase II	Bike for 1.5 hours @ 40 mph	Foot for 3 hours @ 3.33 mph	Bus for 3 hours @ 10 mph
Phase III	Foot for 3 hours @ 3.33 mph	Bus for 4 hours @ 10 mph	Bike for 2 hours @ 30 mph

8. When did Ram overtake Shyam?

   (a) 3:15 PM

   (b) 2:22 PM

   (c) 2:30 PM

   (d) 2:20 PM

9. At what distance from the start does Mohan overtake Shyam?

   (a) 40 miles

   (b) 57 miles

   (c) 70 miles

   (d) 80 miles

10. If Ram travelled by bike instead of foot in the last leg of his journey (for the same distance as he had covered by foot and his original biking speed), what is the difference in the times of Ram and Mohan to cover 90 miles?

    (a) 6 h 50 minutes

    (b) 10 h 40 minutes

    (c) 3 h 55 minutes

    (d) 4 h 10 minutes

11. If all of them travelled a distance of 100 miles, who reached first and at what time (assume the last leg time increases to cover 100 miles)?

    (a) Mohan at 6 PM

    (b) Ram at 8 PM

    (c) Shyam at 6 PM

    (d) Mohan at 8 PM

12. In the above question, who reached last and at what time?

    (a) Ram at 9:30 PM

    (b) Ram at 10 PM

    (c) Shyam at 9:30 PM

    (d) Shyam at 10 PM

Directions for Questions 13 and 14: Read the following and answer the questions that follow.

The Kalinga Express started from Patna to Tata at 7 PM at a speed of 60 km/h. Another train, Rajdhani Express, started from Tata to Patna at 4 AM next morn-

ing at a speed of 90 km/h. The distance between Patna to Tata is 800 km.

13. How far from Tata will the two trains meet?

    (a) 164 km

    (b) 156 km

    (c) 132 km

    (d) 128 km

14. At what time will the two trains meet?

    (a) 5 : 32 AM

    (b) 5 : 28 AM

    (c) 5 : 36 AM

    (d) 5 : 44 AM

15. A dog after travelling 50 km meets a swami who counsels him to go slower. He then proceeds at 3/4 of his former speed and arrives at his destination 35 minutes late. Had the meeting occurred 24 km further the dog would have reached its destination 25 minutes late. The speed of the dog is

    (a) 48 km/h

    (b) 36 km/h

    (c) 54 km/h

    (d) 58 km/h

16. Anand Pagare entered a bar between 12 AM to 1 AM when the angle between the minute-hand and the hour-hand of the clock was at 30°. If he spent exactly 1 hour 20 minutes in the bar and came out, and he came

out at a time represented by A: B: C where A represents hours, B represents minutes and C represents seconds. Then, find the value of $A + B + C$.

(**Note**: Take C as a whole number only.)

17. An ant moved for several seconds and covered 3 mm in the first second and 4 mm more in each successive second than in its predecessor. If the ant had covered 1 mm in the first second and 8 mm more in each successive second, then the difference between the path it would cover during the same time and the actual path would be more than 6 mm but less than 30 mm. Find the time for which the ant moved (in seconds).

    (a) 5 seconds

    (b) 4 seconds

    (c) 6 seconds

    (d) 2 seconds

18. A train leaves Muzaffarpur for Hazipur at 2:15 p.m. and travels at the rate of 50 km/h. Another train leaves Hazipur for Muzaffarpur at 1:35 p.m. and travels at the rate of 60 km/h. If the distance between Hazipur and Muzaffarpur is 590 km at what distance from Muzaffarpur will the two trains meet?

    (a) 200 km

    (b) 300 km

    (c) 250 km

    (d) 225 km

Directions for Questions 19 and 20:

Two trains — *A* and *B* simultaneously started from Delhi to Agra and Agra to Delhi, respectively. After reaching their respective destinations, they turned back towards their starting points and finished their journeys after reaching their starting stations. They met for the first time at a distance of 80 km away from the Delhi station and they met for the second time 40 km away from the Agra station. It is further known that during both the meetings they were travelling in the opposite direction. Answer the following questions:

19. What is the distance (in km) between Delhi and Agra?

20. What is the ratio of the speeds of trains *B* and *A*?

21. The J&K Express from Delhi to Srinagar was delayed by snowfall for 16 minutes and made up for the delay on a section of 80 km travelling with a speed 10 km per hour higher than its normal speed. Find the original speed of the J&K Express (according to the schedule).

    (a) 60 km/h

    (b) 66.66 km/h

    (c) 50 km/h

    (d) 40 km/h

22. Ayrton Senna had to cover a distance of 60 km. However, he started six minutes later than his scheduled time and raced at a speed 1 km/h higher than his originally planned speed. He reached the finish at the time he would reach it if he began to race strictly at the appointed time and raced with the assumed speed. Find the speed at which he travelled during the journey described.

    (a) 25 km/h

(b) 15 km/h

(c) 10 km/h

(d) 6 km/h

23. Two ports *A* and *B* are 300 km apart. Two ships leave *A* for *B* such that the second leaves eight hours after the first. The ships arrive at *B* simultaneously. Find the time the slower ship spent on the trip if the speed of one of them is 10 km/h higher than that of the other.

    (a) 25 hours

    (b) 15 hours

    (c) 10 hours

    (d) 20 hours

24. Two rifles are fired from the same place at a difference of 11 minutes 45 seconds. But a man who is coming towards the place in a train hears the second sound after 11 minutes. Find the speed of train. (Assume the speed of sound as 330 m/s).

    (a) 72 km/h

    (b) 36 km/h

    (c) 81 km/h

    (d) 108 km/h

25. Two *ghats* are located on a riverbank and are 21 km apart. Leaving one of the *ghats* for the other, a motorboat returns to the first *ghat* in 270 min-

utes, spending 40 min of that time in taking the passengers at the second *ghat*. Find the speed of the boat in still water if the speed of the river flow is 2.5 km/h.

(a) 10.4 km/h

(b) 12.5 km/h

(c) 22.5 km/h

(d) 11.5 km/h

26. Two cyclists start simultaneously towards each other from Aurangabad and Ellora, which are 28 km apart. An hour later, they meet and keep pedalling with the same speed without stopping. The second cyclist arrives at Ellora 35 minutes later than the first arrives at Aurangabad. Find the speed of the cyclist who started from Ellora.

(a) 12 km/h

(b) 16 km/h

(c) 15 km/h

(d) 10 km/h

27. An ant climbing up a vertical pole ascends 12 meters and slips down 5 meters in every alternate hour. If the pole is 63 meters high, how long will it take it to reach the top?

(a) 18 hours

(b) 17 hours

(c) 16 hours 35 minutes

(d) 16 hours 40 minutes

28. The distance between two towns is x km. A car travelling between the towns covers the first k km at an average speed of y km/h and the remaining distance at z km/h. The time taken for the journey is

(a) $\frac{k}{y}+\frac{(x-k)}{z}$

(b) $ky+\frac{(k-x)}{z}$

(c) $\frac{k}{y}+\frac{(k-x)}{z}$

(d) $ky+z(x-k)$

29. Two points A and B are located 48 km apart on the riverfront. A motorboat must go from A to B and return to A as soon as possible. The river flows at 6 km/h. What must be the least speed of the motorboat in still water for the trip from A to B and back again to be completed in not more than six hours (assume that the motorboat does not stop at B)?

(a) 18 km/h

(b) 16 km/h

(c) 25 km/h

(d) 46 km/h

30. Bhola and Vijay start running simultaneously on a circular track from the same points in the same direction. How many times Bhola meets Vijay before they meet at the starting point for the first time (Ratio of speeds of Bhola and Vijay is 6:1)?

31. Two motorists met at 10 AM at the Dadar railway station. After their meeting, one of them proceeded in the East direction while the other proceeded in the North direction. Exactly at noon, they were 60 km apart. Find the speed of the slower motorist if the difference of their speeds is 6 km/h.

    (a) 28 km/h

    (b) 18 km/h

    (c) 9 km/h

    (d) 19 km/h

32. A tank of 4800 m^3 capacity is full of water. The discharging capacity of the pump is 10 m^3/min higher than its filling capacity. As a result, the pump needs 16 min less to discharge the fuel than to fill up the tank. Find the filling capacity of the pump.

    (a) 50 m^3/min

    (b) 25 m^3/min

    (c) 55 m^3/min

    (d) 24 m^3/min

33. The metro service has a train going from Mumbai to Pune and Pune to Mumbai every hour, the first one at 6 AM. The trip from one city to other takes 4 hours 30 minutes, and all trains travel at the same speed. How many trains will you pass while going from Mumbai to Pune, if you start at 12 noon?

    (a) 8

    (b) 10

(c) 9

(d) 13

34. A wall clock gains two minutes in 12 hours, while a table clock loses two minutes in 36 hours; both are set right at noon on Tuesday. The correct time when they both show the same time next would be

    (a) 12:30 night

    (b) 12 noon

    (c) 1:30 night

    (d) 12 night

Directions for Questions 35 and 36:

Two places *A* and *B* are 120 feet apart. Ramesh starts travelling from *A* to *B* and at the same time Akhilesh starts travelling from *B* to *A*. Ramesh travels one-third of the total journey at a speed of 8 feet/minute, half of the remaining distance at 10 feet/minute and the rest at 16 feet/minute. Akhilesh completes the whole journey by travelling at 8 feet/minute, 10 feet/minute and 12 feet/minute, respectively, for equal intervals of time. Based on the above information, answer questions 35 and 36:

35. The distance between Ramesh and Akhilesh after five minutes of the start of the journey was found to be '*x*' meters. Find the value of *x*.

36. After how much time (in seconds) of the starting of the journey will they cross each other?

37. A pedestrian and a cyclist start simultaneously towards each other from Aurangabad and Paithan which are 40 km apart and meet two hours after the start. Then they resumed their trips and the cyclist arrives at

Aurangabad 7 hours 30 minutes earlier than the pedestrian arrives at Paithan. Which of these could be the speed of the pedestrian?

(a) 4 km/h

(b) 5 km/h

(c) 3 km/h

(d) 6 km/h

38. Two joggers left Delhi for Noida simultaneously. The first jogger stopped 42 min later when he was 1 km short of Noida and the other one stopped 52 min later when he was 2 km short of Noida. If the first jogger jogged as many kilometers as the second and the second as many kilometers as the first, the first one would need 17 min less than the second. Find the distance between Delhi and Noida.

(a) 5 km

(b) 15 km

(c) 25 km

(d) 35 km

39. One bad day, at 7 AM, I started on my bike at the speed of 36 km/h to meet one of my relatives. After I had travelled some distance, my bike went out of order and I had to stop. After resting for 35 minutes, I returned home on foot at a speed of 14 km/h and reached home at 1 PM. Find the distance from my house to the point at which my bike broke down.

(a) 54 km

(b) 63 km

(c) 72 km

40. Rahim sets out to cross a forest. On the first day, he completes 1/10th of the journey. On the second day, he covers 2/3rd of the distance travelled the first day. He continues in this manner, alternating the days in which he travels 1/10th of the distance still to be covered, with days on which he travels 2/3 of the total distance already covered. At the end of seventh day, he finds that $22\frac{1}{2}$ km more will see the end of his journey. How wide is the forest?

(a) $66\frac{2}{3}$ km

(b) 100 km

(c) 120 km

(d) 150 km

41. Two people *A* and *B* start from *P* and *Q* (distance = *D*) at the same time towards each other. They meet at a point *R*, which is at a distance 0.4*D* from *P*. They continue to move to-and-fro between the two points. Find the distance from point *P* at which the fourth meeting takes place.

(a) 0.8*D*

(b) 0.6*D*

(c) 0.3*D*

(d) 0.4*D*

42. An urgent message had to be delivered from the house of the Peshwas in Pune to Shivaji who was camping in Bangalore. A horse rider travels on horseback from Pune to Bangalore at a constant speed. If the horse increased its speed by 6 km/h, it would take the rider four hours less to

cover that distance. And travelling with a speed 6 km/h lower than the initial speed, it would take him ten hours more than the time he would have taken had he travelled at a speed 6 km/h higher than the initial speed. Find the distance between Pune and Bangalore.

(a) 120 km

(b) 600 km

(c) 720 km

(d) 750 km

43. Two Indian tourists in the US cycled towards each other, one from point A and the other from point B. The first tourist left point A six hrs later than the second left point B, and it turned out on their meeting that he had travelled 12 km less than the second tourist. After their meeting, they kept cycling with the same speed, and the first tourist arrived at B, eight hours later and the second arrived at A, nine hours later. Find the speed of the faster tourist.

(a) 4 km/h

(b) 6 km/h

(c) 9 km/h

(d) 2 km/h

44. The difference between the times taken by two buses to travel a distance of 350 km is 2 hours 20 minutes. If the difference between their speeds is 5 km/h, find the slower speed.

(a) 35 km/h

(b) 30 km/h

(c) 25 km/h

(d) 20 km/h

45. Hemant and Ajay start a two-length swimming race at the same moment but from opposite ends of the pool. They swim in lane and at uniform speeds, but Hemant is faster than Ajay. They first pass at a point 18.5 meters from the deep end and having completed one length, each one is allowed to rest on the edge for exactly 45 seconds. After setting off on the return length, the swimmers pass for the second time just 10.5 meters from the shallow end. How long is the pool?

    (a) 55.5 meters

    (b) 45 meters

    (c) 66 meters

    (d) 49 meters

46. A dog sees a cat. It estimates that the cat is twenty-five leaps away. The cat sees the dog and starts running with the dog in hot pursuit. If in every minute, the dog makes five leaps and the cat makes six leaps and one leap of the dog is equal to two leaps of the cat. Find the time in which the cat is caught by the dog (assume an open field with no trees).

    (a) 12 minutes

    (b) 15 minutes

    (c) 12.5 minutes

    (d) None of these

Directions for Questions 47 and 48:

Dhoni and Kohli start running simultaneously from opposite ends on a race-track of length 100 meters with speeds of 10 m/s and 4 m/s, respectively. If both of them keep running continuously from one end to the other end (to-and-fro) then answer the following questions.

47. After how much time (in seconds) would they meet for the third time?

48. When they meet for the third time, what will be the distance of Dhoni (in meters) from his starting point?

49. Amitabh covered a distance of 96 km two hours faster than he had planned to. This he achieved by travelling 1 km more every hour than he intended to cover every 1 hour 15 minutes. What was the speed at which Amitabh travelled during the journey?

    (a) 16 km/h

    (b) 26 km/h

    (c) 36 km/h

    (d) 30 km/h

50. A tourist covered a journey partly by foot and partly by *tonga*. He walked for 90 km and rode the *tonga* for 10 km. He spent four hours less on the *tonga* than on walking. If the tourist had reversed the times he travelled by foot and on *tonga*, the distances travelled on each part of the journey would be equal. How long did he ride the *tonga*?

    (a) He rode for 6 hours

    (b) He rode for 4 hours

    (c) He rode for 2 hours

(d) He rode for 5 hours

51. Two horses started simultaneously towards each other and meet each other 3 h 20 min later. How much time will it take the slower horse to cover the whole distance if the first arrived at the place of departure of the second five hours later than the second arrived at the point of departure of the first?

    (a) 10 hours

    (b) 5 hours

    (c) 15 hours

    (d) 6 hours

52. Ravi, who lives in the countryside, caught a train for home earlier than usual yesterday. His wife normally drives to the station to meet him. But yesterday he set out on foot from the station to meet his wife on the way. He reached home 12 minutes earlier than he would have done had he waited at the station for his wife. The car travels at a uniform speed, which is five times Ravi's speed on foot. Ravi reached home at exactly 6 O'clock. At what time would he have reached home if his wife, forewarned of his plan, had met him at the station?

    (a) 5 : 48

    (b) 5 : 24

    (c) 5 : 00

    (d) 5 : 36

53. Karim, a tourist leaves Ellora on a bicycle. Having travelled for 1.5 h at 16 km/h, he makes a stop for 1.5 h and then pedals on with the same speed. Four hours after Karim started, his friend and local guide Rahim leaves Ellora on a motorcycle and rides with a speed of 28 km/h in the same direction as Karim had gone. What distance will they cover before Rahim overtakes Karim?

(a) 88 km

(b) 90.33 km

(c) 93.33 km

(d) 96.66 km

54. A motorcyclist left point *A* for point *B*. Two hours later, another motorcyclist left *A* for *B* and arrived at *B* at the same time as the first motorcyclist. Had both the motorcyclists started simultaneously from *A* and *B* travelling towards each other, they would have met in 80 minutes. How much time did it take the faster motorcyclist to travel from *A* to *B*?

(a) 6 hours

(b) 3 hours

(c) 2 hours

(d) 4 hours

55. Ram Singh and Priyadarshan start together from the same point on a circular path and walk around, each at his own pace, until both arrive together at the starting point. If Ram Singh performs the circuit in 3 minutes 44 seconds and Priyadarshan in 6 minutes 4 seconds, how many

times does Ram Singh go around the path?

(a) 8

(b) 13

(c) 15

(d) Cannot be determined

56. Ozair starts for Pune from Mumbai at 2 PM; after reaching Pune he takes 2 hours to finish his work. After finishing his work, he starts his return journey at 4/5th of his previous speed. He reached Mumbai at 8:30 PM on the same day. If the distance between Pune and Mumbai is 100 kilometers, then find the speed (in km/hr) with which he returns back to Mumbai?

57. Two planes move along a circle of circumference 1.2 km with constant speeds. When they move in different directions, they meet every 15 seconds and when they move in the same direction, one plane overtakes the other every 60 seconds. Find the speed of the slower plane.

(a) 0.04 km/s

(b) 0.03 km/s

(c) 0.05 km/s

(d) 0.02 km/s

58. A racetrack is in the form of a right triangle. The longer of the legs of the track is 2 km more than the shorter of the legs (both these legs being on a highway). The start and end points are also connected to each other through a side road. The escort vehicle for the race took the side road and

rode with a speed of 30 km/h and then covered the two intervals along the highway during the same time with a speed of 42 km/h. Find the length of the racetrack.

(a) 14 km

(b) 10 km

(c) 24 km

(d) 36 km

59. A bus left point *X* for point *Y*. Two hours later a car left point *X* for *Y* and arrived at *Y* at the same time as the bus. If the car and the bus left simultaneously from the opposite ends *X* and *Y* towards each other, they would meet 1.33 hours after the start. How much time did it take the bus to travel from *X* to *Y*?

(a) 2 hours

(b) 4 hours

(c) 6 hours

(d) 8 hours

60. Two ants start simultaneously from two ant holes towards each other. The first ant covers 8% of the distance between the two ants holes in 3 hours, the second ant covered $\frac{7}{120}$ of the distance in 2 hours 30 minutes. Find the speed (feet/h) of the second ant, if the first ant travelled 800 feet to the meeting point.

(a) 15 feet/h

(b) 25 feet/h

(c) 45 feet/h

(d) 35 feet/h

61. A *tonga* started travelling at 10:00 in the morning at a speed of 24 km/hr from Chandigarh towards Delhi. A car started on the same route from Chandigarh at 12:15 PM at a speed of 60 km/hr and in the same direction. After half an hour, it had a puncture and needed 45 minutes to repair it. At what distance from Chandigarh, do the two meet?

    (a) 90 km

    (b) 120 km

    (c) 150 km

    (d) 180 km

62. If the ratio of speeds of three sprinters is 3: 4: 5 find the ratio of time taken by the three to cover 100 meters.

    (a) 3 : 4 : 5

    (b) 5 : 4 : 3

    (c) 1 : 1 : 1

    (d) 20 : 15 : 12

63. *P* and *Q* travel from *D* to *A* and break journey at *M* in between. Somewhere between *D* and *M*, *P* asks "How far have we travelled?" *Q* replies, "Half as far as the distance from here to *M*". Somewhere between *M* and *A*, exactly 300 km from the point where *P* asks the first question, "How far have we to go?" *Q* replies, "Half as far as the distance from *M* to here". The distance between *D* and *A* is

(a) 250 km

(b) 350 km

(c) 450 km

(d) 500 km

64. *A*, *B* and *C* start simultaneously from *X* to *Y*. *A* reaches *Y*, turns back and meets *B* at a distance of 11 km from *Y*. *B* reaches *Y*, turns back and meets *C* at a distance of 9 km from *Y*. If the ratio of the speeds of *A* and *C* is 3:2, what is the distance between *X* and *Y*?

(a) 99 km

(b) 100 km

(c) 120 km

(d) 142 km

65. Laila drives to the station each day to pick up her husband Majnu, who usually arrives on a train at 6 o'clock. Last Monday, Majnu finished work earlier, caught an earlier train and arrived at the station at 5 'o clock. He started to walk home and eventually met Laila who drove him the rest of the way, getting home 20 minutes earlier than usual. On Tuesday, he again finished early and found himself at the station at 5:30 PM. Again he began to walk home, again he met Laila on the way, and she drove him home the rest of the way, Assume constant speed throughout with no wasted time for waiting, backing of the car, etc. How earlier than the usual time were they home on Tuesday?

(a) 6 minutes

(b) 8 minutes

(c) 10 minutes

(d) 12 minutes

LEVEL OF DIFFICULTY (III)

1. Two people started simultaneously towards each other from Siliguri and Darjeeling, which are 60 km apart. They met five hours later. After their meeting, the first person, who travelled from Siliguri to Darjeeling, decreased his speed by 1.5 km/h and the other person, who travelled from Darjeeling to Siliguri, increased his speed by 1.5 km/h. The first person is known to arrive at Darjeeling 2.5 hours earlier than the second person arrived at Siliguri. Find the initial speed of the first person.

   (a) 4.5 km/h

   (b) 6 km/h

   (c) 7.5 km/h

   (d) 9 km/h

2. Two friends Arun and Nishit, on their last day in college, decided to meet after 20 years on a river. Arun had to sail 42 km to the meeting place and Nishit had to sail 35 5/7 per cent less. To arrive at the meeting place at the same time as his friend Nishit, Arun started at the same time as Nishit and sailed with the speed exceeding by 5 km/h, the speed of Nishit. Find the speed of Arun.

(a) 10 km/h

(b) 14 km/h

(c) 9 km/h

(d) Both (b) and (c)

3. Three cars leave Patna for Ranchi after equal time intervals. They reach Ranchi simultaneously and then leave for Vizag, which is 120 km from Ranchi. The first car arrives there an hour after the second car, and the third car, having reached Vizag, immediately reverses the direction and 40 km from Vizag meets the first car. Find the speed of the first car.

   (a) 30 km/h

   (b) 19 km/h

   (c) 32 km/h

   (d) 22 km/h

4. Two sea trawlers left a sea port simultaneously in two mutually perpendicular directions. Half an hour later, the shortest distance between them was 17 km, and another 15 min later, one sea trawler was 10.5 km farther from the origin than the other. Find the speed of each sea trawler.

   (a) 16 km/h, 30 km/h
   (b) 18 km/h, 24 km/h

   (c) 20 km/h, 22 km/h

   (d) 18 km/h, 36 km/h

5. Shaurya and Arjit take a straight route to the same terminal point and travel with constant speeds. At the initial moment, the positions of the two and the terminal point form an equilateral triangle. When Arjit covered a distance of 80 km, the triangle becomes right- angled. When Arjit was at a distance of 120 km from the terminal point, then Shaurya arrived at the point. Find the distance between them at the initial moment assuming that there are integral distances throughout the movements described.

   (a) 300 km

   (b) 240 km

   (c) 200 km

   (d) 225 km

6. Mrinalini and Neha travel to Connaught Place along two straight roads with constant speeds. At the initial moment, the positions of Mrinalini, Neha, and Connaught Place form a right triangle. After Mrinalini travelled 30 km, the triangle between the points became equilateral. Find the distance between Mrinalini and Neha at the initial moment, if at the time Mrinalini arrived at Connaught Place, Neha had to cover 6.66 km to reach Connaught Place.

   (a) $10\sqrt{3}$km

   (b) $12\sqrt{3}$km

   (c) $30\sqrt{5}$ km

(d) None of these

7. Three cars started simultaneously from Ajmer to Benaras along the same highway. The second car travelled with a speed that was 10 km/h higher than the first car's speed and arrived at Benaras one hour earlier than the first car. The third car arrived at Benaras 33.33 minutes earlier than the first car, travelling half the time at the speed of the first car and the other half at the speed of the second car. Find the total distance covered by these three cars during their journey between Ajmer and Benaras.

   (a) 360 km

   (b) 600 km

   (c) 540 km

   (d) 840 km

8. Three sprinters A, B, and C had to sprint from points P to Q and back again (starting in that order). The time interval between the starting times of the three sprinters A, B and C was five seconds each. Thus, C started ten seconds after A, while B started five seconds after A. The three sprinters passed a certain point R, which is somewhere between P and Q, simultaneously (none of them having reached point Q yet). Having reached Q and reversed the direction, the third sprinter met the second one 9 meters short of Q and met the first sprinter 15 meters short of Q. Find the speed of the first sprinter if the distance between PQ is equal to 55 meters.

   (a) 4 m/s

   (b) 3 m/s

   (c) 2 m/s

(d) 1 m/s

9. Two trains start from the same point simultaneously and in the same direction. The first train travels at 40 km/h, and the speed of the second train is 25 per cent more than the speed of the first train. Thirty minutes later, a third train starts from the same point and in the same direction. It overtakes the second train 90 minutes later than it overtook the first train. What is the speed of the third train?

   (a) 20 km/h

   (b) 40 km/h

   (c) 60 km/h

   (d) 80 km/h

10. A passenger train left town Alpha for town Beta. At the same time, a goods train left Beta for Alpha. The speed of each train is constant throughout the whole trip. Two hours after the trains met, they were 450 km apart. The passenger train arrived at the place of destination 16 hours after their meeting and the goods train, 25 hours after the meeting. How long did it take the passenger train to make the whole trip?

    (a) 21 hours

    (b) 28 hours

    (c) 14 hours

    (d) None of these

11. Two ducks move along the circumference of a circular pond in the same direction and come alongside each other every 54 minutes. If they

moved with the same speeds in the opposite directions, they would meet every nine minutes. It is known that when the ducks moved along the circumference in opposite directions, the distance between them decreased from 54 to 14 feet every 48 seconds. What is the speed of the slower duck?

(a) 20 feet/min

(b) 15 feet/min

(c) 30 feet/min

(d) 20.83 feet/min

12. Dev and Nishit started simultaneously from opposite points X and Y on a straight road, at constant speeds. When Dev had covered 40% of the distance from X to y, Nishit was 4 km away from Dev after having crossed Dev. When Nishit had covered half the way, Dev was 10 km short of the midpoint. Find a possible time it took Dev to cover the distance from X to Y to the time it took Nishit to cover the same distance.

(a) $\left[\frac{1+\sqrt{3}}{2}\right]$

(b) $\frac{3\sqrt{2}+4}{2\sqrt{2}+1}$

(c) Either (a) or (b)

(d) None of these

13. For Question 12, which of these is a possible value of the distance between the points X and Y?

(a) $20(2+\sqrt{3})$

(b) $20(1+\sqrt{2})$

(c) 60 km

(d) Both (a) and (b)

14. Two ships sail in a fog towards each other with the same speed. When they are 4 km apart, the captains decelerate the engines for four minutes with a deceleration rate of 0.1 m/s2, and then the ships continue sailing with the speeds attained. For what range of values of the initial speed V0 will the ships avoid collision?

    (a) $0 < V_0 < 10$ m/s

    (b) $0 < V_0 < 20$ m/s

    (c) $0 < V_0 < 30$ m/s

    (d) None of these

15. Three points *A*, *B* and *C* are located at the vertices of an equilateral triangle with sides equal to 168 meters. A donkey called Dinky starts from *A* to *B* at 60 meters/hour and at the same time a cow called Moo starts from *B* to *C* at 30 meters/hour. In what time after their departure will the distance between the donkey and the cow be the least?

    (a) 2 hours

    (b) 3 hours

    (c) 0.5 hours

    (d) 8 hours

16. A train has to travel the distance between Aurangabad and Daulatabad, equal to 20 km, at a constant speed. It travelled half the way with the specified speed and stopped for three minutes, to arrive at Daulatabad on

time, it had to increase its speed by 10 km/h for the rest of the way. Next time, the train stopped half-way for five minutes. By what speed must it increase its speed for the remaining half of the distance to arrive at Daulatabad as per the schedule?

(a) 10 km/h

(b) 20 km/h

(c) 15 km/h

(d) 16 km/h

17. Nishit travels from Patna to Kolkata, a distance of 200 km at the speed of 40 km/h. At the same time, Ravi starts from Kolkata at a speed of 20 km/h along a road, which is perpendicular to the road on which Nishit is travelling. When will Nishit and Ravi be closest to each other?

    (a) In 1.5 hours

    (b) In 4 hours

    (c) In 3.33 hours

    (d) In 5 hours

18. Two towns are at a distance of 240 km from each other. A motorist takes 8 hours to cover the distance if he travels at a speed of V_0 km/h from town A to an intermediate town C, and then continues on his way with an acceleration of x km/hr^2. He needs the same time to cover the whole distance if he travels from A to C at V_0 km/h and from C to B at V_1 km/h or from A to C at V_1 km/h and from C to B at V_0 km/h. Find V_0 if the acceleration 'x' is double V_0 in magnitude and $V_0 \neq V_1$.

    (a) 15 km/h

(b) 10 km/h

(c) 20 km/h

(d) 8 km/h

19. Jaideep travels from Alaska, which is on a highway, to Burgen, which is 16 km from the highway. The distance between Alaska and Burgen along a straight line is 34 km. At what point should Jaideep turn from the highway to reach Burgen in the shortest possible time, if his speed along the highway is 10 km/h and 6 km/h otherwise.

    (a) 30 km away from A

    (b) 20 km away from A

    (c) 18 km away from A

    (d) 15 km away from A

20. An object begins moving at time moment $t = 0$ and 4 s after the beginning of the motion, attains the acceleration of 3 m/s2. Find the speed of the object 6 s after the beginning of motion if it is known that the speed of the body varies accordingly to the law $v(t) = (t2 + 2b.t + 4)$ m/s and the object moves along a straight line.

    (a) 22 m/s

    (b) 10 m/s

    (c) 30 m/s

    (d) 15 m/s

21. For question 20, find the distance covered by the object in the first seven seconds if we assume that the speed of the object in a particular second is the speed it attains at the start of the second.

    (a) 15 meters

    (b) 14 meters

    (c) 10 meters

    (d) 5 meters

22. Three *ghats X*, *Y* and *Z* on the Yamuna in Delhi are located on the river bank. The speed of the river flow is 8 km/h in the direction of its flow, *Ghat Y* being located midway between *X* and *Z*. A raft and a launch leave *Y* at the same time, the raft travelling down the river to *Z* and the launch travelling to *X*. The speed of the launch in still water is 5 km/h. Having reached *X*, the launch reverses its direction and starts to *Z*. Find the range of values of *V* for which the launch arrives at *Z* later than the raft.

    (a) $8 < V < 24$ km/h

    (b) $8 < V < 16$ km/h

    (c) $8 < V < 20$ km/h

    (d) $12 < V < 24$ km/h

23. A pedestrian left point A for a walk, going with the speed of 5 km/h. When the pedestrian was at a distance of 6 km from *A*, a cyclist followed him, starting from *A* and cycling at a speed 9 km/h higher than that of

the pedestrian. When the cyclist overtook the pedestrian, they turned back and returned to A together, at the speed of 4 km/h. At what v will the time spent by the pedestrian on his total journey from A to A be the least?

(a) 5 km/h

(b) 6 km/h

(c) 6.1 km/h

(d) 5.5 km/h

24. A cyclist left point A for point B and travelled at the constant speed of 25 km/h. When he covered the distance of 8.33 km, he was overtaken by a car that left point A twelve minutes after the cyclist and travelled at a constant speed too. When the cyclist travelled another 30 km, he encountered the car returning from B. Assume that the car did not stop at point B. Find the distance between A and B.

(a) 39.5833 km

(b) 41.0833 km

(c) 60.833 km

(d) 43.33 km

25. A robot began moving from point A in a straight line at 6 PM with an initial speed of 3 m/s. One second later, the speed of the robot became equal to 4 m/s. Find the acceleration of the robot at the end of the 2nd second if its speed changes by the law $s(t) = (at2 + 2t + (b))$.

(a) 1 m/s2

(b) –2 m/s2

(c) 0 m/s2

(d) 2 m/s2

26. For Question 25, the distance of the robot from point *A* after 6 seconds will be (assuming that for every second, the robot travels at a constant speed equal to its starting speed for that second and any acceleration occurs at the start of the next second)

(a) 45 meters

(b) 36 meters

(c) 10 meters

(d) 17 meters

27. Two friends Amit and Akshay began moving simultaneously from point *A* along a straight line in the same direction. Amit started moving at the speed of 5 m/s and moved with a uniform acceleration of 4 m/s2, while his friend Akshay moved at a uniform speed. The limits for Akshay's speed (S) so that he should first leave Amit behind and then get overtaken by Amit at a distance of 18 meters from *A* are

(a) $5 < S < 9$

(b) $3 < S < 5$

(c) $4 < S < 8$

(d) None of these

28. On the banks of the river Ganges, there are two bathing points in Varanasi and Patna. A *diya* left in the river at Varanasi reaches Patna in 24 hours.

However, a motorboat covers the whole way to-and-fro in exactly ten hours. If the speed of the motorboat in still water is increased by 40%, then it takes the motorboat seven hours to cover the same way (from Varanasi to Patna and back again). Find the time necessary for the motorboat to sail from Varanasi to Patna when its speed in still water is not increased.

(a) 3 hours

(b) 4 hours

(c) 4.8 hours

(d) None of these

29. Two friends started walking simultaneously from points A and B towards each other. The distance between them 144 minutes later was 20% of the original distance. How many hours does it take the faster walker to cover the distance AB if he needs eight hours less to travel the distance than his friend (assume all times to be in whole numbers and in hours)?

(a) 3 hours

(b) 6 hours

(c) 12 hours

(d) 4 hours

30. Two cars left points A and B simultaneously, travelling towards each other. Nine hours after their meeting, the car travelling from A arrived at B, and sixteen hours after their meeting, the car travelling from B arrived at A. How many hours did it take the slower car to cover the whole distance?

(a) 36 hours

(b) 21 hours

(c) 25 hours

(d) 28 hours

31. A pedestrian and a cyclist left Nagpur for Buti Bori at the same time. Having reached Buti Bori, the cyclist turned back and met the pedestrian an hour after the start. After their meeting, the pedestrian continued his trip to Buti Bori and the cyclist turned back and also headed for Buti Bori. Having reached Buti Bori, the cyclist turned back again and met the pedestrian 30 minutes after their first meeting. Determine what time it takes the pedestrian to cover the distance between Nagpur and Buti Bori.

    (a) 1 hour

    (b) 2 hours

    (c) 2.5 hours

    (d) 3 hours

32. Points A, B and C are at the distances of 120, 104.66 and 112 km from point M respectively. Three people left these points for point M simultaneously: the first person started from point A, the second from B and the third from C. The first person covered the whole way at a constant speed and arrived at M an hour before the second and the third persons (who arrived simultaneously). The third person covered the whole way at a constant speed. The second person, having travelled 72 km at the same speed as the first, stopped for two hours. The rest of the way he travelled at a speed that is less than the speed of the third person by the same

amount as the speed of the third is less than that of the first. Determine the speed of the first person.

(a) 6 km/h

(b) 5 km/h

(c) 4 km/h

(d) 3 km/h

33. Two people started simultaneously from points A and B towards each other. At the moment, the person who started from A had covered two-thirds of the way; the other person had covered 2 km less than half the total distance. If it is known that when the person who started from B had covered 1/4 of the way, the other person was 3 km short of the mid-point. Find the distance between A and B. The speeds of the two people were constant.

(a) $(15 - 3\sqrt{17})$ km

(b) $(15 + 3\sqrt{17})$ km

(c) Both (a) and (b)

(d) $3\sqrt{17} - 5$ km

34. Sohan and Lallan left their house simultaneously. Thirty six minutes later, Sohan met his uncle travelling to their house, while Lallan met the uncle twelve minutes after Sohan. Twenty-four minutes after his meeting with Lallan, the uncle rang the door bell at Sohan and Lallan's house. Assume each person travels at a constant speed. Find the ratio of the speeds of Sohan to Lallan to the uncle.

(a) 1: 2: 2

(b) 1: 3: 2

(c) 3: 1: 3

(d) 2: 1: 2

35. The distance between two towns—Aurangabad and Jalna is 80 km. A bus left Aurangabad and travelled at a constant speed towards Jalna. Thirty minutes later, Deepak Jhunjhunwala left Aurangabad in his car towards Jalna. He overtook the bus in thirty minutes and continued on his way to Jalna. Without stopping at Jalna, he turned back and again encountered the bus 80 minutes after he had left Aurangabad. Determine the speed of the bus.

(a) 40 km/h

(b) 45 km/h

(c) 50 km/h

(d) None of these

36. Rohit left Mahabaleshwar for Nashik at 6 AM An hour and a half later Vimal, whose speed was 5 km/h higher than that of Rohit left Mahabaleshwar. At 10: 30 PM of the same day, the distance between the two friends was 21 km. Find the speed of Vimal.

(a) 40 km/h

(b) 41 km/h

(c) 69 km/h

(d) Either (b) or (c)

37. Aurangzeb and Babar with their troops left from Delhi and Daulatabad towards each other simultaneously. Each of them marched at a constant speed and, having arrived at their respective points of destination, went back at once. Their first meeting was 14 km from Daulatabad, and the second meeting, eight hours after the first meeting was at a distance of 2 km from Delhi. Find the distance between the Delhi and Daulatabad.

(a) 30 km

(b) 25 km

(c) 35 km

(d) None of these

38. Two tourists left simultaneously point A for point B; the first tourist covers each kilometer two minutes faster than the second. After travelling 30 per cent of the way, the first tourist returned to A, stopped there for 102 minutes and again started for B. The two tourists arrived at B simultaneously. What is the distance between A and B if the second tourist covered it in 2.5 hours?

(a) 60 km

(b) 70 km

(c) 45 km

(d) None of these

39. Amar and Akbar left Bhubaneshwar simultaneously and travelled towards Cuttack. Amar's speed was 15 km/h and that of Akbar was 12 km/h. Half-an-hour later, Anthony left Bhubaneshwar and travelled in the

same direction. Sometime later, he overtook Akbar and 90 minutes further on, he overtook Amar. Find Anthony's speed.

(a) 18 km/h

(b) 24 km/h

(c) 20 km/h

(d) 16 km/h

40. Two bodies, moving along a circle in the same direction, meet every 49 minutes. Had they moved at the same speeds in the opposite directions, they would meet every seven minutes. If, moving in the opposite directions, the bodies are at the distance of 40 meters from each other along the arc at time $t = 0$, then at $t = 24$ seconds, their distance will be 26 meters (the bodies do not meet during those 24 seconds). Find the speed of the faster body in meters per minute.

(a) 15

(b) 20

(c) 25

(d) None of these

41. The distance between Varanasi and Lucknow is 220 km. Two buses start from these towns towards each other. They can meet halfway if the first bus leaves two hours earlier than the second. If they start simultaneously, they will meet in four hours. Find the speeds of the buses.

(a) $17.5(3 + \sqrt{5})$ km/h, $17.5(1 + \sqrt{5})$ km/h

(b) $27.5(3 + \sqrt{5})$ km/h, $27.5(1 + \sqrt{5})$ km/h

(c) $27.5(3-\sqrt{5})$ km/h, $27.5(\sqrt{5}-1)$ km/h

(d) None of these

42. A road passes through the towns Sangamner and Yeotmal. A cyclist started from Sangamner in the direction of Yeotmal. At the same time, two pedestrians started from Yeotmal travelling at the same speed, the first of them towards Sangamner and the other in the opposite direction. The cyclist covered the distance between the towns in half an hour and, continued ahead in the same direction. He overtook the second pedestrian, 1.2 hours after he met the first pedestrian. Determine the time the cyclist spent travelling from Sangamner to the point of the meeting with the first pedestrian (assuming the speeds of the cyclist and the pedestrians to be constant).

(a) 24 min

(b) 18 min

(c) 30 min

(d) Cannot be determined

43. Two people A and B start moving from P and Q that are 200 km apart, towards each other A is on a moped and B on foot. They meet at a point R when A gives B a lift to P and returns to his original path to reach Q. On reaching Q he finds that he has taken 2.6 times his normal time. B on the other hand realises that he has saved 40 minutes over his normal travel time. Find the ratio of their speeds.

(a) 3 : 2

(b) 4 : 3

(c) 3 : 1

(d) None of these

44. For Question 43, find the speed of the moped.

(a) 160 km/h

(b) 180 km/h

(c) 200 km/h

(d) None of these

45. Three friends *A*, *B* and *C* start from *P* to *Q* that are 100 km apart. *A* is on a moped while *B* is riding pillion and *C* walks on. *A* takes *B* to a point *R* and returns to pick up *C* on the way and takes him to point *Q*. *B*, on the other hand, walks to *Q* from point *R* (*R* is the mid-point between *P* and *Q*).

If the ratio of speeds of the three people is 5: 2: 2, find where will the last person be when the first person reaches *Q*.

(a) 12.85 km from *Q*

(b) 12.75 km from *Q*

(c) 16.66 km from *Q*

(d) 83.33 km from *P*

46. A motorboat moves from point A to point B and back again, both points being located on the river-bank. If the speed of the boat in still water is doubled, then the trip from *A* to *B* and back again would take 20% of the time that the motorboat usually spends in the journey. How many times is the actual speed of the launch higher than the speed of the river flow?

(a) $\sqrt{\frac{3}{2}}$

(b) $\frac{\sqrt{3}}{3}$

(c) $\frac{2}{3}$

(d) $\frac{3}{2}$

47. A watch loses 2/3% time during the first week and gains 1/3% time during the next week. If on a Sunday noon, it showed the right time, what time will it show at noon on the Sunday after the next?

(a) 11: 26: 24 AM

(b) 10: 52: 18 AM.

(c) 10: 52: 48 AM

(d) 11: 36: 24 AM

48. Clocks *A*, *B* and *C* strike every hour. *B* slows down and takes two minutes longer than *A* per hour while C becomes faster and takes two minutes less than *A* per hour. If they strike together at 12 midnight, when will they strike together again?

(a) 10 AM

(b) 11 AM

(c) 9 PM
(d) 11: 36: 24 AM

48. Clocks *A*, *B* and *C* strike every hour. *B* slows down and takes two minutes longer than *A* per hour while C becomes faster and takes two minutes

less than A per hour. If they strike together at 12 midnight, when will they strike together again?

(a) 10 AM

(b) 11 AM

(c) 9 PM

(d) 8 PM

49. A boat went down the river for a distance of 20 km. It then turned back and returned to its starting point, having travelled a total of seven hours. On its return trip, at a distance of 12 km from the starting point, it encountered a log, which had passed the starting point at the moment at which the boat had started downstream. The downstream speed of the boat is

(a) 7 km/h

(b) 13 km/h

(c) 16 km/h

(d) 10 km/h

50. Two boats go downstream from point X to point Y. The faster boat covers the distance from X to Y 1.5 times as fast as the slower boat. It is known that for every hour, the slower boat lags behind the faster boat by 8 km. However, if they go upstream, then the faster boat covers the distance from Y to X in half the time as the slower boat. Find the speed of the faster boat in still water.

(a) 12 km/h

(b) 20 km/h

(c) 24 km/h

(d) 25 km/h

ANSWER KEY

Level of Difficulty (I)

1. (a)
2. (d)
3. (a)
4. (b)
5. (c)
6. (a)
7. (c)
8. (b)
9. (a)
10. (b)
11. (d)
12. (a)
13. (b)
14. (a)
15. (b)
16. (a)
17. (d)
18. (a)
19. (d)
20. (a)

21. (a)
22. (d)
23. (d)
24. (c)
25. (b)
26. (b)
27. (a)
28. (a)
29. (c)
30. (c)
31. (c)
32. (a)
33. (c)
34. (d)
35. (d)
36. (c)
37. (d)
38. (a)
39. (d)
40. (a)
41. (b)
42. (c)
43. (d)
44. (a)
45. (c)
46. (b)
47. (a)

48. (a)
49. (d)
50. (c)
51. (a)
52. (d)
53. (a)
54. (a)
55. (b)
56. (a)
57. (d)
58. (a)
59. (c)
60. (c)
61. (a)
62. (c)
63. (c)
64. (d)
65. (a)
66. (b)
67. (c)
68. (a)
69. (b)
70. (a)
71. (b)
72. (a)
73. (d)

74. (b)
75. (a)
76. (a)
77. (c)
78. (b)
79. (a)
80. (c)
81. (d)
82. (a)
83. (c)
84. (a)
85. (a)
86. (d)
87. 16 m/s
88. 1400 meters
89. 100 meter
90. 1250 meters
91. 50 seconds
92. 50 seconds
93. 2 km
94. 20 km/h
95. 25%
96. 312.5 km

Level of Difficulty (II)

1. (b)
2. (c)
3. (b)

4. (b)
5. (c)
6. 3
7. (b)
8. (b)
9. (c)
10. (c)
11. (d)
12. (d)
13. (b)
14. (d)
15. (a)
16. 53
17. (b)
18. (c)
19. 200 km
20. 1.5
21. (c)
22. (a)
23. (d)
24. (c)
25. (d)
26. (b)
27. (c)
28. (a)

29. (a)

30. 4 times

31. (b)

32. (a)

33. (c)

34. (b)

35. 38 meters

36. 414 seconds

37. (a)

38. (b)

39. (d)

40. (c)

41. (a)

42. (c)

43. (b)

44. (c)

45. (b)

46. (c)

47. 21.42 seconds

48. 14.28 meters

49. (a)

50. (c)

51. (a)

52. (d)

53. (c)

54. (c)

55. (b)

56. 40 km/h
57. (b)
58. (a)
59. (b)
60. (d)
61. (b)
62. (d)
63. (c)
64. (a)
65. (c)

Level of Difficulty (III)

1. (c)
2. (b)
3. (a)
4. (a)
5. (b)
6. (d)
7. (b)
8. (d)
9. (c)
10. (d)
11. (d)
12. (b)
13. (b)
14. (b)
15. (a)

16. (d)
17. (b)
18. (c)
19. (c)
20. (b)
21. (b)
22. (a)
23. (b)
24. (c)
25. (b)
26. (d)
27. (a)
28. (b)
29. (d)
30. (d)
31. (b)
32. (a)
33. (c)
34. (d)
35. (a)
36. (d)
37. (d)
38. (a)
39. (a)
40. (b)
41. (d)
42. (b)

43. (d)

44. (d)

45. (a)

46. (a)

47. (c)

48. (d)

49. (d)

50. (b)

Solutions and Shortcuts

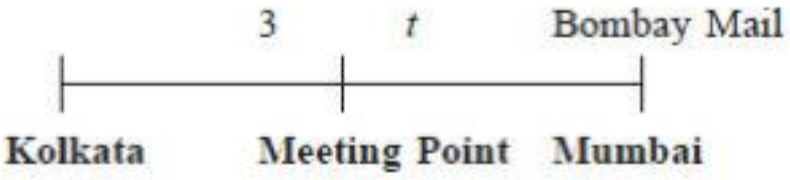
Level of Difficulty (I)

1. In this question, the distance travelled by both the trains is equal. Hence, the ratio of time for the travel being 4:3 (Geetanjali to Calcutta Mail), the ratio of speeds would be 3:4. Since, the sum of their average speeds is 140 km/h, their respective speeds would be 60 and 80 km/h respectively.

   Use alligation (or total distance/total time formula) to get the answer as 68.57 km/h.

2. If you assume that the initial stretch of track is covered by the two trains in time t each, the following figure will give you a clearer picture.

   Calcutta Mail *t* 12



   Kolkata Meeting Point Mumbai

From the above figure, we can deduce that,

$t/3 = 12/t$.

Hence, $t^2 = 36$, gives us $t = 6$.

Hence, the distance between Kolkata to the starting point is covered by the Calcutta Mail in six hours, while the same distance is covered by the Bombay Mail in three hours.

Hence, the ratio of their speeds would be 1:2. Hence, the Bombay Mail would travel at 96 km/h.

3. Since he gains two hours by driving both ways (instead of walking one way), the time taken for driving would be two hours less than the time taken for walking. Hence, he stands to lose another two hours by walking both ways. Hence, his total time should be 10 hrs 45 minutes.

4. Assume the original speed of the train to be '*s*'. According to the question, the train is running at $\frac{7}{11} \times s$. The total distance would be $\frac{7}{11} \times s \times 22 = 14s$. At its original speed of '*s*', it would take $14s/s = 14$ hours to do the same journey. Hence, it would end up saving eight hours.

5. Total distance/Total time = 1590/15 = 106 km/h.

6. Assume the distance to be d. Then, $d/6 + d/4 = 10 \rightarrow d = 24$ km.

7. In four hours, the train will travel 180 km (180,000 meters). The number of poles would be 180,000/50 = 3600.

8. At 40 km/h, Harsh would cover (200/60) × 40 km.

   = 400/3 km = 133.33 km

   This represents the distance by which Vijay would be ahead of Harsh,

when Vijay reaches the endpoint means in essence that Vijay must have travelled for 133.33/20 hours → 6.66 hours.

Hence, the distance is 60 × 6.66 = 400 km.

9. The key for this question is to understand that when he increases his speed by 50%, his time would go down by 33.33% (since the motions are described on the same distance). In this particular case, when he is increasing his speed from 10 km/h to 15 km/h (50% increase in speed), his time is dropping by two hours. This two-hour drop in time is also equal to a 33.33% drop in time. Hence, at10km/h, his original time would have been six hours. Hence, he leaves home at 7 AM and the distance travelled is 10 × 6 = 60 km. If he has to reach the same point by 12 noon, he should cover the distance in five hours. His speed would be 60/5 = 12 km/h.

10. $\frac{d}{\frac{11}{3}} - \frac{d}{4} = 3 \rightarrow \frac{3d}{11} - \frac{d}{4} = 3 \rightarrow d = 132.$

11. By increasing the speed by 50%, it would be able to reduce the time taken for travel by 33.33%. But since this is just able to overcome a time delay of 30 minutes, 30 minutes must be equivalent to 33.33% of the time originally taken. Hence, the original time must have been 1.5 hours and the original speed would be 1000 km/h. Hence, the new speed would be 1500 km/h.

    Alternately, $\frac{1500}{s} - \frac{1500}{1.5s} \rightarrow s = 1000$ and $1.5s = 1500$.

12. Assume a distance of 60 km in each stretch. Get the average speed by the formula. Total distance/ Total time = 180/10 = 18 km/h.

13. Since the distance ratio is 4:3:6 and speed ratio is also 4:3:6, we get the time ratio by dividing the distance ratio by the speed ratio → Hence, the

time ratio = 4/4:3/3:6/6 = 1:1:1.

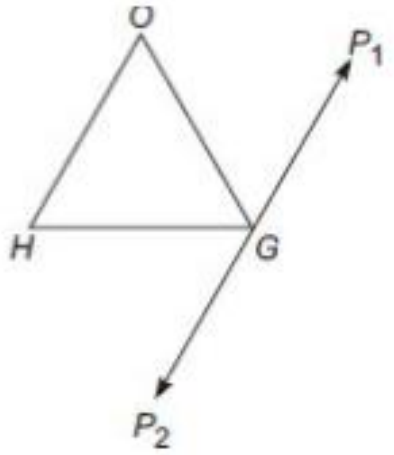
(**Note:** Theory point: This logic comes from the chapter on ratios, where we know that if there are two variables that have a division relationship between them to give an outcome variable; you can simply divide the ratios of the first two variables to get the ratio of the outcome variable. For example, expenditure ratio of three families on rice: 4:3:5; consumption ratio of rice: 4:3:5 → price ratio of rice purchased = 1:1:1.)

14. At 6:45, the first train would have taken a lead of $\frac{3}{4} \times 98$km. The relative speed being 38 km/h, the time taken to catch up for the second train would be $\frac{73.5}{38}$. Hence, distance from the starting point = $\frac{73.5}{38} \approx 263.05$.

15. Solve this one by assuming the speed of the bus from the options. For Option (b) 60, we get: In the first case, distance travelled by bus being 120 km, he would take two hours. Remaining distance = 480 km, in six hours would mean that the speed of the car would be 80 km/h. If he goes 200 km by bus, and 400 km by car, he would take 3 hours 20 minutes by bus and 5 hours by car = a total of 8 hours 20 minutes. This matches the information given in the question – of 20 minutes extra. Hence, this option is correct.

16. When speed goes down to three-fourth (i.e. 75%), time will go up to 4/3rd (or 133.33%) of the original time. Since, the extra time required is 60 minutes; it should be equated to 1/3rd of the normal time. Hence, the usual time required will be 180 minutes.

17.



From the figure above, we see that Shyam would have walked a distance of 4 + 4 + 4 = 12 km (*G* to P_1, P_1 to *G* and *G* to P_2).

18. The diameter of the circle would be given by the hypotenuse of the right triangle with legs 600 and 800, respectively. Hence, the required diameter = 1000 meters.

19. Solve using options. The value in Option (d) fits the situation as 40/16 – 40/20 = 2.5 – 2 = 0.5 hours = 30 minutes.

20. The speed of the first car would be 60 km/h while the speed of the second car would be 40 km/h. The relative speed of the two cars would be 100 km/h. To cover 480 km, they would take 480/100 = 4.8 hours → In 4.8 hours, the car travelling from *A* to *B* would have travelled 4.8 × 60 = 288 km.

21. Since the faster car has moved 48 km more than the slower one, it can be deduced that the total travel must have been for eight hours. Also, since they are travelling in opposite direction, their relative speed would be 42 + 36 = 78 km/h. The total distance would be: 78 × 8 = 624 km.

22. Since, the distance is same; we can assume any distance to calculate the average speed. In this case, if we take the distance equal to 120 km, then

using the formula $\frac{\text{total distance}}{\text{total time}}$, the average speed would be given by: $\frac{120+120}{4}$ km/h.

23. Solve this question using the values given in the options. Option (d) can be seen to fit the situation given by the problem as it gives us the following chain of thought:

    If the average speed of the faster train is 48 km/h, the average speed of the slower train would be 32 km/h. In this case, the time taken by the faster train [Option (d) is 192/48 = 4 hours] is 2 hours lesser than the time taken by the slower train (192/32 = 6 hours). This satisfies the condition given in the problem and hence, is correct.

24. Refer to the solution of question 2 of this exercise.

25. If the car does half the journey at30 km/h and the other half at 40 km/h, its average speed can be estimated using weighted averages.

    Since, the distance travelled in each part of the journey is equal; the ratio of time for which the car would travel will be inverse to the ratio of speeds. Since, the speed ratio is 3:4, the time ratio for the two halves of the journey would be 4:3. The average speed of the car would be:

    (30 × 4 + 40 × 3)/7 = 240/7 km/h

    It is further known that the car travelled for 17.5 hours (which is also equal to 35/2 hours).

    Thus, total distance = average speed × total time = (240 × 35)/ (2 × 7) = 120 × 5 = 600 km.

26. The basic equation in this question would be:

$$\frac{12}{s}+\frac{6}{s+0.5}=\frac{18}{s+0.5}+\frac{1}{3}\rightarrow\frac{12}{s+0.5}=\frac{12}{s}-\frac{1}{3}\rightarrow s=4$$

$$\text{and } s+0.5=4.5\text{km/h}$$

The total time taken by him would be $\frac{12}{4}+\frac{6}{4.5}$ hours.

27. The distance covered in the various phases of his travel would be:

    10 km + 25 km + 50 km + 60 km.

    Thus, the total distance covered = 145 km in 2 hours 50 minutes → 145 km in 2.8333 hours → 51.18 km/h

28. Kalu's speed = 3 m/s.

    For 1200 meters, Kalu would take 400 seconds and Sambhu would take 10 seconds less. Hence, 390 seconds.

29. Since, the fuel efficiency of the car is 19.5 km/litre at a speed of 50 km/h, its fuel efficiency at a speed of 70 km/h can be worked out as: Since, the car uses 30% more diesel, it means that for travelling 19.5 km at 70 km/h, the car would take 1.3 litres of diesel. Hence, its fuel efficiency at 70 km/h = 19.5/1.3 = 15 kmpl. In ten litres, it can travel 10 × 15 = 150 km.

30. Since the ratio of speeds is 3:5, the ratio of times would be 5:3. The difference in the times would be 2 (if looked at in the 5:3 ratio contexts). Further, since Ram takes 30 minutes longer, 2 corresponds to 30. Hence, using unitary method, 5 will correspond to 75 and 3 will correspond to 45 minutes. Hence at 10 km/h, Bharat would travel 7.5 km.

31. When the train from Khandala starts off, the train from Lonavala will already have covered 50 km. Hence, 550 km at a relative speed of 60 km/h will take 550/60 hrs. From this, you can get the answer as:

50 + (550/60) × 25 = 279.166 km

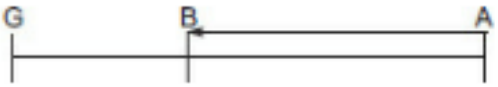
32. Since Chandu is moving at a speed of 10 m/s and he has to cover 360 km or 360000 meters, the time taken would be given by 360000/10 seconds = 36000 seconds = 36000/60 minutes = 600 minutes = 10 hours.

33. The average speed would be given by:

$$\frac{3d}{\frac{d}{v_1}+\frac{d}{v_2}+\frac{d}{v_2}} = \frac{3v_1v_2}{2v_1+v_2}$$

34. Since you are starting at 10:30, the first truck you would encounter would be the truck that started at 6:30 from Kolkata. Also, when you reach Kolkata, you will encounter the truck starting from Kolkata at 2:30 PM. Thus, you would encounter all the trucks that started from Kolkata between 6:30 AM to 2:30 PM. This would be a total of seventeen trucks.

35. To reduce the time of the journey by 25%, he should increase his speed by 33.33% or 1/3rd. Thus, required speed = 120 km/h.

36. 

In the above figure, the train travels from *A* to *B* in 11:30 minutes.

Suppose, you denote the time at which the first gunshot is heard as $t = 0$. Also, if you consider the travel of the sound of the second, the gunshot is heard at point *B* at t = 11:30 minutes. Also, the second gunshot should reach point *B* at t = 12 minutes. Hence, the sound of the second gunshot would take 30 seconds to travel from *B* to *A*.

Thus, $\frac{S_{train}}{S_{sound}} = \frac{t_{sound}}{t_{train}}$

$$S_{train} = 330 \times \frac{30}{690} = \frac{330}{23} \text{ m/s}$$

37. The required speed s would be satisfying the equation:

    $300/s - 300/(s + 5) = 2$

    Solving for s from the options it is clear that $s = 25$.

38. The length of the circular track would be equal to the circumference of the circle. In four minutes thus, the cyclist covers $3.14 \times 400 = 1256$ meters (using the formula for the circumference of a circle).

    Thus, the cyclist's speed would be $1256/4 = 314$ meters/minute.

39. We do not have any information about the ratio of the speeds of the car and the walking speed of the man. Hence, we cannot determine the usual time of travel.

40. The distance would get divided in the ratio of speeds (since time is constant). Thus, the distance ratio would be 5: 7 and required distance = $5/12 \times 600 = 250$ km.

41. The total time taken by the motorist would be $200/53.333 = 200 \times 3/160 = 3.75$ hours = 3 hours 45 minutes. In the first half of the journey, the motorist covers $1/4^{th}$ the distance at 40km/h. This means that he takes $50/40 = 1.25$ hours = 1 hour 15 minutes in covering the first 50 km. This also means that he covers the remaining distance of 150 km in 2 hours 30 minutes → a speed of 60 km/h. Hence, Option (b) is correct.

42. Solve through options using trial-and-error. For usual speed 3 km/h (option c), we have:

    Normal time → 2/3 hours = 40 minutes

At 4 km/h, the time would be 30 minutes. This gives us a reduction of ten minutes. Hence, Option (c) is correct.

43. In six minutes, the car goes ahead by 0.6 km. Hence, the relative speed of the car with respect to the pedestrian is equal to 6 km/h. Since, the pedestrian is walking at 2 km/h, hence, the speed of the car is 8 km/h.

44. You can solve this question using the options. Option (a) fits the given situation best as if we take the distance as 12 km, he would have taken one hour to go by car and four hours to come back walking—a total of five hours as given in the problem.

45. The train that leaves at 6 AM would be 75 km ahead of the other train when it starts. Also, the relative speed being 36 km/h, the distance from Mumbai would be:

    $(75/36) \times 136 = 283.33$ km

46. Let the distance between his home and Durgapur be 'd'. It can be inferred from the travel of Ishan, that he reaches Durgapur at 10 AM and leaves back at 12 noon. Thus, the total distance Ishan has travelled for is $1.33 \times d$ in four hours of travel. Next, when he meets the truck on his outward journey at 7:30 AM, the distance from his home would be $d/6$. When they meet at 1 PM, the distance from Durgapur would be $d/3$. Hence, the truck travels $(1 - d/3) - d/6 = 0.5d$ in five-and-a-half hours (from 7:30AM to 1 PM).

$$\text{Speed ratio} = \frac{\frac{1.33d}{4}}{\frac{0.5d}{5.5}} = \frac{5.5}{1.5} = 11:3$$

47. When his speed becomes 3/4th, his time would increase by 1/3rd. Thus, the normal time = 7.5 hrs (since increase in time = 2.5 hrs).

48. Since the train travels at 60 km/h, its speed per minute is 1 km per minute. Hence, if its speed with stoppages is 40 km/h, it will travel 40 minutes per hour. Consequently, it would stop for 20 minutes per hour.

49. By increasing his speed by 25%, he will reduce his time by 20%. (This corresponds to a six-minute drop in his time for travel—since he goes from being ten minutes late to only four minutes late.) Hence, his time originally must have been 30 minutes. Hence, the required distance is 20 km/h × 0.5 hours = 10 km.

50. Assume that the total distance is 168 km. Then the respective speeds of the two would be 4 km/minute and 3 km/minute. Their relative speed would be 7 km/minute and hence to cover a distance of 168 km, they would take 168/7 = 24 minutes.

51. $9 \times S_T = L_T$ (1)

    $27 \times S_T = L_T + 198$ (2)

    Solving, S_T = 11 m/s

    = 11 × 18/5 = 39.6 km/h

52. In order to solve this, you first need to think of the speed of the river flow (if the speed of the boat in still water is 3 km/h). If we take the speed of the river flow as s, we get downstream speed as $3 + s$ and upstream speed as $3 - s$.

    $10/(3 - s) - 10/(3 + s) = 8$ hours $\rightarrow s = 2$km/h

    (**Note:** It is obvious that since the difference between the downstream

time and the upstream time is eight hours, the upstream and downstream speeds would both be factors of 10. The only value of s such that $3 + s$ and $3 - s$ are factors of 10 is $s = 2$.)

If the boat needs to reach 10 km downstream in 75 minutes (1.25 hours), it means: 10/1.25 = 8 km/h is the downstream speed.

Since, the speed of the stream is 2 km/h, the required speed of the boat = 6 km/h

53. Upstream speed = 80/8 = 10 km/h

Downstream speed = 98/7 = 14 km/h

Speed in still water = average of upstream and downstream speed = 12 km/h

54. $(20 \times 5/18) \times 36 = L_t \rightarrow L_t = 200$ m

55. When Ram runs 2000 meters, Shyam runs (1800 – 30s).

When Ram runs 1000 meters, Shyam runs (2000 – 180s).

Then:

$$2000/1000 = \frac{1800 - 30s}{2000 - 180s}$$

Solving, we get $s = 6.66$ m/s

Thus, shyam's speed = 400 m/minute and he would take 5 minutes to cover the distance. Option (b) fits.

56. Check this one with trial-and-error. From the situation described in the first condition itself, we can see that the speed of coming back has to be double the speed of going downstream. All the four options give that.

Hence, one would need to check the second condition to check if we get a total time of 11.2 hours (i.e. 672 minutes). Checking the options, only option (a) fits this condition and can be thought of as: If the speed of the river flow is doubled in option (a), the speed would become 6 km/h. Then downstream speed would be 15 km/h and upstream speed would be 3 km/h. Total time required to complete the journey = 28/15 + 28/3 = 11.2 hours = 672 minutes. Hence, option (a) is correct.

57. Since A to C is double the distance of A to B, it is evident that the time taken for A to C and back would be double the time taken from A to B and back (i.e. double of 7.5 hours = 15 hours). Since going from A to C takes 10 hours, coming back from C to A would take 5 hours (Since 10 + 5 = 15).

58. $(S_f - S_s) \times 60 = 200$

    Where S_f and S_s are speeds of the faster and slower trains, respectively

    $\rightarrow S_f - S_s = 3.33$

    Also, $(S_f + S_s) \times 10 = 200$

    $\rightarrow S_f + S_s = 20$

    Solving, we get $S_S = 8.33$ m/s

    $= 8.33 \times 18/5 = 30$ km/h

59. Solve through options. For Option (c) at 4 km/h, the boat would take exactly four hours to cover the distance.

60. $d/9 + d/3 = 3/4 \rightarrow 4d/9 = 3/4 \rightarrow d = 27/16$ km = 1.6875 km

61. Assume the speed of Chanakya as 300 km/h. Then, since it takes six hours to cover the distance, it means that the distance is 1800 km. Also, since Chanakya starts at noon, it would cover 300 km by 1 PM. The distance

between the two ships would be 1500 km at 1 PM. At this point, Rajendra would start moving at 200 km/h. Thus, their relative speed would be (300+200) = 500 km/h (as they are moving in opposite direction). To cover a distance of 1500 km, they would take 1500/500 = 3 hours. So they would meet at 4 PM.

62. When *A* scores 60 points, *B* scores 45, and *C* scores 40.

    Thus, when *B* scores 90, *C* would score 80. So, *B* can give *C* 10 points in 90.

63. When Moni does 500, Rohit does 375. Since Rohit has a start of 170 meters, it means that he only needs to cover 330 meters to reach the destination.

    When Rohit does 330, Moni would cover 440 meters and lose by 60 meters (since the ratio of their speeds is 3: 4)

64. 8/ (12 – 2) = 8/10 = 0.8 hours

65. 15 km upstream in 80 minutes → 15/1.33 = 11.25 km/h (upstream speed of the boat)

    Thus, still water speed of the boat

    = 11.25 + 5 = 16.25 km/h

66. Speed of Vinay = 5 m/s, Speed of Ajay = 4m/s. In a hundred meter race, Vinay would take 20 seconds to complete and in this time Ajay would only cover 80 meters. Thus, Vinay beats Ajay by 20 meters in a hundred-meter race.

67. Solve using options 1.33 m/s fits perfectly.

68. When the second train leaves Muzaffarpur, the first train would have already travelled 30 km. Now, after 9 AM, the relative speed of the two trains would be 10 km/h (i.e. the rate at which the faster train would catch the slower train).

    Since the faster train has to catch up a relative distance of 30 km in order for the trains to meet, it would take 30/10 = 3 hours to catch up.

    Distance from Muzaffarpur = 70 × 3 = 210 km

69. Speed of running of the train = 1.25 km/h

    With stoppage, an effective speed of 60 km/h means that the time of travel per hour would be 60/1.25 = 48 minutes.

    Thus, the train stops for 12 minutes per hour.

70. Upstream speed = 4.8 km/h

    Downstream speed = 7.2 km/h

    $d/4.8 + d/7.2 = 1$

    Solving, we get $d = 2.88$ km

71. The length of the train would be given by: 36 × 5/18 × 8 = 80 meters.

72. Look for the solution by thinking of the factors of 91. It can be seen that 91/13 + 91/7 = 7 + 13 = 20 hours. This means that the speed of the boat in still water is 10 km/h and the speed of the water flow would be 3 km/h. Option (a) is correct.

73. When Ajay does 600 meters, Vijay does 540 meters.

    When Vijay does 500 meters, Anjay does 475 m

Thus, Ajay : Vijay : Anjay = 600 : 540 : 513.

Thus, Ajay would beat Anjay by (87 × 2/3) = 58 m in a 400 meters race.

74. $10/(x-2) + 10/(x+2) = 55/60 = 11/12$ hours

    $x = 22$ fits the expression.

75. The speed of the boat in still water is the average of the upstream and downstream speeds. $(x + y)/2$.

76. If we consider the clock to be a circle with circumference 60 km, the speed of the minute-hand = 60 km/h, while the speed of the hour-hand = 5 km/h. The relative speed = 55 km/h. At 2 PM, the distance between the two would be seen as 10 km. This would get covered in 10/55 = 2/11 hours. Option (a) is correct.

77. $14/(5 + x) + 9/(5 - x) = 5$

    $x = 2$, fits this equation.

78. Distance to be covered = 120 meters. Speed = 10m/s → Time required = 120/10 =12 seconds.

79. 20 × (5/18) × 18 = 100 m = 0.1 km.

80. Upstream speed = 3.2 km/h

    Downstream speed = 6 km/h. Speed of the man in still water = 4.6 km/h (average of upstream and downstream speeds)

    Thus, speed of stream = 1.4 km/h

81. Vijay takes nine hours to return upstream after going for six hours downstream. Solve using options. Option (d) fits as we get downstream speed = 18 km/h → distance = 18 × 6 =108 km

82. Rate in still water = (16 + 22)/2 = 19 km/h

83. The given situations are satisfied with the speed of the boat as 8 km/h and the speed of the stream as 3 km/h. Option (c) is correct.

84. $(1/4) \times 2\pi r = 4\pi$ (since r = 8 cm)

85. The hands would be together once in each hour. However, the 12 noon time would be counted in both 11 to 12 and 12 to 1. Hence, the number of times =12 – 1 = 11.

86. $30/(15 + x) + 30/(15 - x)$ = 4 hrs 30 minutes

    At x = 5, the equation is satisfied.

87. Ratio of X and Y = 100: (100 – 10)

    = 100: 90

    = 10: 9

    Ratio of speed of Y and Z = 9: (9 – 1)

    = 9: 8

    Ratio of speed of X: Y: Z = 10: 9: 8

    If speed of X is 20 m/s, then speed of $Z = \frac{8}{10} \times 20$ = 16 m/s.

88. Ratio of speed of Mohan and Sohan =

    5: (5 – 0.5) = 5: 4.5 = 10: 9

    Ratio of Sohan and Chotan = 1: (1 – 0.2) = 5: 4

    Ratio of speeds of Mohan, Sohan and Chotan = 50 : 45 : 36

    Therefore in a 5 km race, if Mohan runs 5000 meters then Chotan runs 3600 meters. Thus, he can give a start of 1400 meters.

89. Let the length of the race track be 1 km. When *A* moves 1 km, *B* moves 800 meters. But '*B*' must cover 900 meters (according to the question).

$\therefore$ *B* must be given a 100 meters start.

90. The ratio of distances would be equal to the ratio of the speeds (since they run for the same time). Thus, 4:5 = ratio of distance travelled. Since, the difference in the distance = 250 meters, the race would be 250 × 5 = 1250 meters.

Solutions for Questions 91 and 92:

91. *Z* meets *X* after every $= \frac{1000}{(60-20)} = \frac{1000}{40} = 25$ s

Z meets *Y* after every $= = \frac{1000}{(60-40)} = \frac{1000}{20} = 50$ s

LCM of 25, 50 = 50 seconds

Therefore, *X*, *Y*, and *Z* meet after every 50 seconds.

92. *X* completes one round in $\frac{1000}{20} = 50$ seconds.

Y completes one round in $\frac{1000}{40} = 25$ seconds.

Z completes one round in $\frac{1000}{60} = \frac{100}{6} = \frac{50}{3}$ seconds.

First meeting at starting point would be after a time equal to the *LCM* of these three times.

Therefore, *X*, *Y*, and *Z* would meet for the first time at the starting point after LCM of (50, 25 and 50/3) = 50 seconds.

93. Ratio of distance covered by them =

Ratio of speeds of *X*, *Y*, *Z* = 10: 20: 25 = 2: 4: 5

If *X* covers 1km, then *Y* covers 2 km .

94. Let's assume the initial speed of John is x km/h.

Now after increasing his speed by 4 km/h, his final speed = $x + 4$ km/h.

According to the question:

$$\frac{80}{x} - \frac{80}{x+4} = 1$$

$x^2 + 4x - 320 = 0$

$(x - 16)(x + 20) = 0$

So $x = 16$ km/h.

Final speed of John = 16 + 4 = 20 km/h.

95. Percentage change in speed from 16 to 20 is 25%.

96. Distance covered by Ram and Rahim together till the firts meeting = 100 km

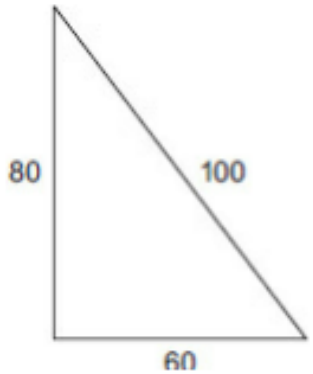
Distance covered by Ram and Rahim together till the third meeting = 100 km + 2 × 200 km = 500 km

Distance covered by Ram and Rahim is always in the ratio of 5:3.

Distance covered by Ram = $\frac{5}{8} \times 500$ = 312.5 km.

Level of Difficulty (II)

1. The following figure gives us the movement of the two swimmers:



The faster swimmer must have travelled 80 km in two hours and hence, his speed is 40 km/h.

2. $\frac{25}{s}-\frac{25}{s+10}=\frac{1}{12}$

   s = 50 km/h

3. The total distance the bird would travel will be dependent on the time that the cars crash with each other. Also, the speed of the bird is the same as the relative speed of the cars. Hence, the answer to question 3 will be 12 km.

4. The bird would travel at 120 km/h for $4+\frac{4}{3}+\frac{4}{9}$ minutes, i.e. 5.77 minutes. Hence, the answer is $(\frac{5.77}{60})\times 120$ 120 = 11.55 km.

5. The bird would be able to theoretically reach the bonnet of the second car an infinite number of times.

6. Let the length of circular track be 'x' meters. If they meet at 'y' meters away from the starting point,

   $$\frac{a}{b}=\frac{3x+y}{2x+y}=1+\frac{x}{2x+y}$$

   Here 'y' must be greater than 0 but less than 'x'. This gives us that the lower limit of the answer would be 1.33 (if you take the higher extreme value of y as 1) and the upper limit would be 1.5 (if we take the lower extreme value of y as 0).

   All the given options lie within this range, hence the correct answer is 3.

7. When the signal happened, distance left was 150 km.

$\frac{150}{s} - \frac{150}{s+15} = \frac{1}{2}$ hours $\rightarrow s = 60$. hours $\rightarrow s = 60$.

Solutions for Questions 8 to 12.

You can make the following table to chart out the motions of the three.

Hour	*Ram*	*Shyam*	*Mohan*
1	10	30	3.33
2	20	33.33	6.66
3	60	36.66	10
4	81.66	40	20
5	85	50	30
6	88.33	60	40
	90(6.5)	70(7)	70(7)
		80(8)	100(8)

8. It is evident that Ram would overtake Shyam between 2 and 3. After two hours at 2 PM, Shyam is ahead by 13.33 km.

Relative speed between 2 and 3 = 36.66 km/h

Time required = = $\frac{13.33}{36.66}$ of the hour

$$= \frac{4}{11} \text{ of the hour}$$
$$= 2{:}\ 22 \text{ (approx.)}$$

9. Mohan would overtake Shyam after 70 miles.

10. Ram would cover 90 miles in 3 hours 45 minutes.

Mohan would cover 90 miles in 7 hours 40 minutes.

Time difference = 3 hours 55 minutes.

11. Mohan at 8 PM (each of the others would reach later).

12. Ram would reach at 9:30 PM, while Shyam would reach at 10:00 PM.

Solutions for Questions 13 and 14.

In 9 hours (7 PM to 4 PM), the Kalinga Express will cover 540 km.

Remaining distance = 260 km

Relative speed = 150 km/h

Time required = $\frac{260}{150}$ = 1.733 hours

= 104 minutes

13. 1.733 90 = 156 km

14. 4 A.M. + 1 hr 44 minutes = 5: 44 A.M.

15. The dog loses 1/3rd of his normal time from the meeting point. (Thus, normal time = 35 × 3 = 105 minutes)

    If the meeting occurred 24 km further, the dog loses 25 minutes.

    This means that the normal time for the new distance would be 75 minutes. Thus, normally the dog would cover this distance of 24 km in 30 minutes. Thus, normal speed = 48 km/hr.

16. Let Anand entered the bar at 'x' minutes past 12 AM.

    Speed of minute-hand = $\frac{360}{60}$ degree/minute

    Speed of hour-hand = = $\frac{30}{60}$ degree/minute

    $(360° - 30°)\frac{x}{60} = 30°$

    $X = \frac{30 \times 60}{330} = \frac{60}{11} = 5\frac{5}{11}$ or 5.455 minutes or 5 minutes 27.27 seconds

    Therefore, Anand entered the bar at 00:05:27 AM.

He came out of the bar at 00:05: 27 AM + 1:20:00

= 1:25:27 AM.

$A = 1; B = 25$ and $C = 27$. Sum of the three = 53.

17. The movement of the ant in the two cases would be 3, 7, 11, 15, 19, 23 and 1, 9, 17, 25, 33, 41. It can be seen that after three seconds the difference is 6 mm, after four seconds, the difference is 16 mm and after five seconds the difference is 30 mm. Thus, it is clearly seen that the ant moved for four seconds.

18. At 2:15 PM, the distance between the two trains would be 550 km as the train from Hazipur to Muzaffarpur would already have travelled for 40 minutes. After that they would take 550/110 = 5 hours to meet. Thus, the train from Muzaffarpur would have travelled 250 km before meeting. Option (c) is correct.

19. Let the distance travelled by train *B* before the first meeting be '*d*' km. Distance travelled by train *A* before second and after first meeting = (40 + *d*) km.Distance travelled by train B before second and after first meeting = 80 + 80 + *d* – 40 = (120 + *d*) km.Since, their speeds are constant; the ratio of distances covered would be constant too (for both the time periods). This gives us the equation:

$$\frac{80}{d} = \frac{40 + d}{120 + d} \rightarrow d = 120.$$

Hence, the distance between Agra and Delhi = 80 + 120 = 200 km.

20. Required ratio $= \frac{120}{80} = \frac{3}{2} = 1.5$

21. By travelling at 10 km/h higher than the original speed, the train is able to make up 16 minutes while travelling 80 km.

This condition is only satisfied at an initial speed of 50 km/h (and a new speed of 60 km/h).

22. Solve this question through options. For instance, if he travelled at 25 km/h, his original speed would have been 24 km/h. The time difference can be seen to be six minutes in this case:

$\frac{60}{24} - \frac{60}{25}$ = 0.1 hrs = 6 mins. Thus, this is the correct answer.

23. If the slower ship took 20 hours (option d), the faster ship would take 12 hours and their respective speeds would be 15 and 25 km/h. This satisfies the basic condition in the question.

24. If we assume the speed of the sound as 330 m/s, we can see that the distance travelled by the sound in 45 seconds is the distance travelled by the train in 11 minutes.

$330 \times 45 = 660 \times s \rightarrow s$ = 22.5 m/s = 81 km/h

25. Check through options. Option (d) will give us 14 km/h and 9 km/h as the downstream and upstream speeds. This would mean that the total travel time would be 1.5 hours and 2.33 hours downstream and upstream respectively. This means a total time of 230 minutes, which is correct as per the question. Hence, Option (d) is correct.

26. Since the two cyclists meet after an hour, their relative speed is 28 km/h. Use options to check out the values. Since the speed of the faster cyclist is asked for it has to be greater than 14 km/h. Hence, only check options > 14 km/h. You would get the answer at 16 km/h.

27. The ant would cover $7 \times 8 = 56$ meters in 16 hours.

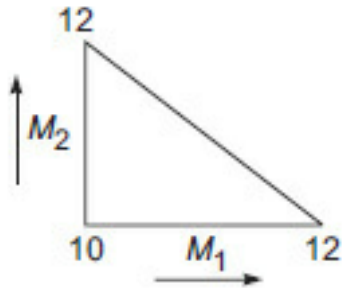
Further, it would require 7/12 of the 17th hour to reach the top. Thus, time required = 16 hours 35 minutes.

28. The total time = time in the first part of the journey + time for the second part of the journey = $\frac{k}{s}+\frac{x-k}{z}$. Option (a) is correct.

29. Solve through options. At 18 km/h, the motorboat would take exactly six hours.

30. Since their ratio of speeds is 6:1, they will meet for the first time at the starting point when Vijay completes his first round. At that time, since Bhola too would have been running for the entire time, Bhola would have covered six times the distance which would mean that Bhola would have covered the track for the sixth time — thus, it would be their fifth meeting. Hence, he would have met Vijay four times before they meet at the starting point.

31.



The distance between the motorists will be shown on the hypotenuse. Using the 3, 4, 5 Pythagoras triplet and the condition that the two speeds are 6 km/h different from each other, you will get the triplet as: 18, 24, 30. Hence, the slower motorist travelled at 18 km/h.

32. Solve this through options as: For option (a)

$$\frac{4800}{50} - \frac{4800}{60} = 16 \text{ minutes}$$

33. If you start at 12 noon, you would reach at 4:30 PM. You would be able to meet the train which left Mumbai at 8 AM, 9 AM, 10 AM, 11 AM, 12 Noon, 1 PM, 2 PM, 3 PM and 4 PM – a total of 9 trains.

34. In 36 hours, there would be a gap of eight minutes. The two watches would show the same time when the gap would be exactly 12 hours or 720 minutes.The number of 36-hour time frames required to create this gap = 720/8 = 90. Total time = 90 × 36 = 3240 hours. Since this is divisible by 24, the correct time would be 12 noon.

35. If Akhilesh travels at 8 feet/minute, 10 feet /minute and 12 feet/minute for 't' minutes then according to the conditions in the problem: $8t + 10t + 12t = 120 \rightarrow t = 4$ minutes. Distance travelled by Akhilesh in 5 minutes = $8 \times 4 + 10 \times 1 = 42$ meters..

    Time taken by Ramesh to travel 1/3rd of the distance = $\frac{120}{3 \times 8}$ = 5 minutes.

    Therefore, distance between Ramesh and Akhilesh after 5 minutes = 120 – (42 + 40) = 38 meters

36. Time after which Ramesh and Akhilesh meet = 5 minutes + $\frac{38}{10+10}$ = 6.9 minutes or 414 seconds

37. The relative speed is 20 km/h. Also, the pedestrian should take 7:30 hours more than the cyclist. Using option (a), the speeds of the two people are 4 km/h and 16 km/h respectively. At this speed, the respective times would be 10 hours and 2:30 hours, giving the required answer.

38. Solve using options. The first option you would check for (given the values in the questions) would be option (b). This would give that the first jogger would run at 3 min per km, while the second jogger would run at 4 min per km. In the new condition, the first jogger would jog for 13 km while the second jogger would jog for 14 km and their respective times would be 39 minutes and 56 minutes. This is consistent with the condition in the question which talks about a difference of 17 minutes in their respective times.

39. The total travel time should be 5 hours 25 minutes.

Or $5\frac{5}{12}$ hours = $\frac{65}{12}$ hours

$\frac{d}{36}+\frac{d}{14}=\frac{65}{12}\rightarrow d$ = 54.6 km

Thus, option (d)is correct.

40. The distances covered in percentage would be, 10% + 6.66% + 8.33% + 16.66% + 5.833% + 31.666 + 2.0833 = 81.25%.

(22.5/18.75) × 100 = 120 km

41. Refer to the following figure which helps us understand that the ratio of speeds of *A* to *B* would be 2: 3.

The fourth meeting would occur after a combined movement of $D + 6D = 7D$. Two-fifth of this distance would be covered by A and 3/5th of this distance would be the distance covered by *B*. Thus, distance covered by *A* would be 2/5th of $7D$, i.e. distance covered by $A = 2.8D$ – which means

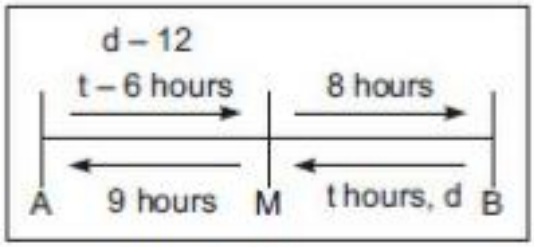
that the fourth meeting occurs at a distance of $0.8D$ from P.

42. The question's structure (and solving) has to be done on the basis of integers. The following equations emerge:

$$\frac{d}{s} - \frac{d}{(s+6)} = 4 \text{ and } \frac{d}{(S-6)} - \frac{d}{(S+6)} = 10$$

Solving these expressions through normal solving methods is close to impossible (at the very least, it would take a huge amount of time). Instead this question has to be solved using the logic that integral difference in ratios in such a situation can only occur in all the three ratios (d/s), $d/(s + 6)$ and $d/(s - 6)$) are integers.Hence, d should have three divisors which are six units apart from each other. The only option that gives the required outcome is 720 km.

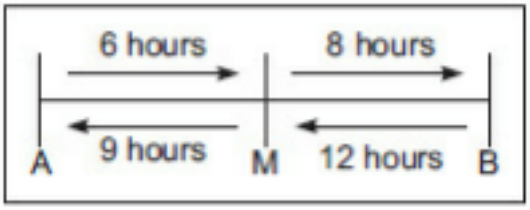
43. This is a complex trial-and-error based question and the way you would have to think in this is:



From the figure above, it is clear that A is faster as he takes only $t + 2$ hours while B has taken $t + 9$ hours to complete the journey.

Then, we get: $\frac{t-6}{9} = \frac{8}{t}$ = Solving for t, we get $t = -6$ (not possible).

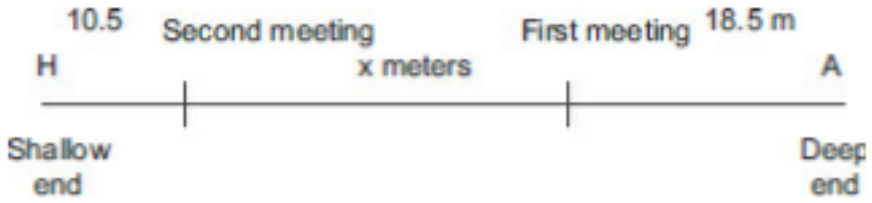
Or $t = 12$. Putting this value of t in the figure it changes to:



We also get ratio of speeds = 3: 2 (inverse of ratio of times) The next part of the puzzle is to think of the 12 km less travelled by the first person till the meeting point.If the speed of the faster person is 3s, that of the slower person = 2s. Further $12 \times 2s - 6\ 3s = 12$ km $s = 2$ km/h. The speed of the faster tourist is $3 \times 2 = 6$ km/h.

44. Solve by putting options in the equation: $\frac{350}{s} - \frac{350}{s+5} = 2.33$ hours. → $s = 25$ fits the situation perfectly.

45. The following figure represents the travel of the two:



Once, you can visualise this figure, try to extract the value of x by taking the length as given in the options. For option (a), length of pool is 55.5 meters, the ratio of speeds of Ajay to Hemant on the basis of the first meeting = 18.5/37. The ratio of speeds on the basis of the second meeting = Ajay's travel to Hemant's travel = 47.5/ 63.5. The two ratios are not the same- which they should have been as both these ratios represent the speed ratio between Ajay and Hemant.

For option (b), length of pool is 45 meters, the ratio of speeds of Ajay to Hemant on the basis of the first meeting = 18.5/26.5. The ratio of speeds on the basis of the second meeting = Ajay's travel to Hemant's travel = 37/

53. The two ratios are same — which they should have been as both these ratios represent the speed ratio between Ajay and Hemant. Hence, this is the correct answer.

46. Initial distance = 25 dog leaps

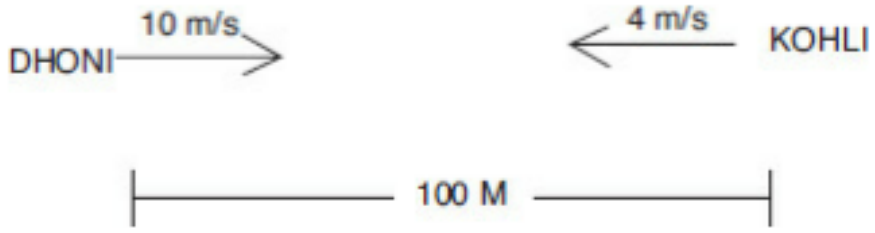
Per minute → dog makes 5 dog leaps

Per minute → cat makes 6 cat leaps = 3 dog leaps

Relative speed = 2 dog leaps/minutes

An initial distance of 25 dog leaps would get covered in 12.5 minutes.

47.



Dhoni will cover two laps in 20 seconds (as he runs at a speed of 10 m/s and the track is 100 meters).In the same time: Kohli will cover 4 × 20 = 80 meters.Therefore, during the first 20 seconds they would meet twice. Also, after covering the track twice, Dhoni would be back to his original position. At that time, the distance between them would be 20 meters (distance left for Kohli to finish his first lap). Also, they would be moving in opposite directions and hence their relative speed would be 14 m/s.

Therefore, they will meet after $\frac{20}{(10+4)} = \frac{10}{7}$ seconds.

So total time taken will be = $10 + 10 + \frac{10}{7} = \frac{150}{7} = 21.42$ seconds

48. At their third meeting, Dhoni will be at $10\frac{10}{7}$ meters from his starting

point.

49. In 1 hour 15 minutes, an individual will be able to cover 25% more than his speed per hour. The relationship between the original speed and the new speed is best represented as below: Original speed increased by 25% → speed per 75 minutes. This is increased by +1 km/h → to give us the new speed. Thus, to go from the new speed to the original speed the process would be: New speed – 1 → Speed per 75 minutes. Speed per 75 minutes – 20% → Original speed. We need to use this process to check the options. Only the first option satisfies this condition (at 16 km/h, it would take six hours while at 12 km/h, it would take eight hours).

50. Solve this question through options.

    For option (c), the conditions match since: If he rode for two hours (speed = 5 km/h), he would have walked for six hours (four hours more) and his walking speed would be 15 km/h. If we interchange the times, we get 15 × 2 = 5 × 6.

51. Since the two horses meet after 200 minutes, they cover 0.5% of the distance per minute (combined) or 30% per hour. This condition is satisfied only if the slower rider takes 10 hours (thereby, covering 10% per hour) and the faster rider takes five hours (thereby, covering 20% per hour).

52. The wife drives for 12 minutes less than her driving on normal days. Thus, she would have saved six minutes each way. Hence, Ravi would have walked for 30 minutes (since his speed is 1/5th of the car's speed). In effect, Ravi spends 24 minutes extra on the walking (rather than if he had travelled the same distance by car). Thus, if Ravi had got the car at

the station only, he would have saved 24 minutes more and reached at 5: 36.

53. When Rahim starts, Karim would have covered 40 km. Also, their relative speed is 12 km/h and the distance between the two would get to 0 in 40/12 = 3.33 hours. Distance covered = 28 × 3.33 = 93.33 km.

54. Since they cover the distance in 80 minutes travelling in opposite directions, we infer 100% distance is covered in 80 minutes → 1.25% per minute → 75% per houri.e. their combined distance coverage is 75% per hour.Since we are asked for the time the faster motorcyclist takes, we can pick up this time from the options.

Options	*Time for faster motorcyclist*	*Faster's % coverage per hour*	*Slower's % coverage per hour*
a	6 hours	16.66	58.33
b	3 hours	33.33	41.66
c	2 hours	50	25
d	4 hours	25	50

It is clear that options *a*, *b*, and *d* are not feasible as it is making the faster motorcyclist slower. Thus, option (c) has to be correct.

(**Note:** You can use the values in option (c) to check the other condition in problem and see that it works.)

55. The respective times are 224 seconds and 364 seconds. They will meet at the starting point in the LCM of these times, i.e. 224 × 13. Hence, Ram Singh will cover the circle 13 times.

56. Since he reduces his speed to 4/5th his going out speed, his time would increase to 5/4th of his normal time. Thus, the total travel time (if we as-

sume that the time going out is t, the time coming back would be $1.25t$). Thus, the total time would be $2.25t$, which is also equal to 4 hours 30 minutes. This gives us t = 2 hours and the returning time = 2 hours 30 minutes. The return speed would be 100/2.5 = 40 km/h.

57. The sum of speeds would be 0.08 km/s (relative speed in opposite direction). Also if we go by option (b), the speeds will be 0.03 and 0.05 km/s respectively. At this speed, the overlapping would occur every 60 seconds.

58. The requisite conditions are met on a Pythagoras triplet 6, 8, 10. Since the racetrack only consists of the legs of the right triangle, the length must be 6 + 8 = 14 km.

59. In this question, consider the total distance as 100%. Hence, the sum of their speeds will be 75% per hour. Checking option (c):

    If the bus took six hours, it would cover 16.66% distance per hour and the car would cover 25% distance per hour (as it takes 2 hours less than the bus).

    This gives an addition of only 41.66%. Hence, the answer is not correct.

    You can check the second option in the same way to see that it is correct. Option (b) is the correct answer.

60. Since the second ant covers $\frac{7}{120}$ of the distance in 2 hours 30 minutes, we can infer that it covers $\frac{8.4}{120}$ = 7% of the distance in three hours. Thus, in three hours both ants together cover 15% of the distance → 5% per hour → they will meet in 20 hours.

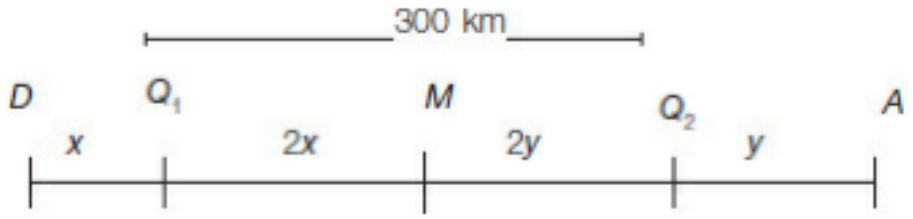
Also, ratio of speeds = 8: 7.

So, the second ant would cover 700 ft to the meeting point in 20 hours and its speed would be 35 feet/h.

61. Effectively, the car starts at 1 PM, thus giving a head start of three hours to the *tonga*. This would mean that the *tonga* has a lead of 72 km, when the car starts. Since, the relative speed is 60 – 24 = 36 km/h, the car would catch up in 72/36 = 2 hours. The distance from Chandigarh would be 60 × 2 = 120 km.

62. The normal reaction is to invert the speed ratio to get the time ratio, since the distance is constant. That reaction would work for two speeds (for instance, if the speed ratio of two cars over the same distance is 2:3, their time ratio would be 3:2). But for the given ratio of three speeds, 3:4:5 as speed ratio does not become 5:4:3 as the time ratio. The process in this situation is to assume the distance of 60 (LCM of 3, 4 and 5). Then, the time ratio would be 60/3:60/4:60/5 = 20:15:12. Hence, Option (d) is correct.

63. The following figure represents the situation. The distance between Q1 and Q2 is 300 km = $2x + 2y$. Hence, $x + y = 150$. Also, total distance = $3x + 3y = 3(x + y) = 450$.



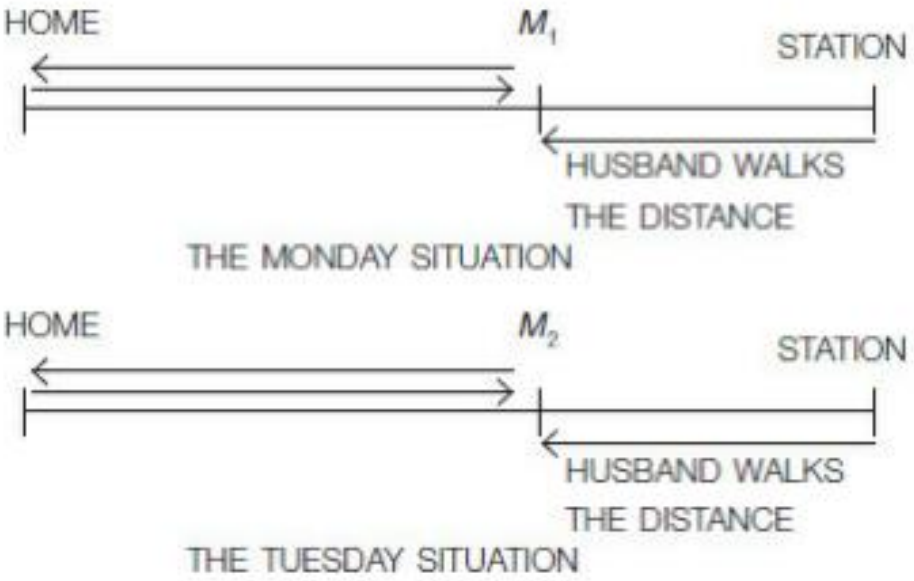
64. Solve this one using the options. If we check option (a), the meeting of *A* and *B* can be perceived as *A* does 110 km when *B* does 88 km. This gives us a ratio of 10:8 (or 5:4) for the speeds of *A* and *B*. Likewise, the meeting

of B and C can be interpreted as: When B does 108 km, C does 90. So their ratio of speeds would be 6:5. Thus, we have A: B = 5:4, while B: C = 6:5 → A: B:C = 30:24:20 = 15:12:10. The ratio of A and C's speed is 15:10, which is the same as 3:2. Hence, this option fits the given situation perfectly and is the correct answer.

(**Note:** If you were to try this using a different option, the numbers would not match to get us 3:2 as the ratio of A and C.)

65. Ameeta's normal journey on a normal day would be from home to station and back. From the figure of Monday, we can see that Ameeta saved 20 minutes because she did not travel her normal journey to the station and back. This means that she must have saved 10 minutes since she did not have to go from $M1$ to the station and back from the station to $M1$. We can infer that this would mean that she would have saved 10 minutes because she did not travel from $M1$ to the station and 10 minutes since she did not travel back from the station to $M1$. Hence, we can also infer that since she would normally reach the station at 6 PM, she must have met him 10 minutes before that at 5:50 PM. Thus, her husband must have taken 50 minutes to walk from the station to $M1$ (5 PM to 5:50 PM). So, the speed ratio of the car to the walking speed would be 5:1. Now if we consider the deductions from Tuesday, we see that they met at $M2$. The time taken by Ameeta to drive from $M2$ to the station would be 1/5th the time taken by her husband to walk from the station to $M2$. Since, the husband starts at 5:30 that day from the station, if we split the 30 minutes between 5:30 to 6 in the ratio of 5:1, we would be able to get the times taken by her husband and Ameeta to travel the distance from $M2$ to the station. The 5:1 split of 30 minutes gives us 25 minutes travel time for the husband and 5 minutes travel time for Ameeta. This means that she

meets him at 5:55 and saves five minutes going and five minutes coming back. Thus, they would reach ten minutes early on that day. Thus, Option (c) is correct.



Level of Difficulty (III)

1. The first person who travels from Siliguri to Darjeeling is obviously faster than the second. Hence, reject options (a) and (b). Then, check all the conditions with options

   (c) and

   (d) and select the one which satisfies the conditions.

2. Since distance to be travelled by Nishit is $35\frac{5}{7}$% less, his speed will also be $35\frac{5}{7}$% less than Arun's speed. Check the options with the conditions that Arun's speed is 5 km/h higher than that of Nishit.

3. Let S_1, S_2 and S_3 be the speeds of the three cars.

Then: $\frac{120}{S_1} - \frac{120}{S_2} = 1$ hour (1)

It is also known that the speed of the third car is double the speed of the first car.

With these realisations, check for factors of 120 which can satisfy the equation above.

(**Note**: In equations like (1) above, normally the respective values of S_1 and S_2 will be factors of 120.)

5. If the side of the initial equilateral triangle is S, then when Arjit covers $(S - 120)$ km, Shaurya covers S kilometers. Also, when Arjit covers a distance of 80 kilometers, Shaurya covers a distance such that the resultant triangle is right-angled.

   Check these conditions through options.

6. Solve through a process similar to the previous question.

7. If S_1 is the speed of the first car, then $(S1 + 10)$ will be the second car's speed. If t_1 hours is the time required for the first car, then $(t_1 - 1)$ hours is the time required for the second car in covering the same distance, while that of the third car is $\left(t_1 - \frac{33.33}{60}\right)$ hours.

   Check these conditions through options.

10. The relative speed is 225 km/h.

11. The sum of the speeds of the ducks is 50 feet/min.

Hence, circumference = 9 × 50 = 450 feet and difference of speeds = $\frac{450}{54}$ = 8.33.

15. Use options to solve.

16. Through trial-and-error, try to find the initial speed of the train, so that the first condition is met.

17. Use options to solve.

18. Let the distance $AC = d$

    Then, $\frac{d}{V_0} + \frac{240 - d}{V_1} = \frac{d}{V_1} + \frac{240 - d}{V_0}$

    If $V_0 \neq V_1$, then the above condition will be satisfied only if d = 120 km.

19. The time required will be represented by

$$\frac{\text{Distance travelled on highway}}{10} + \frac{\text{Distance travelled on side roads}}{10}$$

    This has to be minimised, check the options.

Solutions for Questions 20 and 21:

Acceleration is $\frac{dv}{dt} = 2t + 2b$

At t = 4, the acceleration is given to be 3.

Hence, $b = \frac{-5}{2}$

Hence, the velocity equation becomes

$V(t) = t^2 - 5t + 4$

29. Total time taken to cover the entire distance together = $144 \times \frac{5}{4} = 180$ minutes = 3 hours.

Hence, distance covered per hour = 33.33% of the total by both of them combined.

Check this condition for all the options.

31. Suppose A and B are the points where the first and the second meetings took place.

    The total distance covered by the pedestrian and the cyclist before the first meeting = Twice the distance between Nagpur and Buti Bori

    Total time taken is 1 hour.

    Total distance covered by the pedestrian and the cyclist between the two meetings = Twice the distance between A and Buti Bori. and time taken is half an hour.

    Hence, A is the mid-point. This will result in a GP.

32. Solve through options by checking all the conditions given in the question.

33. If $2d$ is the distance between A and B, then

$$\frac{\frac{2}{3}\times 2d}{d-2} = \frac{d-3}{2d\times\frac{1}{4}}$$

34. In 24 minutes, the uncle covers the distance for which Lallan requires 48 minutes.

35. Check the options for all the conditions.

36. Vimal could either be 21 km behind Rohit or 21 km ahead of Rohit.

37. If d is the distance between Delhi and Daulatabad, then you will get the following equation.

$$\frac{d-14}{14} = \frac{28+(d-16)}{(d-14)+2}$$

38. Check the conditions through the options.

47. The net time loss is 1/3% of 168 hours.

49. In the time taken by the boat in travelling $d + (d - 12)$ km, the log travels 12 km. Let, S_B be the speed of the boat in still water and, S_S be the speed of the stream.

Then

$$\frac{12}{S_S} = \frac{20}{(S_S + S_B)} + \frac{8}{(S_B - S_S)} \qquad (1)$$

It is also known that,

$$\frac{20}{(S_S + S_B)} + \frac{20}{(S_B - S_S)} = 7 \text{ hours} \qquad (2)$$

50. Solve through options.

EXERCISE ON APPLICATIONS OF TIME, SPEED AND DISTANCE

1. At the ancient Athens Olympic Games, in a duel between two runners, Portheus and Morpheus, they were made to start running in opposite direction from diametrically opposite ends of a circular racetrack of length

(circumference) 2 km. The first time they met was after 24 minutes. If the distance between them exactly 'n' minutes after they start is equal to a quarter of the length of the track, which of the following is a possible value of 'n'?

(a) 124

(b) 184

(c) 160

(d) 204

2. Aman and Biman started a walkathon around a circular track starting from the same point on the track in opposite directions. They met for the first after time't'. Had they walked in the same direction with their speeds intact, they would have met after a time '$7t$'. It was also observed that Aman was slower than Biman, and Aman's speed was measured at 12 km/h. Find the speed of Biman.

(a) 4 m/s

(b) 5 m/s

(c) 6 m/s

(d) None of these

3. Abhishek and Aishwarya start from two opposite ends of a tunnel AB, which is 182 meters in length. Abhishek starts from A and Aishwarya starts from B. After they meet, they continue moving in their respective directions, till one of them reaches his end point and immediately reverses direction and starts walking back towards the other end. The ratio

of their speeds is 7:6. At what distance (in meters) from A, will they meet when Abhishek is in his eight round?

(a) 105

(b) 130

(c) 125

(d) They will not meet

4. For the above question, at what distance (in meters) from *A* will they meet when Abhishek is in his twelfth round?

(a) 126

(b) 118

(c) 91

(d) They will not meet

5. Two runners Portheus and Zeus, are running around a circular track at different speeds such that they meet after regular time intervals. The length of the track (circumference) is 1600 meters. If they run in opposite directions, they meet at eight different points while if they run in the same direction, it is observed that they meet at two distinct points on the circular track. If they meet at intervals of 1.33 minutes when they run in the same direction, how much time does the faster runner (Portheus) take to complete one round?

(a) 80 s

(b) 32 s

(c) 120 s

(d) None of these

6. At the Vijayantkhand Mini Stadium, there are two circular racetracks — A with radius 40 meters and B with radiu80 meters, respectively such that they touch each other at a point X. The coach Vijay Sir has a particular ritual with his best athletes Mridul and Odeon. Mridul runs at a speed of 80π m/min on racetrack A and Odeon runs at a speed of 40π m/min along the racetrack B. Both of them start from the point X and run multiple rounds. If Mridul gives Odeon a start of 4 minutes exactly before he starts running himself, after how much time (in minutes) will the straight line distance between the two be exactly 240 meters?

   (a) 6

   (b) 10

   (c) 12.5

   (d) Never

7. Bolt and Milkha, start running around a racetrack simultaneously. Bolt runs at a speed of 's' km/h, while Milkha runs at a speed of 'm' km/h. They meet for the first time when Bolt is in his third round. Which of the following can be the value of s: m?

   (a) 11 : 6
   (b) 11 : 5

   (c) 17 : 8

   (d) 9 : 4

8. Amar, Abhijit and Arun start running on a circular racetrack (from the same point). Amar and Abhijit run in a clockwise fashion while Arun runs anticlockwise. When Amar and Arun meet for the first time, Abhijit is at a distance which is equal to half of the circumference of the circular racetrack. It is also known that Amar runs faster than Arun. The ratio of speeds of Amar, Arun and Abhijit cannot be

   (a) 5 : 1 : 2

   (b) 3: 1: 1

   (c) 4 : 2 : 1

   (d) 3 : 2 : 1

9. At what time between 6 and 7 o'clock is the miniute-hand of a clock 4 minutes ahead of the hour-hand?

   (a) $34\frac{1}{11}$ minutes past 6

   (b) $36\frac{5}{11}$ minutes past 6

   (c) $37\frac{1}{11}$ minutes past 6

   (d) None of these

10. The minute-hand of a clock overtakes the hour-hand at intervals of 66 minutes of the correct time. How much time does the clock gain or lose in four hours?

   (a) $1\frac{119}{121}$ minutes minutes

   (b) $1\frac{114}{121}$ minutes minutes

(c) 2 minutes

(d) None of these

11. Robin Varkey's watch always runs faster than the actual time and gains time uniformly. He sets the watch to be ten minutes behind time at 12 noon on a Sunday. He observes that the watch is 5 minutes 48 seconds faster the following Sunday at 12 noon. At what exact time would the watch be correct?

(a) $\frac{26}{79}$ Hours past 10 PM on Thursday

(b) $\frac{13}{79}$ Hours past 8 PM on Thursday

(c) $\frac{26}{79}$ Hours past 6 PM on Thursday

(d) None of these

12. Prawin Tiwari sets his clock right at 10 AM on Monday . However, being a defective piece (the clock); it loses 32 minutes every day. He has to get up on Friday at exactly 4 AM to catch his flight to Lebuana. At what time on Friday morning should he set the alarm on his watch in order for the watch to ring at exactly 4 AM?

(a) 3 AM

(b) 2 AM

(c) 5 AM

(d) None of these

13. At what time, in minutes, between 4 o'clock and 5 o'clock, would both the hands of a clock coincide with each other?

(a) $22\frac{1}{11}$

(b) $21\frac{9}{11}$

(c) $22\frac{4}{11}$

(d) $21\frac{7}{11}$

14. At what time between 8 PM to 9 PM will the hands of a clock be in the same straight line pointing away from each other?

(a) $10\ \frac{8}{11}$ Minutes past 8

(b) $10\ \frac{10}{11}$ Minutes past 8

(c) $10\ \frac{3}{11}$ Minutes past 8

(d) $9\ \frac{10}{11}$ Minutes past 8

15. A watch which gains five seconds in three minutes was set right at 7 AM. In the afternoon of the same day, when it indicated quarter past 4 o'clock, the true time is

(a) $59\ \frac{7}{12}$ Minutes past 3

(b) 4 PM

(c) $58\ \frac{7}{11}$ Minutes past 3

(d) $2\ \frac{3}{11}$ Minutes past 4

16. In a 2000 meters race between Portheus and Cassius, Portheus gives Cassius a head start of a minute but still beats him by 200 meters. When, he

increases the head start to 80 seconds, the race ends in a dead heat. Find the speed of Portheus.

(a) 25m m/s

(b) 18 m/s

(c) 13.33 m/s

(d) 16.66 m/s

17. How many right angles would be formed between the minute and the hour hand of a watch in a day?

(a) 48

(b) 46

(c) 45

(d) 44

18. How many times between 2 PM and 4 PM does the minutes hand coincide with the second's hand?

(a) 118

(b) 119

(c) 120

(d) 121

19. A man enters his house at some time between 6 to 7 PM. When he leaves his house sometime between 7 to 8 PM, he observes that the minute-hand and the hour-hand have interchanged positions. At what exact time did the man enter the house?

(a) $38\frac{82}{121}$ Minutes past 6

(b) $37\frac{42}{121}$ Minutes past 6

(c) $\frac{82}{121}$ Minutes past 6

(d) $37\frac{62}{121}$ Minutes past 6

20. How many straight lines would be formed between the minute and the hour-hand of a watch in a day?

(a) 48

(b) 46

(c) 45

(d) 44

21. Two friends started simultaneously from Kanpur towards Lucknow in the same direction along a straight road. The faster friend Raveesh was on a bike while Prakash was in an auto. The ratio of their speeds was 1: 5 respectively. Two hours later, Raveesh parked his bike and started running back towards Prakash's auto. His speed dropped by 80% as a result of this. They meet at a point which is 15 km from Kanpur. What was the speed of the auto?

(a) 2 km/hr

(b) 2.5 km/hr

(c) 3 km/hr

(d) None of these.

22. Two brothers came to know about their sister's wedding at the last minute. The wedding was to be held at a location which was 800 km away from Mumbai where both of them lived. The elder brother Kanhaiya came to know about the wedding at 6 PM and left immediately in his car. His younger brother Ramaiyya came to know about the wedding at 9:30 PM and left in his car immediately at a speed which was 15 km/h higher than the speed of his elder brother. At 4:30 AM, it was found that the two cars were 70 km apart. If the cars had travelled continuously without taking any rest, find the speed (in km/hr) of Kanhaiya's car.

    (a) 40

    (b) 50

    (c) 60

    (d) Cannot be determined

23. Ranatunga once challenged Bolt to a race. The distance of the race was set at 2 km. They start at the same time and the ratio of their speeds is seen to be 4:1 (obviously Bolt would be faster). After sometime passes, Bolt realises that he is far ahead and calculates that even if he stops for a snack and a nap for 'n' minutes, he would still reach his destination and beat Ranatunga by 13 minutes. Hence, he plans to take a break of 'n' minutes. Ranatunga keeps walking during this whole time. However, when Bolt wakes up, he realises that he has stopped for a total of $(n + 15)$ minutes. He redoubles his efforts by increasing his speed to double his original speed. The race eventually ended in a dead heat. If it is known that Bolt overstayed his stop by $6n/5$ mins, how long did Ranatunga take to complete the race?

(a) 32 minutes

(b) 34 minutes

(c) 25 minutes

(d) None of these

24. *A* and *B* run a 300 meters race where the initial speed of *B* is double the speed of *A*. After some time, going on these speeds, *A* realises that he would be losing the race and redoubled his effort and increased his speed to four times his initial speed. As a result, they reached the end point at the same time and the race resulted in a dead heat. What was the distance travelled by *B*, when A quadrupled his speed?

(a) 100 m

(b) 200 m

(c) 150 m

(d) None of these

25. Amit and Bimal start running around a circular track of circumference 4200 meters. Their respective speeds are 15m/s and 3 m/s. Their fourteenth meeting occurs at point *P* and their twenty-second meeting occurs at the point *Q*. Find the longer distance (along the circumference) between points *P* and *Q*.

(a) 2800

(b) 1400

(c) 3500

(d) 3150

26. In a 2 km race, Ravi beats Sandeep by 45 seconds and Sandeep beats Tarun by a further 75 seconds. In the same race, Ravi beats Tarun by 400 meters. Find the time in which Ravi can run the race (in seconds).

    (a) 240

    (b) 300

    (c) 360

    (d) 480

ANSWER KEY

1. (d)
2. (d)
3. (d)
4. (a)
5. (b)
6. (d)
7. (a)
8. (d)
9. (c)
10. (a)
11. (a)
12. (b)
13. (b)
14. (b)
15. (b)

16. (d)
17. (d)
18. (d)
19. (a)
20. (c)
21. (b)
22. (b)
23. (b)
24. (b)
25. (a)
26. (d)

Solutions and Shortcuts

1. They would first meet after 24 minutes (after covering 50% of the distance represented by the circumference of the circle). The next time they would meet will be at 72 minutes, then 120 minutes, then 168 minutes, 216 minutes and so on.

   Every time they meet, they will be together and after the meeting point they continue running in opposite directions till they meet again. Between two meeting points, the distance between them would be 25% of the length of the circle's circumference in two cases: first when they are going away from each other after meeting (this would occur at a time of 12 minutes after the meeting point) and second when they are approaching each other before their next meeting (this would occur at a time of 12 minutes before the next meeting point).

   The meeting times 24, 72, 120, 168, 216, and 264, etc.; the times at which the distance would be 25% of the circumference:

(24 –12 = 12); (24 + 12 = 36); (72 – 12 = 60);

(72 + 12 = 84); (120 – 12 = 108); (120 + 12 = 132);

(168 – 12 = 156); (168 + 12 = 180);

(216 – 12 = 204)

Only Option (d) is possible and hence is the correct answer.

2. The ratio of their speeds can be worked out to be 4:3. Hence, Biman's speed (b) would be 16 km/h.

   b = 16 km/h = 16 × 5 ÷ 18 = 80 ÷ 18 m/s = 4.44 m/s. Option (d) is the correct answer.

3. When Abhishek would complete seven rounds, Aishwarya would have completed: 7 × 6 ÷ 7 = 6 rounds.

   This means that both of them would be at the point B at this time. Since Abhishek is faster than Aishwarya, during his eighth round; there would be no meeting with Aishwarya. Hence, Option (d) is correct.

4. When Abhishek would complete eleven rounds, Aishwarya would have completed: 11 × 6 ÷ 7 rounds = $9\frac{3}{7}$ rounds.

   This means that Aishwarya would be at a distance of 3/7 from A, while Abhishek would be at B at this point of time. The distance between them would be 4/7 of the total distance between A and B. Aishwarya would further cover a distance of 4/7 × 6/13 in order to meet Abhishek. Thus, the total distance from A is (3/7 + 24/91) × 182 = 63 × 182 ÷ 91 = 126 meters from A and 56 meters from B. Option (a) is correct.

5. Let the ratio of speeds be P: Z (where $P>Z$).

   Since they meet at eight distinct points on the circle when they move in opposite directions, it automatically means that the sum of $P + Z = 8$. (I would like to encourage you to discover this piece of logic through trial-and-error.)

   Similar logic gives us that $P - Z = 2$ (since they meet at two distinct points when travelling in the same direction).

   Using these two equations, we can determine that if $P = 5, Z = 3$. Let the speeds of P be $5x$ and Z be $3x$ (in m/s). Then we have: $1600/2x = 80$ seconds $\rightarrow x = 10$ and hence, the speeds are $P = 50$ m/s and $Z = 30$ m/s.

   P would take $1600 \div 50 = 32$ seconds to complete one round.

   Option (b) will be the correct answer.

6. Since the radii of the circles are 40 meters and 80 meters respectively, the circumference would be 80π and 160π meters respectively. Since Odeon's speed is 40π m/min, he would take four minutes to cover a round. This also means that when Mridul starts running, they would both be at point X, since Odeon would have covered one round exactly in four minutes. Also, for the straight line distance to be 240 meters, they should be at the diametrically opposite ends from the point X (of their respective circles).

   Mridul reaches the diametrically opposite end (from X) of his circle for the first time in 30 seconds and after that he would reach the same point every 1 minute at 1:30, 2:30 and so on. Odeon on the other hand would reach the diametrically opposite end at 2 minutes, 6 minutes, and 10 minutes and so on. They would never be exactly 240 meters apart. Option (d) is correct.

7. Check using the options. You can see that only in the case of option (a) do they meet when Bolt is in his third round. For all other options, Bolt would cross Milkha when Bolt is in his second round.

8. Checking the options, it can be seen that the condition of diametrically opposite is satisfied in each of the first three options. It is only in Option (d) that it is not satisfied. Hence, Option (d) is correct.

9. At 6 o'clock, the minute-hand is 30 minutes behind the hour-hand.

   From this position, we need to reach a position, where the minute-hand is four minutes ahead of the hour-hand. For this to occur, the minute-hand has to gain (30 + 4) = 34 minute spaces on the hour-hand. In one hour, the minute-hand moves 60 minutes while the hour-hand moves 5 minute spaces on the clock. Hence, the minute-hand gains 55 minutes on the hour-hand in an hour.

   Hence, to gain 34 minutes, the minute-hand would take $\left(\frac{60}{55}\times 34\right) = 37\frac{1}{11}$ minutes.

   The required answer would be $37\frac{1}{11}$ minutes past 6. Option (c) is correct.

10. Assume the clock to be a circular race track of 60 km with each minute denoting 1 km. Also imagine two runners Mr. Minute and Mr. Hour running on this track. Normally, in a correct clock, Mr. Minute would cover 55 km more than Mr. Hour every hour.

    This means that they would be together (meaning Mr. Minute would overtake Mr. Hour) every $\left(\frac{60}{55}\times 60\right)$ minutes. = $65\frac{5}{11}$ minutes. If they meet at longer time intervals than this, it means that the clock is slow. If the time intervals are shorter, it would mean that the clock is fast.

In this problem, they are together after 66 minutes. Thus, the clock loses time.

Loss in 66 minutes $\left(66-65\frac{5}{11}\right)=\frac{6}{11}$ minutes.

Using unitary method, we get loss in 4 hours $\left(\frac{6}{11}\times\frac{60\times4}{66}\right)$ minutes $=1\frac{119}{121}$ minutes.

11. In one week, the time elapsed is exactly 168 hours. Robin's watch gains 15 minutes 48 seconds in 168 hours. In other words, it gains $\left(10+5\frac{4}{5}\right)$ minutes or $\frac{79}{5}$ minutes in 168 hrs.

    To be showing the exact time, the watch should have gained exactly 10 minutes.

    Using unitary method, it can be seen that ten minutes would be gained by the watch in: $\left(168\times\frac{5}{79}\times10\right)$ hrs. $=106\frac{26}{79}$ hours.

    ∴ Watch is correct at $\frac{26}{79}$ hours past 10 PM on Thursday. Option (a) is the correct answer.

12. Time from 10 AM on Monday to 2 AM on Friday = 88 hours.

    Now 23 hrs 28 minutes of this clock = 24 hours of correct clock.

    ∴ $\frac{352}{15}$ hrs of this clock = 24 hours of correct clock

    88 hrs of this clock = $\left(24\times\frac{15}{352}\times88\right)$ hrs of correct clock.

    = 90 hrs of correct clock. This means that at 4 AM on Friday, his clock would show 2 AM. Hence, if he needs to wake up at 4 AM, he should set his clock's alarm at 2 AM.

Hence, Option (b) is the correct answer.

13. Assume the clock to be a circular race track of 60 km with each minute denoting 1 km. Also imagine two runners Mr. Minute and Mr. Hour running on this track. Normally, in a correct clock, Mr. Minute would cover 55 km more than Mr. Hour every hour.

    At 4 o'clock, the minute-hand is 20 km behind the hour-hand.

    It would hence, need to gain 20 km to coincide with the hour-hand.

    In 60 minutes, it gains 55 km.

    In t minutes, it gains 20 km.

    $t = \left(\frac{60}{55} \times 20\right)$ minutes $= 21\frac{9}{11}$ minutes

14. Thinking as in the previous question, we can think that at 8 PM, the minute-hand is 40 km behind the hour-hand. For it to become 30 km behind the hour-hand, we would need it to cover 10 km over the hour-hand.

    In 60 minutes, it gains 55 km.

    In t minutes, it gains 10 km.

    $$t = \left(\frac{60}{55} \times 10\right) \text{ minutes} = 10\frac{10}{11} \text{ minutes}$$

    Option (b) is correct.

15. Time from 7 AM to 4:15 PM = 9 hrs 15min = $\frac{37}{4}$ hrs

    3 min 5 sec of this clock = 3 min of the correct clock

    $\Rightarrow \frac{37}{720}$ hrs of this clock = $\frac{1}{20}$ hrs of the clock

$\Rightarrow \frac{37}{720}$ hrs of this clock = $\left(\frac{1}{20} \times \frac{720}{37} \times \frac{37}{4}\right)$ hrs of the correct clock

= 9 hrs of the correct clock

The correct time is 9 hrs after 7 AM, i.e. 4 PM.

16. Since Cassius is able to get a dead heat when he gets a head start of 80 seconds, it means that he would cover 200 meters in 20 seconds. Hence, his speed is 10m/s.

    Let the time taken by Portheus to finish the race be t seconds. Then tracking the movement of Cassius we get:

    $t \times 10 + 60 \times 10 = 2000 - 200$.

    So t = 120 seconds.

    Hence, the speed of Portheus would be = 2000/120 = 250/15 = 50/3 = 16.666 m/s. Option (d) is correct.

17. There are two right angles that are formed every hour between the hands of a watch. Hence, in 24 hours, we would expect 48 right angles. However, between 2 to 4 AM and 2 to 4 PM the number of right angles formed is only 3, because the right angle formed at 3 O'Clock (both AM and PM) is the second right angle for the hour between 2 O'Clock and 3 O'Clock. It is also the first right angle between 3 O'Clock and 4 O'Clock. This makes the clock lose two of its 48 expected right angles. Similarly, two right angles are lost when the clock passes through 8 O'Clock to 10 O'Clock. Hence, there would be a total of 44 right angles formed. Option (d) is correct.

18. In two hours, the minute-hand completes two rounds around the circumference of the clock's dial. In the same time, the seconds-hand covers 120 rounds. If we count 2 PM coincidence as the first one, the 4 PM coinci-

dence would be the last one. There would be a total of 121 coincidences in two hours. Option (d) is correct.

19. Assume the clock to be a circular race track of 60 km with each minute denoting 1 km. Also imagine two runners Mr. Minute and Mr. Hour running on this track. Normally, in a correct clock, Mr. Minute would cover 55 km more than Mr. Hour every hour. For the conditions given in the problem, when the man enters the house, the time would be somewhere between 6:35 to 6:40 while when he leaves the time would be somewhere between 7:30 to 7:35.

Let, the distance between the two is equal to x km. When the hands interchange positions, the hour-hand would have travelled x km and the minute-hand would have travelled $(60 - x)$ km.

Using unitary method, we get:

When the minute-hand travels 60 km, the hour-hand travels 5 km.

When the minute-hand travels '$60 - x$' km, the hour-hand travels 'x' km.

$60x = 300 - 5x \rightarrow x = \frac{300}{55} = 5\frac{5}{11}$ minutes.

This means that when he comes home, the minute-hand is $5\frac{5}{11}$ minutes ahead of the hour-hand.

In order to find the exact time at which this happens between 6 and 7, we know that at 6, the minute-hand is 30 km behind the hour-hand. For the minute-hand to move $5\frac{5}{11}$ minutes ahead of the hour-hand, we would need the minute- hand to cover $\frac{5}{11}$.

In 60 minutes, the minute-hand covers 55 km.

In t minutes, the minute-hand covers $35\frac{5}{11}$ minutes.

$$121 = 38\frac{82}{121} \text{ minutes.}$$

He comes home at 38 minutes past 6.

20. There are two times that the hands of a watch form straight lines every hour. Hence, in 24 hours, we would expect 48 straight lines. However, between 11 and 1 and between 5 and 7, we would 'lose' one straight line as the 12 o'clock straight line and the 6 o'clock straight lines are double counted. Hence, the number of straight lines = 48 – 1 (for 5 AM to 7AM) – 1 (for 11 AM to 1 PM) – 1 (for 5 PM to 7 PM). Hence, there would be a total of 45 straight lines formed in a day. Hence, Option (c) is correct.

21. Solve this through options. Option (b) matches the conditions of the problem and is hence, the correct answer.

The thought-process for this goes as follows:

If the auto's speed is 2.5, the bike's speed would be 12.5. Naturally two hours later, Raveesh would be at 25 km while Prakash would be at 5 km: a distance of 20 km. When Raveesh starts back, his speed would be 2.5 km/h and hence, the total speed at which they would approach each other would be 5 km/h. They would meet six hours after starting — and in this time Prakash would have covered 15 km and hence they would meet at 15 km from Kanpur. (This last bit would not match for the other options.)

For example, if we check option (a):

The thought-process for this goes as follows:

If the auto's speed is 2, the bike's speed would be 10. Naturally two hours later, Raveesh would be at 20 km while Prakash would be at 4 km:a distance of 16 km. When Raveesh starts back, his speed would be 2 km/h and hence, the total speed at which they would approach each other would be 4 km/h. They would meet six hours after starting — and in this time Prakash would have covered 12 km and hence, they would meet at 12 km from Kanpur which does not match the information in the problem.

22. Solve using options. For option (b), at 4:30 AM, the elder brother has travelled for 10:30 hours and hence, must have covered 525 km. The younger brother has travelled only for seven hours and at a speed of 65 km/h, the distance travelled would be 455 km. This would mean that the distance between them would be 70 km (as given). Hence, this option works correctly. The other options do not work and can be tested in a similar way.

For instance, for option (a), 40 km/h does not work because $10.5 \times 40 - 7 \times 55 \neq 70$.

Similarly, Option (c) can be rejected because $10.5 \times 60 - 7 \times 75 \neq 70$.

23. Since Bolt outstretched his time by $6n/5$ minutes and this is also equal to 15 minutes. Solving, we get: $n = 12.5$ minutes.

Let their original speeds be '$4s$' and 's' km/h respectively.

Had Bolt not overstretched his nap, he would have beaten Ranatunga by 13 minutes.

$$\therefore \quad \frac{2000}{4s} + 12.5 + 13 = \frac{2000}{s} \Rightarrow s = 1000/17$$

Hence, the time taken by Ranatunga to complete the race = 2000 × 17 ÷ 1000 = 34 minutes.

Hence, Option (b) is correct.

24. The distance travelled by *B* in the initial phase of the race will be double the distance travelled by *A* during the same time. Likewise, in the second phase of the race, the distance travelled by *A* will be double the distance travelled by B. Also the total distance travelled by *A* and *B* would be 300 meters. The only value which creates this symmetrical situation is if the initial phase is such that *B* travels 200 meter and *A* travels 100 meter. Hence, Option (b) is correct.

25. Imagine the circle to be a clock with 12 divisions on the circumference — each division equal to a distance of 4200 ÷ 12 = 350 meters. (Imagine these are representing 1 o'clock to 12 o'clock for ease of understanding). Since they travel at a ratio of speed as 5:1, imagine Amit travels clockwise and Bimal travels anti clockwise. Their first meeting would occur at the point representing 10 o'clock, the next at 8 o'clock, then 6 o'clock and so on. It can be seen that the 14th meeting would occur at 8 o'clock and the 22nd meeting at 4 o'clock. The longer distance between them would be equal to eight markings on the clock. This distance would be 8 × 350 = 2800 meters. Option (a) is correct.

26. Ravi beats Tarun by 120 seconds or 400 meters. Hence, Tarun's speed is 400 ÷ 2 = 200 meters/minute. Also, when Ravi does 2000 meters, Tarun does 1600 meters — which he would do in eight minutes. Thus, Ravi takes 8 minutes = 480 seconds to complete the race. Hence, Option (d) is correct

REVIEW CAT Scan 1

1. A man earns x% on the first ₹5,000 of his investment and y% on the rest of his investment. If he earns ₹1250 from ₹7,000 and ₹1750 from ₹9,000 invested, find the value of x.

   (a) 20%

   (b) 15%

   (c) 25%

   (d) None of these

2. The price of a television set drops by 30% while the sales of the set goes up by 50% What is the percentage change in the total revenue from the sales of the set?

   (a) –4%

   (b) –2%

   (c) +5%

   (d) +2%

3. A person who has a certain amount with him goes to the market. He can buy 100 oranges or 80 mangoes. He retains 20% of the amount for petrol expenses and buys 40 mangoes and of the balance, he purchases oranges. The number of oranges he can purchase is

   (a) 30

   (b) 40

(c) 15

(d) 20

4. A cloth merchant cheats his supplier and his customer to the tune of 20% while buying and selling cloth, respectively. He professes to sell at the cost price but also offers a discount of 20% on cash payment, what is his overall profit percentage?

   (a) 20%

   (b) 25%

   (c) 40%

   (d) 15%

5. I sold two horses for ₹50000 each, one at the loss of 20% and the other at the profit of 20%. What is the percentage of loss (–) or profit (+) that resulted from the transaction?

   (a) (+) 20

   (b) (–) 4

   (c) (+) 4

   (d) (–) 20

6. The cost of a diamond varies directly as the square of its weight. A diamond fell and broke into four pieces whose weights were in the ratio 1:2:3:4. As a result, the merchant had a loss of ₹700000. Find the original price of the diamond.

   (a) ₹14 lacs

(b) ₹20 lacs

(c) ₹10 lacs

(d) ₹25 lacs

7. Two oranges, three bananas and four apples cost ₹25. Three oranges, two bananas and one apple cost ₹20. I brought three oranges, three bananas and three apples. How much did I pay?

   (a) ₹22.5

   (b) ₹27

   (c) ₹30

   (d) Cannot be determined

REVIEW CAT Scan 2

1. From each of two given numbers, half the smaller number is subtracted. Of the resulting numbers, the larger one is five times as large as the smaller one. What is the ratio of the two numbers?

   (a) 2: 1

   (b) 3: 1

   (c) 3: 2

   (d) None of these

Directions for Questions 2 and 3: Answer these questions based on the following information.

A watch dealer incurs an expense of ₹150 for producing every watch. He also incurs an additional expenditure of ₹30,000, which is independent of the num-

ber of watches produced. If he is able to sell a watch during the season, he sells it for ₹250. If he fails to do so, he has to sell each watch for ₹100.

2. If he is able to sell only 1,000 out of 1,500 watches he has made in the season, then he has made a profit of

   (a) ₹90,000

   (b) ₹75,000

   (c) ₹45,000

   (d) ₹60, 000

3. If he produces 2000 watches, what is the number of watches that he must sell during the season (to the nearest 100) in order to break-even, given that he is able to sell all the watches produced?

   (a) 700

   (b) 800

   (c) 900

   (d) 1,000

4. A stockist wants to make some profit by selling oil. He contemplates about various methods. Which of the following would maximise his profit?

   I. Sell oil at 20% profit

   II. Use 800 g of weight instead of 1 kg

   III. Mix 20% impurities in oil and selling it at cost price

   IV. Increase the price by 10% and reduce weights by 10%

   (a) I or III

(b) II

(c) II and IV

(d) Profits are same

5. A dealer offers a cash discount of 20% and still makes a profit of 20%, when he further allows 160 articles when the customer buys 120. How much percent above the cost price were his wares listed?

   (a) 100%

   (b) 80%

   (c) 75%

   (d) 66(2/3) %

6. A man buys spirit at ₹600 per litre, adds water to it and then sells it at ₹750 per litre. What is the ratio of the spirit's weight to the weight of the water if his profit in the deal is 37.5%?

   (a) 9:1

   (b) 10:1

   (c) 11:1

   (d) None of these

7. At a bookstore, "MODERN BOOK STORE" is flashed using neon lights. The words are individually flashed at long intervals of $2\frac{1}{2}$, $4\frac{1}{4}$, $5\frac{1}{8}$ seconds respectively, and each word is put off after a second. The least time after which the full name of the bookstore can be read again, is

   (a) 49.5 seconds

(b) 73.5 seconds

(c) 1744.5 seconds

(d) 855 seconds

REVIEW CAT Scan 3

Directions for Questions 1 to 3: Answer these questions based on the following information.

Aamir, on his death bed, keeps half his property for his wife and divides the rest equally among his three sons: Bimar, Cumar and Danger. Some years later, Bimar dies, leaving half his property to his widow and half to his brothers, Cumar and Danger together, sharing equally. When Cumar makes his will, he keeps half his property for his widow and the rest he bequeaths to his younger brother Danger. When Danger dies some years later, he keeps half his property for his widow and the remaining for his mother. The mother now has ₹15, 75, 0000.

1. What was the worth of the total property?

   (a) ₹3 crore

   (b) ₹0.8 crore

   (c) ₹1.8 crore

   (d) ₹2.4 crore

2. What was Cumar's original share?

   (a) ₹40 lakh

   (b) ₹120 lakh

   (c) ₹60 lakh

   (d) ₹50 lakh

3. What was the ratio of the property owned by the widows of the three sons, in the end?

   (a) 7:9:13

   (b) 8:10:15

   (c) 5:7:9

   (d) 9:12:13

4. A train approaches a tunnel AB. Inside the tunnel, a cat is located at a point that is 2/5th the distance AB measured from the entrance A. When the train whistles, the cat runs. If the cat moves to the entrance of the tunnel, A, the train catches the cat exactly at the entrance. If the cat moves to the exit B, the train catches the cat at exactly the exit. The speed of the train is greater than the speed of the cat by what order?

   (a) 3 : 1

   (b) 4: 1

   (c) 5: 1

   (d) None of these

5. Six technicians working at the same rate complete the work of one server in 2.5 hours. If one of them starts at 11:00 AM and one additional technician per hour is added beginning at 5:00 PM, at what time the server will be complete?

   (a) 6:40 PM

   (b) 7 PM

   (c) 7:20 PM

(d) 8:00 PM

Directions for Questions 6 and 7: Answer the questions based on the following information.

A thief, after committing the burglary, started fleeing at 12 noon, at a speed of 60 km/hr. He was then chased by a policeman *X*. *X* started the chase; 15 min after the thief had started, at a speed of 65 km/hr.

6. At what time did *X* catch the thief?

   (a) 3.30 PM

   (b) 3 PM

   (c) 3.15 PM

   (d) None of these

7. If another policeman had started the same chase along with *X*, but at a speed of 60 km/hr, then how far behind was he when *X* caught the thief?

   (a) 18.75 km

   (b) 15 km

   (c) 21 km

   (d) 37.5km

REVIEW CAT Scan 4

1. Two typists undertake to do a job. The second typist begins working one hour after the first. Three hours after the first typist has begun working, there is still 9/20 of the work to be done. When the assignment is completed, it turns out that each typist has done half the work. How many hours will it take each one to do the whole job individually?

(a) 12 hr and 8 hr

(b) 8 hr and 5.6 hr

(c) 10 hr and 8hr

(d) 5 hr and 4 hr

2. A man can walk up a moving 'up' escalator in 30 *s*. The same man can walk down this moving 'up' escalator in 90s. Assume that his walking speed is same upwards and downwards. How much time will he take to walk up the escalator, when it is not moving?

   (a) 30s

   (b) 45s

   (c) 60s

   (d) 90s

Directions for Questions 3 to 5: Answer the questions based on the following information.

Boston is four hours ahead of Frankfurt and two hrs behind India. *X* leaves Frankfurt at 6 PM on Friday and reaches Boston the next day. After waiting there for two hours, he leaves exactly at noon and reaches India at 1 AM. On his return journey, he takes the same route as before, but halts at Boston for one hour less than his previous halt there. He then proceeds to Frankfurt.

3. If his journey, including stoppage, is covered at an average speed of 180 mph, what is the distance between Frankfurt and India?

   (a) 3,600 miles

(b) 4,500 miles

(c) 5580 miles

(d) Data insufficient

4. If *X* had started the return journey from India at 2.55 AM on the same day that he reached there, after how much time would he reach Frankfurt?

(a) 24 hrs

(b) 25 hrs

(c) 26 hrs

(d) Data insufficient

5. What is *X*'s average speed for the entire journey (to-and-fro)?

(a) 176 mph

(b) 180 mph

(c) 165 mph

(d) Data insufficient

6. A car after travelling 18 km from a point *A* developed some problem in the engine and the speed became 4/5th of its original speed. As a result, the car reached point *B* 45 minutes late. If the engine had developed the same problem after travelling 30 km from *A*, then it would have reached *B* only 36 minutes late. The original speed of the car (in km per hour) and the distance between the points *A* and *B* (in km) are

(a) 25,130

(b) 30,150

(c) 20,190

(d) None of these

7. A, B and C individually can finish a work in 6, 8 and 15 hours respectively. They started the work together and after completing the work got ₹94.60, when they divide the money among themselves. A, B and C will get respectively (in ₹)

   (a) 44, 33, 17.60

   (b) 43, 27, 24.60

   (c) 45, 30, 19.60

   (d) 42, 28, 24.60

REVIEW CAT Scan 5

1. Two trains are travelling in opposite direction at uniform speed 60 and 50 km per hour respectively. They take 5 seconds to cross each other. If the two trains had travelled in the same direction, then a passenger sitting in the faster moving train would have overtaken the other train in 18 seconds. The length of the trains in meters is

   (a) 112, 78.40

   (b) 97.78, 55

   (c) 102.78, 50

   (d) 102.78, 55

2. Assume that an equal number of people are born on each day. Find approximately the percentage of the people whose birthday will fall on 29th February.

   (a) 0.374

(b) 0.5732

(c) 0.0684

(d) None of these

3. A sum of money compounded annually becomes₹625 in two years and ₹675 in three years. The rate of interest per annum is

   (a) 7%

   (b) 8%

   (c) 6%

   (d) 5%

4. Every day Asha's husband meets her at the city railway station at 6:00 PM and drives her to their residence. One day she left early from the office and reached the railway station at 5:00 PM. She started walking towards her home, met her husband coming from their residence on the way and they reached home ten minutes earlier than the usual time. For how long did she walk?

   (a) 1 hour

   (b) 50 minutes

   (c) 1/2 hour

   (d) Cannot be Determined

5. Three machines, *A*, *B* and *C* can be used to produce a product. Machine *A* will take 60 hours to produce a million units. Machine *B* is twice as fast as Machine *A*. Machine *C* will take the same amount of time to produce a million units as *A* and *B* running together. How much time will be

required to produce a million units if all the three machines are used simultaneously?

(a) 12 hours

(b) 10 hours

(c) 8 hours

(d) 6 hours

6. Mr. and Mrs. Shah travel from City *A* to City *B* and break journey at City *C* in between. Somewhere between City *A* and City *C*, Mrs. Shah asks "How far have we travelled?" Mr. Shah replies, "Half as far as the distance from here to city *C*". Somewhere between City *C* and City *B*, exactly 200 km from the point where she asked the first question, Mrs. Shah asks "How far do we have to go?" Mr. Shah replies "Half as far as the distance from City *C* to here." The distance between Cities *A* and *B* in km is

   (a) 200

   (b) 100

   (c) 400

   (d) 300

7. A shop sells ball point pens and refills. It used to sell refills for 50 paisa each, but there were hardly any takers. When he reduced the price, the remaining refills were sold out enabling the shopkeeper to realise ₹35.89. How many refills were sold at the reduced price?

   (a) 37

   (b) 71

(c) 89

(d) 97

REVIEW CAT Scan 6

1. Anand and Bharat can cut 5 kg of wood in 20 minutes, Bharat and Chandra can cut 5 kg of wood in 40 minutes. Chandra and Anand can cut 5 kg of wood in 30 minutes. How much time Chandra will take to cut 5 kg of wood alone?

   (a) 120 minutes

   (b) 48 minutes

   (c) 240 minutes

   (d) (240/7) minutes

2. If 200 soldiers eat 10 tons of food in 200 days, how much will 20 soldiers eat in 20 days? (1ton = 1000 kgs)

   (a) 1 ton

   (b) 10 kg

   (c) 100 kg

   (d) 50 kg

3. A servant is paid ₹100 plus one shirt for a full year of work. He works for 6 months and gets ₹30 plus the shirt. What is the cost of the shirt (in Rupees)?

   (a) 20

   (b) 30

   (c) 40

(d) 50

4. A train without stopping travels at 60 km per hour and with stoppages at 40 km per hour. What is the time taken for stoppages on a route of 300 km?

   (a) 11 hours

   (b) 22 hours

   (c) 5 hours

   (d) 2.5 hours

5. A contractor receives a certain sum every week for paying wages. His own capital together with the weekly sum enables him to pay 45 men for 52 weeks. If he had 60 men and the same wages, his capital and weekly sum would suffice for 13 weeks, how many men can be maintained for 26 weeks?

   (a) 60
   (b) 52

   (c) 50

   (d) 65

6. A supply of water lasts for 150 days if 12 gallons leak off every day, but only for 100 days if 15 gallons leak off daily. What is the total quantity of water in the supply?
   (a) 900

   (b) 1125

   (c) 3350

(d) 1250

7. If a dealer were to diminish the selling price of his wares by 10%, he would double his sale making the same profit as before. In what ratio would his profit diminish if he were to increase his selling price by 10% and thereby halve his sale?

   (a) 2:1.5

   (b) 5:4

   (c) 1:1.5

   (d) 9:7

REVIEW CAT Scan 7

1. A can is full of paint. Out of this, five litres are removed and a thinning liquid substituted. The process is repeated. Now the ratio of paint to thinner is 49:15. What is the full capacity of the can?

   (a) 20 litres

   (b) 60 litres

   (c) 40 litres

   (d) 50 litres

Directions for Questions 2 to 4: Use the following information.

Kachua Bhaiya started to move from point *B* towards point *A* exactly an hour after Jiggly Pup started from *A* in the opposite direction. Kachua Bhaiyas's speed was twice that of Jiggly Pup. When Jiggly Pup had covered one-sixth of the distance between the points *A* and *B*, Kachua Bhaiya had also covered the same distance.

2. The point where the two would meet is

   (a) Closer to A

   (b) Exactly between A and B

   (c) Closer to B

   (d) P and Q will not meet at all

3. How many hours would Jiggly Pup take to reach B?

   (a) 2

   (b) 5

   (c) 6

   (d) 12

4. How many more hours would Jiggly Pup (compared to Kachua Bhaiya) take to complete his journey?

   (a) 4

   (b) 5

   (c) 6

   (d) 7

5. A group of workers was put on a publishing job. From the second day onwards, one worker was withdrawn each day. The job was finished when the last worker was withdrawn. Had no worker been withdrawn at any stage, the group would have finished the job in two-thirds the time. How many workers were there in the group?

(a) 2

(b) 3

(c) 5

(d) 10

6. A ship leaves on a long voyage. When it is 18 miles from the shore, a seaplane, whose speed is ten times that of the ship, is sent to deliver mail. How far from the shore does the seaplane catch up with the ship?

   (a) 24 miles

   (b) 25 miles

   (c) 22 miles

   (d) 20 miles

7. One man can do as a woman can do in two days. A child does one-third the work in a day as a woman. If an estate-owner hires 39 pairs of hands, men, women and children in the ratio 6:5:2 and pays them in all ₹1113 at the end of days work, what must the daily wages of a child be, if the wages are proportional to the amount of work done?

   (a) ₹14

   (b) ₹5

   (c) ₹20

   (d) ₹7

REVIEW CAT Scan 8

1. A water tank has three taps *A*, *B* and *C*. A fills four buckets in 24 minutes, *B* fills eight buckets in 1 hour and *C* fills two buckets in 20 minutes. If

all the taps are opened together a full tank is emptied in two hours. If a bucket can hold five litres of water, what is the capacity of the tank?

(a) 120 litres

(b) 240 litres

(c) 180 litres

(d) 60 litres

2. A man buys spirit at ₹60 per litre, adds water to it and then sells it at ₹75 per litre. What is the ratio of spirit to water if his profit in the deal is 37.5%?

(a) 9:1

(b) 10:1

(c) 11:1

(d) None of these

3. There is a leak in the bottom of a tank. This leak can empty a full tank in eight hours. When the tank is full, a tap is opened into the tank which admits 6 litres per hour and the tank is now emptied in twelve hours. What is the capacity of the tank?

(a) 28.8 litres

(b) 36 litres

(c) 144 litres

(d) Cannot be determined

4. The winning relay team in a high school sports competition clocked 48 minutes for a distance of 13.2 km. Its runners A, B, C and D maintained

speeds of 15 km/h, 16 km/h, 17 km/h and 18 km/h, respectively. What is the ratio of the time taken by *B* to that taken by *D*?

(a) 5:16

(b) 5:17

(c) 9:8

(d) 8:9

5. Three bells chime at intervals of 18, 24 and 32 minutes respectively. At a certain time, they begin to chime together. What length of time will elapse before they chime together again?

   (a) 2 hours 24 minutes

   (b) 4 hours 48 minutes

   (c) 1 hours 36 minutes

   (d) 5 hours

6. In a race of 200 meters run, Ashish beats Sunil by 20 meters and Nalin by 40 meters. If Sunil and Nalin are running a race of 100 meters with exactly the same speeds as before, then by how many meters will Sunil beat Nalin?

   (a) 11.11 meters

   (b) 10 meters

   (c) 12 meters

   (d) 25 meters

7. A man invests ₹3000 at a rate of 5% per annum. How much more should he invest at a rate of 8%, so that he can earn a total of 6% per annum?

   (a) ₹1200

   (b) ₹1300

   (c) ₹1500

   (d) ₹2000

REVIEW CAT Scan 9

Use the following data for questions 1 to 4: Helitabh and Ruk Ruk are running along a circular course of radius 14 km in opposite directions such that when they meet they reverse their directions as well as they interchange their speeds, i.e. after they meet Helitabh will run at the speed of Ruk Ruk and vice-versa. However, this interchange occurs only when they meet outside the starting point. They do not interchange directions or speeds when they meet at the starting point. Initially, the speed of Helitabh is thrice the speed of Ruk Ruk. Assume that they start from M_0 and they first meet at M_1, then at M_2, next M_3, and finally at M_4.

1. What is the shortest distance between M_1 and M_2?

   (a) 22 km

   (b) $14\sqrt{2}$ km

   (c) 14 km

   (d) 28 km

2. What is the shortest distance between M and M_3 along the course?

   (a) 44 km

   (b) $28\sqrt{2}$ km

   (c) $44\sqrt{2}$ km

(d) 28 km

3. Which is the point that coincides with M_0?

   (a) M_1

   (b) M_2

   (c) M_3

   (d) M_4

4. What is the distance travelled by Helitabh when they meet at M_3?

   (a) 154 km

   (b) 132 km

   (c) 198 km

   (d) 176 km

Directions for Questions 5 to 7: A certain race is made up of three stretches *A*, *B* and *C*, each 4 km long, and to be covered by a certain mode of transport. The following table gives these modes of transport for the stretches, and the minimum and maximum possible speeds (in km/h) over these stretches. The speed over a particular stretch is assumed to be constant. The previous record for the race is ten minutes.

Stretch	*Mode of transport*	*Min. Speed*	*Max. Speed*
A	Car	80	120
B	Motorcycle	60	100
C	Bicycle	20	40

5. Anshuman travels at minimum speed by car over *A* and completes stretch *B* at the fastest possible speed. At what speed should he cover stretch *C* in order to break the previous record?

(a) Maximum speed for *C*

(b) Minimum speed for *C*

(c) This is not possible

(d) None of these

6. Mr. Hare completes the first stretch at the minimum speed and takes the same time for stretch *B*. He takes 50% more time than the previous record to complete the race. What is Mr. Hare's speed for the stretch *C*?

   (a) 21.8 km/h

   (b) 26.66 km/h

   (c) 34.2 km/h

   (d) None of these

7. Mr. Tortoise completes the race at an average speed of 40 km/h. His average speed for the first two stretches is four times that for the last stretch. Find his speed over stretch *C*.

   (a) 30 km/h

   (b) 24 km/h

   (c) 20 km/h

   (d) This is not possible

REVIEW CAT Scan 10

1. After allowing a discount of 11.11%, a trader still makes a gain of 20%. At what percent above the cost price does he mark his goods?

(a) 28.56%

(b) 35%

(c) 22.22%

(d) None of these

2. A dealer buys oil at ₹100, ₹80 and ₹60 per litre. He mixes them in the ratio 5:6:7 by weight and sells them at a profit of 50%. At what price does he sell oil?

   (a) ₹80/litre

   (b) ₹116.666/ litre

   (c) ₹95/litre

   (d) None of these

3. An express train travelling at 80 km/h overtakes a goods train twice as long and going at 40 km/h on a parallel track, in 54 seconds. How long will the express train take to cross a station 400 meters long?

   (a) 36 seconds

   (b) 45 seconds

   (c) 27 seconds

   (d) None of these

4. A man earns x% on the first 2000 rupees and y% on the rest of his income. If he earns ₹700 from ₹4000 and ₹900 from ₹5000 of income. Find x.

   (a) 20

   (b) 15

(c) 25

(d) None of these

5. In the famous Harrods museum, the value of each of a set of gold coins varies as the square of its diameter, if its thickness remains constant and it varies as the thickness, if the diameter remains constant. If the diameters of the two coins are in the ratio 4:3, what should the ratio of their thickness be if the value of the first is four times that of the second?

   (a) 16:9

   (b) 9:4

   (c) 9:16

   (d) 4:9

Directions for Questions 6 and 7: Answer the questions on the basis of the information given below.

On a large field, Q is a point to the north of P, R is a point to the east of Q and S is a point to the north of R. The length of the line segments PQ and RS is 4 kms and 3 kms respectively. At time $t = 0$, two persons M and N are at the point P. M and N start walking towards point S with same uniform speed at time $t = 0$ and $t = 15$ minutes respectively. M follows the path PQRS and N follows the direct path PS. Given that both M and N reach point S simultaneously and PS = 8.75 kms.

6. What is the speed at which M walks?

   (a) 10 km/h

   (b) 12 km/h

   (c) 20 km/h

   (d) 14 km/h

7. What is the distance between M and N, at t = 30 minutes?

   (a) 1 km

   (b) 3 kms

   (c) 2 kms

   (d) 1.5 kms

REVIEW CAT Scan 11

1. *A* and *B* walk from *X* to *Y*, a distance of 27 km at 5 km/h and 7 km/h, respectively. *B* reaches *Y* and immediately turns back meeting *A* at *Z*. What is the distance from *Y* to *Z*?

   (a) 2 km

   (b) 4.5 km

   (c) 3 km

   (d) 7 km

2. A motorist leaves the post office to go to the airport to collect mail. The plane arrives early, and the mail is sent on a horse-cart. After half an hour, the motorist meets the horse-cart, collects the mail and returns to the post office, thus saving 20 minutes. How many minutes early did the plane arrive?

   (a) 20

   (b) 25

   (c) 30

   (d) 40

3. In his book on Leonardo da Vinci, Sigmund Freud, after a detailed psycho-analysis concluded that Goethe could complete the masterpiece in nine days while Da Vinci, as he could channelize overly but was more possessed as a result of which, he could generate 50% more efficiency than Goethe. The number of days it takes Leonardo da Vinci to do the same piece of work that Goethe completes in nine days is

   (a) 4 (1/2) days

   (b) 6 days

   (c) 13 (1/2) days

   (d) None of these

4. The North South Express is a pair of trains between the cities Jammu and Chennai. A train leaves Jammu for Chennai exactly at 12 noon every day of the week. Similarly, there is a train that leaves from Chennai to Jammu on every day of the week at exactly 12 noon. The time required by a train to cover the distance between Chennai and Jammu is exactly 7 days and 1 minute. Find the number of trains from Chennai to Jammu which a train from Jammu to Chennai will encounter in completing its journey. (Assume all trains run exactly on time).

   (a) 7

   (b) 8

   (c) 14

   (d) 15

5. For the question above, the minimum number of rakes that the Indian Railways will have to devote for running this daily service will be

(a) 16

(b) 32

(c) 30

(d) None of these

6. There are two candles each of the same initial length. The first candle can burn for 24 hours, while the second candle can burn for 16 hours. Both of them are lit at the same time. After sometime, it was found that one of the candles was twice as long as the second. For how long had the candle been burning?

   (a) 6 hours

   (b) 8 hours

   (c) 10 hours

   (d) 12 hours

7. Two friends *A* and *B* run around a circular track of length 510 meters, starting from the same point, simultaneously and in the same direction. *A* who runs faster, laps *B* in the middle of A's fifth round. If *A* and *B* were to run a 3 km long race, how much start, in terms of distance, should *A* give *B* so that they finish the race in a dead heat?

   (a) 545.45 meters

   (b) 666.67 meters

   (c) 857.14 meters

   (d) Cannot be determined

ANSWER KEY

REVIEW CAT Scan 1

1. (b)
2. (c)
3. (a)
4. (a)
5. (b)
6. (c)
7. (b)

REVIEW CAT Scan 2

1. (b)
2. (c)
3. (c)
4. (b)
5. (a)
6. (b)
7. (b)

REVIEW CAT Scan 3

1. (d)
2. (a)
3. (b)
4. (c)
5. (d)
6. (c)
7. (b)

REVIEW CAT Scan 4

1. (c)
2. (b)
3. (b)
4. (a)
5. (d)
6. (d)
7. (a)

REVIEW CAT Scan 5

1. (c)
2. (c)
3. (b)
4. (d)
5. (b)
6. (d)
7. (d)

REVIEW CAT Scan 6

1. (c)
2. (c)
3. (c)
4. (d)
5. (c)
6. (a)
7. (a)

REVIEW CAT Scan 7

1. (c)
2. (a)
3. (d)

4. (c)
5. (b)
6. (d)
7. (d)

REVIEW CAT Scan 8

1. (b)
2. (b)
3. (c)
4. (c)
5. (b)
6. (a)
7. (c)

REVIEW CAT Scan 9

1. (b)
2. (a)
3. (d)
4. (a)
5. (c)
6. (b)
7. (c)

REVIEW CAT Scan 10

1. (b)
2. (b)
3. (c)
4. (b)
5. (b)
6. (d)

7. (d)

REVIEW CAT Scan 11

1. (b)
2. (d)
3. (b)
4. (d)
5. (a)
6. (d)
7. (b)

TASTE OF THE EXAMS—BLOCK II AND III

CAT

1. At the end of year 1998, Shepard bought nine dozen goats. Henceforth, every year he added p per cent of the goats at the beginning of the year and sold q per cent of the goats at the end of the year where $p > 0$ and $q > 0$. If Shepard had nine dozen goats at the end of year 2002, after making the sales for that year, which of the following is true? **(CAT 1998)**

   (a) $p = q$

   (b) $p < q$

   (c) $p > q$

   (d) $p = q/2$

2. The speed of a railway engine is 42 kmph when no compartment is attached, and the reduction in speed is directly proportional to the square root of the number of compartments attached. If the speed of the train carried by this engine is 24 kmph when 9 compartments are attached,

the maximum number of compartments that can be carried by the engine is **(CAT 1999)**

(a) 49

(b) 48

(c) 46

(d) 47

3. Total expenses of a boarding house are partly fixed and partly varying linearly with the number of boarders. The average expense per boarder is ₹700 when there are 25 boarders and ₹600 when there are 50 boarders. What is the average expense per boarder when there are 100 boarders? **(CAT 1999)**

(a) 550

(b) 580

(c) 540

(d) 570

4. Forty per cent of the employees of a certain company are men, and 75% of the men earn more than ₹25,000 per year. If 45% of the company's employees earn more than ₹25,000 per year, what fraction of the women employed by the company earn less than or equal to ₹25,000 per year? **(CAT 1999)**

(a) 2/11

(b) 1/4

(c) 1/3

(d) 3/4

5. Navjivan Express from Ahmedabad to Chennai leaves Ahmedabad at 6.30 a.m. and travels at 50kmph towards Baroda situated 100 km away. At 7.00 a.m. Howrah-Ahmedabad Express leaves Baroda towards Ahmedabad and travels at 40 kmph. At 7.30 a.m. Mr Shah, the traffic controller at Baroda realizes that both the trains are running on the same track. How much time does he have to avert a head-on collision between the two trains? **(CAT 1999)**

   (a) 15 min

   (b) 20 min

   (c) 25 min

   (d) 30 min

Directions for Questions 6 and 7: The following table presents the sweetness of different forms relative to sucrose, whose sweetness is taken to be 1.00. **(CAT 1999)**

Lactose 0.16

Maltose 0.32

Glucose 0.74

Sucrose 1.00

Fructose 1.70

Saccharin 675.00

6. What is the maximum amount of sucrose (to the nearest gram) that can be added to one-gram of saccharin to make a mixture that will be at least 100 times as sweet as glucose?

(a) 7

(b) 8

(c) 9

(d) 100

7. Approximately how many times sweeter than sucrose is a mixture consisting of glucose, sucrose and fructose in the ratio of 1 : 2 : 3?

(a) 1.3

(b) 1

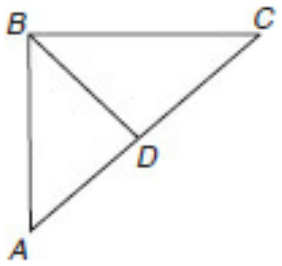
(c) 0.6

(d) 2.3

Directions for Questions 8 to 10: These questions are based on the situation given below:

A road network (shown in the figure below) connects cities *A*, *B*, *C* and *D*. All road segments are straight lines. *D* is the midpoint on the road connecting *A* and *C*. Roads *AB* and *BC* are at right angles to each other with *BC* shorter than *AB*. The segment *AB* is 100 km long. **(CAT 1999)**

Mr. *X* and Mr. *Y* leave A at 8: 00 am take different routes to city *C* and reach at the same time. *X* takes the highway from *A* to *B* to *C* and travels at an average speed of 61.875 km per hour. *Y* takes the direct route *AC* and travels at 45 km per hour on segment *AD*. *Y*'s speed on segment *DC* is 55 km per hour. **(CAT 1999)**



8. What is the average speed of *Y* in km per hour?

   (a) 47. 5

   (b) 49.5

   (c) 50

   (d) 52

9. The total distance traveled by *Y* during the journey is approximately

   (a) 105 km

   (b) 150 km

   (c) 130 km

   (d) Cannot be determined

10. What is the length of the road segment *BD*?

    (a) 50 km

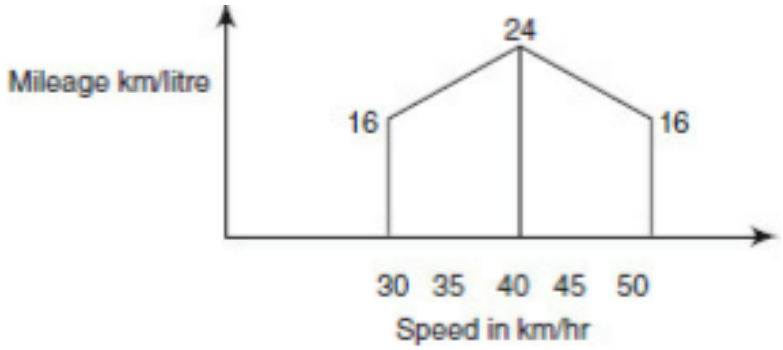
    (b) 52.5 km

    (c) 55 km

    (d) Cannot be determined

Directions for Questions 11 and 12: These questions are based on the situation given below.

Rajiv reaches city B from city A in 4 hours, driving at the speed of 35 km per hour for the first 2 hours and at 45 km per hour for the next two hours. Aditi follows the same route, but drives at three different speeds 30, 40 and 50 km per hour, covering an equal distance in each speed segment. The two cars are similar with petrol consumption characteristics (km per liter) shown in the figure below. **(CAT 1999)**



11. The amount of petrol consumed by Aditi for the journey is

    (a) 8.3 liters
    (b) 8.6 liters

    (c) 8.9 liters

    (d) 9.2 liters

12. Zoheb would like to drive Aditi's car over the same route from *A* to *B* and minimize the petrol consumption for the trip. The amount of petrol required by him is **(CAT 1999)**

    (a) 6.67 liters

    (b) 7 liters

    (c) 6.33 liters

    (d) None of these

13. In a survey of political preferences, 78 per cent of those asked, were in favour of at least one of the proposals I, II and III. 50 per cent of those asked favoured proposal I, 30 per cent favoured proposal II and 20 per cent favoured proposal III. If 5 per cent of those asked favoured all the three proposals, what percentage of those asked favoured more than one? **(CAT 1999)**

(a) 10

(b) 12

(c) 17

(d) 22

14. A truck travelling at 70 km/hr uses 30% more diesel to travel a certain distance than it does when it travels at a speed of 50 km/hr. If the truck can travel 19.5 km/L of diesel at 50 km/hr, how far can the truck travel on 10 L of diesel at a speed of 70 km/hr? **(CAT 2000)**

(a) 130 km

(b) 140 km

(c) 150 km

(d) 175 km

15. Consider a sequence of seven consecutive integers. The average of the first five integers is n. The average of all the seven integers is **(CAT 2000)**

(a) n

(b) $n + 1$

(c) $k \times n$, where k is a function of n

(d) $n + \left(\frac{2}{7}\right)$

16. A shipping clerk has five boxes of different but unknown weights each weighing less than 100 kg. The clerk weighs the boxes in pairs. The weights obtained are 110, 112, 113, 114, 115, 116, 117, 118, 120 and 121 kg. What is the weight of the heaviest box? **(CAT 2000)**

(a) 60 kg

(b) 62 kg

(c) 64 kg

(d) Cannot be determined

17. The table below shows the age-wise distribution of the population of Reposia. The number of people aged below 35 years is 400 million. **(CAT 2000)**

Age group	Percentages
Below 15 years	30.00
15–24	17.75
25–34	17.00
35–44	14.50
45–54	12.50
55–64	7.10
65 and above	1.15

If the ratio of females to males in the 'below 15 years' age group is 0.96, then what is the number of females (in millions) in that age group?

(a) 82.8

(b) 90.8

(c) 80.0

(d) 90.0

Directions for Questions 18 and 19: Answer the questions based on the following information.

There are five machines — *A*, *B*, *C*, *D*, and *E* — situated on a straight line at dis-

tances of 10 m, 20 m, 30 m, 40 m and 50 m respectively from the origin of the line. A robot is stationed at the origin of the line. The robot serves the machines with raw material whenever a machine becomes idle. All the raw materials are located at the origin. The robot is in an idle state at the origin at the beginning of a day. As soon as one or more machines become idle, they send messages to the robot-station and the robot starts and serves all the machines from which it received messages. If a message is received at the station while the robot is away from it, the robot takes notice of the message only when it returns to the station. While moving, it serves the machines in the sequence in which they are encountered, and then returns to the origin. If any messages are pending at the station when it returns, it repeats the process again. Otherwise, it remains idle at the origin till the next message(s) is(are) received. **(CAT 2000)**

18. Suppose on a certain day, machines *A* and *D* have sent the first two messages to the origin at the beginning of the first second, and *C* has sent a message at the beginning of the 5th second and *B* at the beginning of the 6th second, and *E* at the beginning of the 10th second. How much distance has the robot travelled since the beginning of the day, when it notices the message of *E*? Assume that the speed of movement of the robot is 10 m/s.

    (a) 140 m

    (b) 80 m

    (c) 340 m

    (d) 360 m

19. Suppose there is a second station with raw material for the robot at the other extreme of the line which is 60 m from the origin, i.e. 10 m from *E*. After finishing the services in a trip, the robot returns to the nearest station. If both stations are equidistant, it chooses the origin as the station

to return to. Assuming that both stations receive the messages sent by the machines and that all the other data remains the same, what would be the answer to the above question?

(a) 120
(b) 140

(c) 340

(d) 70

20. A student took five papers in an examination, where the full marks were the same for each paper. His marks in these papers were in the proportion of 6 : 7 : 8 : 9 : 10. In all papers together, the candidate obtained 60 per cent of the total marks. Then the number of papers in which he got more than 50 per cent marks is: **(CAT 2001)**

(a) 2

(b) 3

(c) 4

(d) 5

21. Every 10 years the Indian government counts all the people living in the country. Suppose that the director of the census has reported the following data on two neighbouring villages—ChotaHazri and MotaHazri.

ChotaHazri has 4,522 fewer males than MotaHazri.

MotaHazri has 4,020 more females than males.

ChotaHazri has twice as many females as males.

ChotaHazri has 2,910 fewer females than MotaHazri.

What is the total number of males in ChotaHazri? **(CAT 2001)**

(a) 11264

(b) 14174

(c) 5632

(d) 10154

22. Shyama and Vyom walk up an escalator (moving stairway). The escalator moves at a constant speed. Shyama takes three steps for every two of Vyom's steps. Shyama gets to the top of the escalator after having taken 25 steps, while Vyom (because her slower pace lets the escalator do a little more of the work) takes only 20 steps to reach the top. If the escalator were turned off, how many steps would they have to take to walk up? **(CAT 2001)**

(a) 40

(b) 50

(c) 60

(d) 80

23. A can complete a piece of work in 4 days. *B* takes double the time taken by *A*. *C* takes double that of *B*, and *D* takes double that of *C* to complete the same task. They are paired in groups of two each. One pair takes two-thirds the time needed by the second pair to complete the work. Which is the first pair? **(CAT 2001)**

(a) A, B

(b) A, C

(c) B, C

(d) A, D

24. A lot of work remains while preparing a birthday dinner. Even after the turkey is in the oven, there are still the potatoes and gravy, yams, salad, and cranberries, not to mention setting the table. Three friends, Asit, Arnold and Afzal work together to get all of these chores done. The time it takes them to do the work together is six hours less than Asit would have taken working alone, one hour less than Arnold would have taken alone, and half the time Afzal would have taken working alone. How long did it take them to do these chores working together? **(CAT 2001)**

(a) 20 minutes

(b) 30 minutes

(c) 40 minutes

(d) 50 minutes

25. Two men *X* and *Y* started working for a certain company at similar jobs on 1 January 1950. *X* asked for an initial salary of ₹300 with an annual increment of ₹30. *Y* asked for an initial salary of ₹200 with a raise of ₹15 every six months. Assume that the arrangements remained unaltered till 31 December 1959. Salary is paid on the last day of the month. What is the total amount paid to them as salary during the period? **(CAT 2001)**

(a) ₹93,300

(b) ₹93,200

(c) ₹93,100

(d) None of these

26. 9 December 2001 is Sunday. What was the day on 9 December 2001, 1971? **(CAT 2001)**

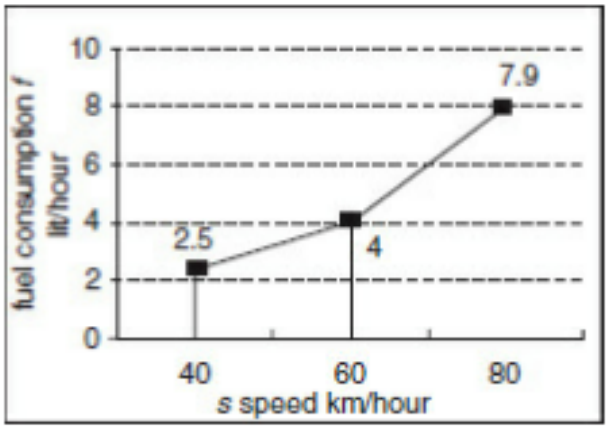
(a) Thursday

(b) Wednesday

(c) Saturday

(d) Sunday

Directions for Questions 27 and 28: The petrol consumption rate of a new model car 'Palto' depends on its speed and may be described by the graph below **(CAT 2001)**



27. Manisha makes the 200 km trip from Mumbai in Pune at a steady speed of 60 km per hour. What is the amount of petrol consumed for the journey?

(a) 12.5 liters

(b) 13.33 liters

(c) 16 liters

(d) 19.75 liters

28. Manisha would like to minimize the fuel consumption for the trip by driving at the appropriate speed. How should she change the speed?

(a) Increase the speed

(b) Decrease the Speed

(c) Maintain the speed at 60 km/hour

(d) Cannot be determined

29. Three runners *A*, *B* and *C* run a race, with runner *A* finishing 12 meters ahead of runner *B* and 18 meters ahead of runner *C*, while runner *B* finishes 8 meters ahead of runner *C*. Each runner travels the entire distance at a constant speed. What was the length of the race? **(CAT 2001)**

(a) 36 meters

(b) 48 meters

(c) 60 meters

(d) 72 meters

30. A train *X* departs from station *A* at 11.00 a.m. for station *B*, which is 180 km away. Another train *Y* departs from station *B* at the same time. Train *X* travels at an average speed of 70 km/hr and does not stop anywhere until it arrives at station *B*. Train *Y* travels at an average speed of 50 km/hr, but has to stop for 15 minutes at station *C*, which is 60 km away from station *B* enroute to station *A*. At what distance (to the closest kilometer) from *A* would they meet? **(CAT 2001)**

(a) 112

(b) 118

(c) 120

(d) 113

31. The owner of an art shop conducts his business in the following manner: every once in a while he raises his prices by X%, then a while later he reduces all the new prices by X%. After one such updown cycle, the price of a painting decreased by ₹441. After a second up-down cycle the painting was sold for ₹1,944.81. What was the original price of the painting? **(CAT 2001)**

(a) ₹2,756.25

(b) ₹2,256.25

(c) ₹2,500

(d) ₹2,000

32. A set of consecutive positive integers beginning with 1 is written on the blackboard. A student came along and erased one number. The average of the remaining numbers is $35\frac{7}{17}$. What was the number erased? **(CAT 2001)**

(a) 7

(b) 8

(c) 9

(d) None of these

33. Three math classes: X, Y and Z take an algebra test. **(CAT 2001)**

The average score in class X is 83.

The average score in class Y is 76.

The average score in class Z is 85.

The average score of all students in classes X and Y together is 79.

The average score of all students in classes *Y* and *Z* together is 81.

What is the average for all the three classes?

(a) 81
(b) 81.5

(c) 82

(d) 84.5

34. A can complete a piece of work in 4 days. *B* takes double the time taken by *A*, *C* takes double that of *B*, and *D* takes double that of *C* to complete the same task. They are paired in groups of two each. One pair takes two-thirds the time needed by the second pair to complete the work. Which is the first pair? **(CAT 2001)**

(a) *A* and *B*

(b) *A* and *C*

(c) *B* and *C*

(d) *A* and *D*

35. A college has raised 75% of the amount it needs for a new building by receiving an average donation of ₹600 from the people already solicited. The people already solicited represent 60% of the people the college will ask for donations. If the college is to raise exactly the amount needed for the new building, what should be the average donation from the remaining people to be solicited? **(CAT 2001)**

(a) ₹300

(b) ₹250

(c) ₹400

(d) ₹500

36. At his usual rowing rate, Rahul can travel 12 miles downstream in a certain river in 6 hr less than it takes him to travel the same distance upstream. But if he could double his usual rowing rate for this 24 miles round trip, the downstream 12 miles would then take only 1 hr less than the upstream12 miles. What is the speed of the current in miles per hour? **(CAT 2001)**

(a) 7/3

(b) 4/3

(c) 5/3

(d) 8/3

37. Fresh grapes contain 90% water by weight while dried grapes contain 20% water by weight. What is the weight of dry grapes available from 20 kg of fresh grapes? **(CAT 2001)**

(a) 2 kg

(b) 2.4 kg

(c) 2.5 kg

(d) None of these

Directions for Questions 38 and 39: Answer the questions based on the following information.

The batting average (*BA*) of a Test batsman is computed from runs scored and innings played — completed innings and incomplete innings (not out) in the following manner:

r_1 = Number of runs scored in completed innings

n_1 = Number of completed innings

r_2 = Number of runs scored in incomplete innings

n_2 = Number of incomplete innings

$BA = (r_1 + r_2)/n_1$

To better assess a batsman's accomplishments, the ICC is considering two other measures $MBA1$ and $MBA2$ defined as follows:

$$\text{MBA}_1 = \frac{r_1}{n_1} + \frac{n_2}{n_1}\max\left[0, \left(\frac{r_2}{n_2} - \frac{r_1}{n_1}\right)\right]$$

$$\text{MBA}_2 = \frac{r_1 + r_2}{n_1 + n_2}$$

(CAT 2001)

38. Based on the above information which of the following is true?

(a) $MBA1 \le BA \le MBA2$

(b) $BA \le MBA2 \le MBA1$

(c) $MBA2 \le BA \le MBA1$

(d) None of these

39. An experienced cricketer with no incomplete innings has BA of 50. The next time he bats, the innings is incomplete and he scores 45 runs. It can be inferred that

(a) BA and $MBA1$ will both increase

(b) BA will increase and $MBA2$ will decrease

(c) BA will increase and not enough data is available to assess change in $MBA1$ and $MBA2$

(d) None of these

40. A train approaches a tunnel AB. Inside the tunnel is a cat located at a point that is 3/8 of the distance AB measured from the entrance A. When the train whistles the cat runs. If the cat moves to the entrance of the tunnel A, the train catches the cat exactly at the entrance. If the cat moves to the exit B, the train catches the cat at exactly the exit. The speed of the train is greater than the speed of the cat by what order? **(CAT 2002)**

(a) 3 : 1

(b) 4 : 1

(c) 5 : 1

(d) None of these

41. Three small pumps and a large pump are filling a tank. Each of the three small pumps works at 2/3rd the rate of the large pump. If all four pumps work at the same time, they should fill the tank in what fraction of the time that it would have taken the large pump alone? **(CAT 2002)**

(a) 4/7

(b) 1/3

(c) 2/3

(d) 3/4

42. On a 20 km tunnel, connecting two cities A and B, there are three gutters (1, 2 and 3). The distance between gutters 1 and 2 is half the distance between gutters 2 and 3. The distance from city A to its nearest gutter, gutter 1, is equal to the distance of city B from gutter 3. On a particular day, the hospital in city A receives information that an accident has happened at gutter 3. The victim can be saved only if an operation is started within

40 min. An ambulance started from city A at 30 km/hr and crossed gutter 1 after 5 min. If the driver had doubled the speed after that, what is the maximum amount of time would the doctor get to attend the patient at the hospital. Assume 1 min is elapsed for taking the patient into and out of the ambulance? **(CAT 2002)**

(a) 4 min

(b) 2.5 min

(c) 1.5 min

(d) The patient died before reaching the hospital

43. Only a single rail track exists between stations *A* and *B* on a railway line. One hour after the northbound super fast train *N* leaves station *A* for station *B*, a south-bound passenger train S reaches station *A* from station *B*. The speed of the super fast train is twice that of a normal express train *E*, while the speed of a passenger train *S* is half that of *E*. On a particular day, *N* leaves for *B* from *A*, 20 min behind the normal schedule. In order to maintain the schedule, both *N* and *S* increased their speeds. If the super fast train doubles its speed, what should be the ratio (approximately) of the speeds of passenger train to that of the super fast train so that the passenger train *S* reaches exactly at the scheduled time at *A* on that day? **(CAT 2002)**

(a) 1 : 3

(b) 1 : 4

(c) 1 : 5

(d) 1 : 6

44. Amol was asked to calculate the arithmetic mean of ten positive integers each of which had two digits. By mistake, he interchanged the two digits, say a and b, with one of these ten integers. As a result, his answer for the arithmetic mean was 1.8 more than what it should have been. Then, $b - a$ equals **(CAT 2002)**

(a) 1

(b) 2

(c) 3

(d) None of these

45. It takes six technicians a total of ten hours to build a new server from Direct Computer, with each working at the same rate. If six technicians start to build the server at 11.00 am, and one technician per hour is added beginning at 5.00 pm, at what time will the server be complete? **(CAT 2002)**

(a) 6:40 pm

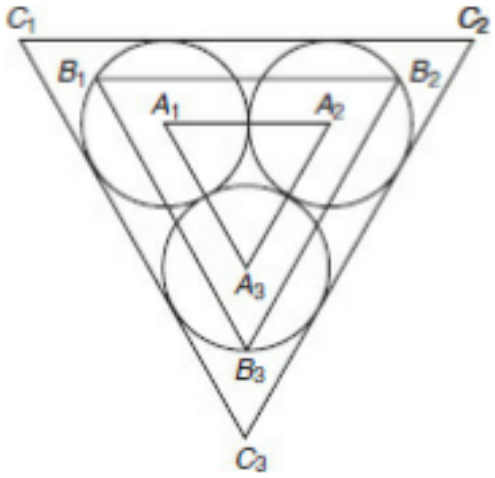
(b) 7:00 pm

(c) 7:20 pm

(d) 8 pm

Direction for Questions 46 to 48 On the basis of the information given below:

Consider three circular parks of equal size with centers at $A1$, $A2$ and $A3$ respectively. The parks touch each other at the edge as shown in the figure (not drawn to scale). There are three paths formed by the triangles $A1A2A3$, $B1B2B3$ and $C1C2C3$, as shown. Three sprinters A, B and C begin running from points $A1$, $B2$ and $C1$ respectively. Each sprinter traverses her triangular path clockwise and returns to her starting point.



46. Let the radius of each circular park be r, and the distances to be traversed by the sprinters A, B and C be a, b and c, respectively. Which of the following is true? **(CAT 2003)**

(a) $b - a = c - b = 3\sqrt{3}\,r$

(b) $b - a = c - b = \sqrt{3}\,r$

(c) $b = (a + c)/2 = 2\,(1 + \sqrt{3})\,r$

(d) $c = 2b - a = (2 + \sqrt{3})\,r$

47. Sprinter A traverses distances A_1A_2, A_2A_3, and A_3A_1 at average speeds of 20, 30 and 15, respectively. B traverses her entire path at a uniform speed of $10\sqrt{3+20}$. C traverses distances C_1C_2, C_2C_3, and C_3C_1 at average speeds of $(40/3)(\sqrt{3} + 1)$, $(40/3)\sqrt{3} + 1)$, and 120, respectively. All speeds are in the same unit. Where would B and C respectively be, when A finishes her sprint? **(CAT 2003)**

(a) B_1, C_1

(b) B_3, C_3

(c) B_2, C_3

(d) B_1, Somewhere between C_3 and C_1

48. Sprinters A, B and C traverse their respective paths at uniform speeds of u, v and w respectively. It is known that $u^2 : v^2 : w^2$ is equal to Area A: Area B: Area C, where Area A, Area B and Area C are the areas of triangles $A_1A_2A_3$, $B_1B_2B_3$, and $C_1C_2C_3$, respectively. Where would A and C be when B reaches point $B3$? **(CAT 2003)**

    (a) A_2, C_3

    (b) A_3, C_3

    (c) A_2, C_2

    (d) Somewhere between A_2 and A_3, Somewhere between C_3 and C_1.

49. In a coastal village, every year floods destroy exactly half of the huts. After the flood water recedes, twice the number of huts destroyed are rebuilt. The floods occurred consecutively in the last three years namely 2001, 2002 and 2003. If floods are again expected in 2004, the number of huts expected to be destroyed is: **(CAT 2003)**

    (a) Less than the number of huts existing at the beginning of 2001.

    (b) Less than the total number of huts destroyed by floods in 2001 and 2003.

    (c) Less than the total number of huts destroyed by floods in 2002 and 2003.

    (d) More than the total number of huts built in 2001 and 2002.

50. Two straight roads *R1* and *R2* diverge from a point A at an angle of 120o . Ram starts walking from point A along *R1* at a uniform speed of 3 km/hr. Shyam starts walking at the same time from A along *R2* at a uniform

speed of 2 km/h. They continue walking for 4 hours along their respective roads and reach points *B* and *C* on *R1* and *R2*, respectively. There is a straight line path connecting *B* and *C*. Then, Ram returns to point *A* after walking along the line segments *BC* and *CA*. Shyam also returns to *A* after walking along line segments *CB* and *BA*. Their speeds remain unchanged. The time interval (in hours) between Ram's and Shyam's return to point *A* is: **(CAT 2003)**

(a) $(10\sqrt{19} + 26)/3$

(b) $(2\sqrt{19} + 10)/3$

(c) $(\sqrt{19} + 26)/3$

(d) $(\sqrt{19} + 10)/3$

51. A leather factory produces two kinds of bags, standard and deluxe. The profit margin is ₹20 on a standard bag and ₹30 on a deluxe bag. Every bag must be processed on machine *A* and *B*. The processing time per bag on the two machines are as follows: (Time required (Hours/bag)

	Standard Bag	**Deluxe Bag**
Machine A	4	5
Machine B	6	10

The total time available on machine *A* is 700 hours and on machine *B* is 1250 hours. Among the following production plans, which one meets the machine availability constraints and maximises the profit? **(CAT 2003)**

(a) Standard 75 bags, Deluxe 80 bags

(b) Standard 100 bags Deluxe 60 bags

(c) Standard 50 bags, Deluxe 100 bags

(d) Standard 60 bags, Deluxe 90 bags

Directions for Questions 52 to 54: Answer the questions on the basis of the information given below. A city has two perfectly circular and concentric ring roads, the outer ring road (OR) being twice as long as the inner ring road (IR). There are also four (straight line) chord roads from $E1$, the east end point of OR to $N2$, the north end point of IR; from $N1$, the north end point of OR to $W2$, the west end point of IR; from $W1$, the west end point of OR, to $S2$, the south end point of IRand from $S1$, the south end point of OR to $E2$, the east end point of IR.; Traffic moves at a constant speed of 30π km/hr on the IR road, and the OR road; $15\sqrt{5}$ km/hr on all the chord roads.

52. The ratio of the sum of the lengths of all chord roads to the length of the outer ring road is **(CAT 2003)**

(a) $\sqrt{5} : 2$

(b) $\sqrt{5} : 2\pi$

(c) $\sqrt{5} : \pi$

(d) None of these

53. Amit wants to reach $N2$ from $S1$. It would take him 90 minutes if he goes on minor arc $S1–E1$ on OR, and then on the chord road $E1–N2$. What is the radius of the outer ring road in kms? **(CAT 2003)**

(a) 60

(b) 40

(c) 30

(d) 20

54. Amit wants to reach *E2* from *N1* using first the chord *N1–W2* and then the inner ring road. What will be his travel time in minutes on the basis of information given in the above question? **(CAT 2003)**

(a) 60

(b) 45

(c) 90

(d) 105

Directions for Questions 55 and 56: Answer the questions on the basis of the information given below. A certain perfume is available at a duty-free shop at the Bangkok International Airport. It is priced in Thai currency–Baht, but other currencies are also acceptable. In particular, the shop accepts Euro and US Dollar at the following rates of exchange:

US Dollar 1 = 41 Bahts; Euro 1 = 46 Bahts.

The perfume is priced at 520 Bahts per bottle. After one bottle is purchased, subsequent bottles are available at a discount of 30 per cent. Three friends *S*, *R* and *M* together purchase three bottles of the perfume, agreeing to share the cost equally. *R* pays 2 Euros, *M* pays 4 Euros and 27 Thai Bahts and *S* pays the remaining amount in US Dollars.

55. How much does *R* owe to *S* in Thai Baht? **(CAT 2003)**

(a) 428

(b) 416

(c) 334

(d) 324

56. How much does *M* owe to *S* in US Dollars? **(CAT 2003)**

(a) 3

(b) 4

(c) 5

(d) 6

57. A milkman mixes 20 liters of water with 80 liters of milk. After selling one-fourth of this mixture, he adds water to replenish the quantity that he had sold. What is the current proportion of water to milk? **(CAT 2004)**

(a) 2 : 3
(b) 1 : 2

(c) 1 : 3

(d) 3 : 4

58. If a man cycles at 10 km/hr, then he arrives at a certain place at 1 p.m. If he cycles at 15 km/hr, he will arrive at the same place at 11 a.m. At what speed must he cycle to get there at noon? **(CAT 2004)**

(a) 11 km/hr

(b) 12 km/hr
(c) 13 km/hr

(d) 14 km/hr

59. Two boats, traveling at 5 and 10 kms per hour, head directly towards each other. They begin at a distance of 20 kms from each other. How far apart are they (in kms) one minute before they collide. **(CAT 2004)**

    (a) 1/12

    (b) 1/6

    (c) 1/4

    (d) 1/3

60. Karan and Arjun run a 100-meter race, where Karan beats Arjun by10 meters. To do a favour to Arjun, Karan starts 10 meters behind the starting line in a second 100 meter race. They both run at their earlier speeds. Which of the following is true in connection with the second race? **(CAT 2004)**

    (a) Karan and Arjun reach the finishing line simultaneously.

    (b) Arjun beats Karan by 1 meter

    (c) Arjun beats Karan by 11 meters.

    (d) Karan beats Arjun by 1 meter.

Directions for Questions 61 and 62: Answer the questions on the basis of the information given below:

In an examination, there are 100 questions divided into three groups *A*, *B* and *C* such that each group contains at least one question. Each question in group *A* carries 1 mark, each question in group *B* carries 2 marks and each question in group *C* carries 3 marks. It is known that the questions in group *A* together carry at least 60% of the total marks. **(CAT 2004)**

61. If group *B* contains 23 questions, then how many questions are there in Group *C*?

(a) 1

(b) 2

(c) 3

(d) Cannot be determined

62. If group *C* contains 8 questions and group *B* carries at least 20% of the total marks, which of the following best describes the number of questions in group *B*?

(a) 11 or 12

(b) 12 or 13

(c) 13 or 14

(d) 14 or 15

63. A sprinter starts running on a circular path of radius *r* meters. Her average speed (in meters/minute) is pr during the first 30 seconds, $\frac{\pi r}{2}$ during next one minute, $\frac{\pi r}{4}$ during next 2 minutes, $\frac{\pi r}{8}$ during the next 4 minutes, and so on. What is the ratio of the time taken for the nth round to that for the previous round? **(CAT 2004)**

(a) 4

(b) 8

(c) 16

(d) 32

64. In a nuts and bolts factory, one machine produces only nuts at the rate of 100 nuts per minute and needs to be cleaned for 5 minutes after production of every 1000 units. Another machine produces only bolts at the rate of 75 bolts per minute and needs to be cleaned for 10 minutes after production of every 1500 bolts. If both the machines start production at the same time, what is the minimum duration required for producing 9000 pairs of nuts and bolts? **(CAT 2004)**

(a) 130 minutes

(b) 135 minutes

(c) 170 minutes

(d) 180 minutes

65. A chemical plant has four tanks (*A*, *B*, *C* and *D*), each containing 1000 liters of a chemical. The chemical is being pumped from one tank to another as follows. **(CAT 2005)**

From *A* to *B* @ 20 liters/minute

From *C* to *A* @ 90 liters/minute

From *A* to *D* @ 10 liters/minute

From *C* to *D* @ 50 liters/minute

From *B* to *C* @ 100 liters/minute

From *D* to *B* @ 110 liters/minute

Which tank gets emptied first, and how long does it take (in minutes) to get empty after pumping starts?

(a) *A*, 16.66

(b) *C*, 20

(c) *D*, 20

(d) *D*, 25

Directions for Questions 66 and 67: Answer the questions on the basis of the information given below:

Ram and Shyam run a race between points *A* and *B*, 5 km apart, Ram starts at 9 a.m from *A* at a speed of 5 km/hr, reaches *B*, and returns to *A* at the same speed, Shyam starts at 9:45 a.m. from A at a speed of 10 km/hr, reaches *B* and comes back to *A* at the same speed. **(CAT 2005)**

66. At what time do Ram and Shyam first meet each other?

(a) 10 a.m

(b) 10:10 a.m

(c) 10:20 a.m

(d) 10:30 a.m.

67. At what time does Shyam over take Ram?

(a) 10:20 a.m

(b) 10:30 a.m

(c) 10:40 a.m

(d) 10:50 a.m

68. A telecom service provider engages male and female operators for answering 1000 calls per day. A male operator can handle 40 calls per day whereas a female operator can handle 50 calls per day.

The male and the female operators get a fixed wage of ₹250 and ₹300 per day respectively. In addition, a male operator gets ₹15 per call he answers and female operator gets ₹10 per call she answers. To minimize the total cost, how many male operators should the service provider employ assuming he has to employ more than 7 of the 12 female operators available for the job? **(CAT 2005)**

(a) 15
(b) 14
(c) 12
(d) 10

69. Arun, Barun and Kiranmala start from the same place and travel in the same direction at speeds of 30, 40 and 60 km per hour respectively. Barun starts two hours after Arun. If Barun and Kiranmala overtake Arun at the same instant, how many hours after Arun did Kiranmala start? **(CAT 2006)**

(a) 3
(b) 3.5
(c) 4
(d) 4.5
(e) 5

Directions for Questions 70 and 71: Answer questions on the basis of the information given below:

An airline has a certain free luggage allowance and charges for excess luggage at a fixed rate per kg. Two passengers, Raja and Praja have 60 kg of luggage between them, and are charged ₹1200 and ₹2400 respectively for excess luggage. Had the

entire luggage belonged to one of them, the excess luggage charge would have been ₹5400. **(CAT 2006)**

70. What is the weight of Praja's luggage?

    (a) 20 kg

    (b) 25 kg

    (c) 30 kg

    (d) 35 kg

    (e) 40 kg

71. What is the free luggage allowance?

    (a) 10 kg

    (b) 15 kg

    (c) 20 kg

    (d) 25 kg

    (e) 30 kg

72. If $a/b = 1/3$, $b/c = 2$, $c/d = 1/2$, $d/e = 3$ and $e/f = 1/4$, then what is the value of abc/def? **(CAT 2006)**

    (a) 3/8

    (b) 27/8

    (c) 3/4

    (d) 27/4

    (e) 1/4

Directions for Question 73: Each question is followed by two statements A and B. Indicate your response based on the following directives. **(CAT 2007)**

Mark (a) if the question can be answered using *A* alone but not using *B* alone.

Mark (b) if the question can be answered using *B* alone but not using *A* alone.

Mark (c) if the question can be answered using *A* and *B* together, but not using either *A* or *B* alone.

Mark (d) if the question cannot be answered even using *A* and *B* together.

73. The average weight of a class of 100 students is 45 kg. The class consists of two sections, I and II, each with 50 students. The average weight, W_I, of Section I is smaller than the average weight W_{II}, of the Section II. If the heaviest student say Deepak, of section II is moved to Section I, and the lightest student, say Poonam, of Section I is moved to Section II, then the average weights of the two sections are switched, i.e., the average weight of Section I becomes W_{II} and that of Section II becomes W_I. What is the weight of Poonam?

    A: $W_{II} - W_I = 1.0$.

    B: Moving Deepak from Section II to I (without any move I to II) makes the average weights of the two sections equal.

Directions for Questions 74 and 75: Answer the following questions based on the information given below: Cities *A* and *B* are in different time zones. *A* is located 3000 km east of *B*. The table below describes the schedule of an airline operating non-stop flights between *A* and *B*. All the times indicated are local and on the same day.

Departure		*Arrival*	
City	Time	City	Time
B	8:00 am	A	3:00 pm
A	4:00 pm	B	8:00 pm

Assume that planes cruise at the same speed in both directions. However, the effective speed is influenced by a steady wind blowing from east to west at 50 km per hour. **(CAT 2007)**

74. What is the time difference between *A* and *B*?

(a) 1 hour and 30 minutes

(b) 2 hours

(c) 2 hours and 30 minutes

(d) 1 hour

(e) Cannot be determined

75. What is the plane's cruising speed in km per hour?

(a) 700

(b) 550

(c) 600

(d) 500

(e) Cannot be determined.

Directions for Questions 76 and 77: Answer the following questions based on the information given below:

Mr. David manufactures and sells a single product at a fixed price in a niche market. The selling price of each unit is ₹30. On the other hand the cost, in rupees, of producing '*x*' units is $240 + bx + cx2$, where '*b*' and '*c*' are some constants. Mr.

David noticed that doubling the daily production from 20 to 40 units increases the daily production cost by 66.66%. However, an increase in daily production from 40 to 60 units results in an increase of only 50% in the daily production cost. Assume that demand is unlimited and that Mr. David can sell as much as he can produce. His objective is to maximize the profit. **(CAT 2007)**

76. How many units should Mr. David produce daily?

    (a) 130

    (b) 100

    (c) 70

    (d) 150

    (e) Cannot be determined

77. What is the maximum daily profit, in rupees, that Mr. David can realize from his business?

    (a) 620

    (b) 920

    (c) 840

    (d) 760

    (e) Cannot be determined

78. Ten years ago, the ages of the members of a joint family of eight people added up to 231 years. Three years later, one member died at the age of 60 years and a child was born during the same year. After another three years, one more member died, again at 60, and a child was born during

the same year. The current average age of this eight-member joint family is nearest to: **(CAT 2007)**

(a) 23 years

(b) 22 years

(c) 21 years

(d) 25 years

(e) 24 years

Directions for Questions 79 and 80: Shabnam is considering three alternatives to invest her surplus cash for a week. She wishes to guarantee maximum returns on her investment. She has three options, each of which can be utilised fully or partially in conjunction with others.

Option A: Invest in a public sector bank. It promises a return of + 0.10%.

Option B: Invest in mutual funds of *ABC* Ltd. A rise in the stock market will result in a return of + 5%, while a fall will entail a return of –3%.

Option C: Invest in mutual funds of *CBA* Ltd. A rise in the stock market will result in a return of –2.5%, while a fall will entail a return of + 2%.

79. The maximum guaranteed return to Shabnam is: **(CAT 2007)**

(a) 0.25%

(b) 0.10%

(c) 0.20%

(d) 0.15%

(e) 0.30%

80. Which strategy will maximise the guaranteed return to Shabnam? **(CAT 2007)**

(a) 100% in option *A*

(b) 36% in option *B* and 64% in option *C*

(c) 64% in option *B* and 36% in option *C*

(d) 1/3 in each of the three options

(e) 30% in option *A*, 32% in option *B* and 38% in option

81. Rahim plans to drive from city *A* to station *C*, at the speed of 70 km per hour, to catch a train arriving there from B. He must reach *C* at least 15 minutes before the arrival of the train. The train leaves *B*, located 500 km south of *A*, at 8:00 am and travels at a speed of 50 km per hour. It is known that *C* is located between west and northwest of *B*, with *BC* at 60o to *AB*. Also, *C* is located between south and south west of *A* with *AC* at 30o to *AB*. The latest time by which Rahim must leave *A* and still catch the train is closest to **(CAT 2008)**

(a) 6:15 am

(b) 6:30 am

(c) 6:45 am

(d) 7:00 am

(e) 7:15 am

82. A shop stores *x* kg of rice. The first customer buys half this amount plus half a kg of rice. The second customer buys half the remaining amount plus half a kg of rice. Then the third customer also buys half the remaining amount plus half a kg of rice. Thereafter, no rice is left in the shop. Which of the following best describes the value of *x*? **(CAT 2008)**

(a) $2 \le x \le 6$

(b) $5 \le x \le 8$

(c) $9 \le x \le 12$

(d) $11 \le x \le 14$

(e) $13 \le x \le 18$

83. In Coorg, the production of tea is three times the production of coffee. If a percent more tea and b percent more coffee were produced, the aggregate amount would be $5c$ percent more. But if b percent more tea and a percent more coffee were produced, the aggregate amount produced would be $3c$ percent more. What is the ratio $a : b$? **(CAT 2009)**

(a) 1 : 3

(b) 1 : 2

(c) 2 : 1

(d) 3 : 1

84. A group of men was employed to shift 545 crates. Every day after the first, 6 more men than the previous day were put on the job. Also, every day after the first, each man working, shifted 5 fewer crates than the number of crates moved by each man the previous day. The result was that during the latter part of the period, the number of crates shifted per day began to go down. 5 days were required to finish the work. What was the number of crates shifted on the third day? **(CAT 2009)**

(a) 137

(b) 169

(c) 26

(d) 152

85. In a 10 km race, *A*, *B*, and *C*, each running at uniform speed, get the gold, silver, and bronze medals, respectively. If *A* beats *B* by 1 km and *B* beats *C* by 1 km, then by how many metres does *A* beat *C*? **(CAT 2017)**

86. Bottle 1 contains a mixture of milk and water in 7 : 2 ratio and Bottle 2 contains a mixture of milk and water in 9 : 4 ratio. In what ratio of volumes should the liquids in Bottle 1 and Bottle 2 be combined to obtain a mixture of milk and water in 3 : 1 ratio? **(CAT 2017)**

(a) 27 : 14

(b) 27 : 13

(c) 27 : 16

(d) 27 : 18

87. Arun drove from home to his hostel at 60 miles per hour. While returning home he drove half way along the same route at a speed of 25 miles per hour and then took a bypass road which increased his driving distance by 5 miles, but allowed him to drive at 50 miles per hour along this bypass road. If his return journey took 30 minutes more than his onward journey, then the total distance traveled by him is: **(CAT 2017)**

(a) 55 miles

(b) 60 miles

(c) 65 miles

(d) 14000

89. The average height of 22 toddlers increases by 2 inches when two of them leave this group. If the average height of these two toddlers is one-third the average height of the original 22, then the average height, in inches, of the remaining 20 toddlers is **(CAT 2017)**

(a) 30

(b) 28

(c) 32

(d) 26

90. The manufacturer of a table sells it to a wholesale dealer at a profit of 10%. The wholesale dealer sells the table to a retailer at a profit of 30%. Finally, the retailer sells it to a customer at a profit of 50%. If the customer pays ₹4290 for the table, then its manufacturing cost (in ₹) is **(CAT 2017)**

(a) 1500

(b) 2000

(c) 2500

(d) 3000

91. A tank has an inlet pipe and an outlet pipe. If the outlet pipe is closed then the inlet pipe fills the empty tank in 8 hours. If the outlet pipe is open then the inlet pipe fills the empty tank in 10 hours. If only the outlet pipe is open then in how many hours the full tank becomes half-full? **(CAT 2017)**

(a) 20

(b) 30

(c) 40

(d) 45

92. Mayank buys some candies for ₹15 a dozen and an equal number of different candies for ₹12 a dozen. He sells all for ₹16.50 a dozen and makes a profit of ₹150. How many dozens of candies did he buy altogether? **(CAT 2017)**

(a) 50

(b) 30

(c) 25

(d) 45

93. In a village, the production of food grains increased by 40% and the per capita production of food grains increased by 27% during a certain period. The percentage by which the population of the village increased during the same period is nearest to **(CAT 2017)**

(a) 16

(b) 13

(c) 10

(d) 7

94. If a, b, c are three positive integers such that a and b are in the ratio 3 : 4 while b and c are in the ratio 2 : 1, then which one of the following is a possible value of $(a + b + c)$? **(CAT 2017)**

(a) 201

(b) 205

(c) 207

(d) 210

95. A motorbike leaves point *A* at 1 pm and moves towards point *B* at a uniform speed. A car leaves point *B* at 2 pm and moves towards point *A* at a uniform speed, which is double that of the motorbike. They meet at 3:40 pm at a point, which is 168 km away from *A*. What is the distance, in km, between *A* and *B*? **(CAT 2017)**

(a) 364

(b) 378

(c) 380

(d) 388

96. Amal can complete a job in 10 days and Bimal can complete it in 8 days. Amal, Bimal and Kamal together complete the job in 4 days and are paid a total amount of ₹1000 as remuneration. If this amount is shared by them in proportion to their work, then Kamal's share, in rupees, is **(CAT 2017)**

(a) 100

(b) 200

(c) 300

(d) None of these

97. Consider three mixtures – the first having water and liquid *A* in the ratio 1 : 2, the second having water and liquid *B* in the ratio 1 : 3, and the third

having water and liquid C in the ratio 1 : 4. These three mixtures of A, B, and C, respectively, are further mixed in the proportion 4 : 3 : 2. Then the resulting mixture has **(CAT 2017)**

(a) The same amount of water and liquid B

(b) The same amount of liquids B and C

(c) More water than liquid B

(d) More water than liquid A

98. Arun's present age in years is 40% of Barun's. In another few years, Arun's age will be half of Barun's. By what percentage will Barun's age increase during this period? **(CAT 2017)**

99. A person can complete a job in 120 days. He works alone on Day 1. On Day 2, he is joined by another person who also can complete the job in exactly 120 days. On Day 3, they are joined by another person of equal efficiency. Like this, everyday a new person with the same efficiency joins the work. How many days are required to complete the job? **(CAT 2017)**

100. An elevator has a weight limit of 630 kg. It is carrying a group of people of whom the heaviest weighs 57 kg and the lightest weighs 53 kg. What is the maximum possible number of people in the group? **(CAT 2017)**

101. A man leaves his home and walks at a speed of 12 km per hour, reaching the railway station 10 minutes after the train had departed. If instead he had walked at a speed of 15 km per hour, he would have reached the station 10 minutes before the train's departure. The distance (in km) from his home to the railway station is **(CAT 2017)**

102. Ravi invests 50% of his monthly savings in fixed deposits. Thirty percent of the rest of his savings is invested in stocks and the rest goes into Ravi's savings bank account. If the total amount deposited by him in the bank (for savings account and fixed deposits) is ₹59500, then Ravi's total monthly savings (in ₹) is? **(CAT 2017)**

103. If a seller gives a discount of 15% on retail price, she still makes a profit of 2%. Which of the following ensures that she makes a profit of 20%? **(CAT 2017)**

(a) Give a discount of 5% on retail price

(b) Give a discount of 2% on retail price

(c) Increase the retail price by 2%

(d) Sell at retail price

104. A man travels by a motor boat down a river to his office and back. With the speed of the river unchanged, if he doubles the speed of his motor boat, then his total travel time gets reduced by 75%. The ratio of the original speed of the motor boat to the speed of the river is? **(CAT 2017)**

(a) $\sqrt{6} : \sqrt{2}$

(b) $\sqrt{7} : 2$

(c) $2\sqrt{5} : 3$

(d) 3 : 2

105. Suppose $C1$, $C2$, $C3$, $C4$, and $C5$ are five companies. The profits made by $C1$, $C2$, and $C3$ are in the ratio 9 : 10 : 8 while the profits made by $C2$, $C4$, and $C5$ are in the ratio 18 : 19 : 20. If $C5$ has made a profit of ₹19 crore

more than C1, then the total profit (in ₹) made by all five companies is: **(CAT 2017)**

(a) 438 crore

(b) 435 crore

(c) 348 crore

(d) 345 crore

106. The number of girls appearing for an admission test is twice the number of boys. If 30% of the girls and 45% of the boys get admission, the percentage of candidates who do not get admission is: **(CAT 2017)**

(a) 35

(b) 50

(c) 60

(d) 65

107. A stall sells popcorn and chips in packets of three sizes: large, super, and jumbo. The numbers of large, super, and jumbo packets in its stock are in the ratio 7 : 17 : 16 for popcorn and 6 : 15 : 14 for chips. If the total number of popcorn packets in its stock is the same as that of chips packets, then the numbers of jumbo popcorn packets and jumbo chips packets are in the ratio **(CAT 2017)**

(a) 1 : 1

(b) 8 : 7

(c) 4 : 3

(d) 15%

109. If Fatima sells 60 identical toys at a 40% discount on the printed price, then she makes 20% profit. Ten of these toys are destroyed in fire. While selling the rest, how much discount should be given on the printed price so that she can make the same amount of profit? **(CAT 2017)**

(a) 30%

(b) 25%

(c) 24%

(d) 28%

110. A water tank has inlets of two types *A* and *B*. All inlets of type *A* when open bring in water at the same rate. All inlets of type *B*, when open, bring in water at the same rate. The empty tank is completely filled in 30 minutes if 10 inlets of type *A* and 45 inlets of type *B* are open and in 1 hour if 8 inlets of type A and 18 inlets of type *B* are open. In how many minutes will the empty tank get completely filled if 7 inlets of type *A* and 27 inlets of type *B* are open? **(CAT 2018)**

111. Points *A*, *P*, *Q* and *B* lie on the same line such that *P*, *Q* and *B* are, respectively, 100 km, 200 km and 300 km away from *A*. Cars 1 and 2 leave *A* at the same time and move towards *B*. Simultaneously, car 3 leaves *B* and moves towards *A*. Car 3 meets car 1 at *Q*, and car 2 at *P*. If each car is moving in uniform speed then the ratio of the speed of car 2 to that of car 1 is **(CAT 2018)**

(a) 2 : 7

(b) 2 : 9

(c) 1 : 4

(d) 1 : 2

112. Gopal borrows ₹X from Ankit at 8% annual interest. He then adds ₹Y of his own money and lends ₹$X + Y$ to Ishan at 10% annual interest. At the end of the year, after returning Ankit's dues, the net interest retained by Gopal is the same as that accrued to Ankit. On the other hand, had Gopal lent ₹$X + 2Y$ to Ishan at 10%, and then the net interest retained by him would have increased by ₹150. If all interests are compounded annually, then find the value of $X + Y$. **(CAT 2018)**

113. The scores of Amal and Bimal in an examination are in the ratio 11 : 14. After an appeal, their scores increase by the same amount and their new scores are in the ratio 47 : 56. The ratio of Bimal's new score to that of his original score is **(CAT 2018)**

(a) 8 : 5
(b) 3 : 2

(c) 4 : 3

(d) 5 : 4

114. The strength of a salt solution is p% if 100 ml of the solution contains p grams of salt. If three salt solutions A, B, C are mixed in the proportion 1: 2: 3, then the resulting solution has strength 20%. If instead the proportion is 3 : 2 : 1, then the resulting solution has strength 30%. A fourth solution, D, is produced by mixing B and C in the ratio 2 : 7. The ratio of the strength of D to that of A is **(CAT 2018)**

(a) 1 : 3

(b) 2 : 5

(c) 1 : 4

(d) 3 : 10

115. A 20% ethanol solution is mixed with another ethanol solution, say, S of unknown concentration in the proportion 1 : 3 by volume. This mixture is then mixed with an equal volume of 20% ethanol solution. If the resultant mixture is a 31.25% ethanol solution, then the unknown concentration of S is **(CAT 2018)**

(a) 55%

(b) 52%

(c) 48%

(d) 50%

116. There are two drums, each containing a mixture of paints A and B. In drum 1, A and B are in the ratio 18 : 7. The mixtures from drums 1 and 2 are mixed in the ratio 3 : 4 and in this final mixture, A and B are in the ratio 13 : 7. In drum 2, then A and B were in the ratio **(CAT 2018)**

(a) 239 : 161

(b) 220 : 149

(c) 229 : 141

(d) 251 : 163

117. Ramesh and Ganesh can together complete a work in 16 days. After seven days of working together, Ramesh got sick and his efficiency fell by 30%. As a result, they completed the work in 17 days instead of 16 days. If Ganesh had worked alone after Ramesh got sick, in how many days would he have completed the remaining work? **(CAT 2018)**

(a) 14.5

(b) 13.5

(c) 11

(d) 12

118. On a long stretch of east-west road, A and B are two points such that B is 350 km west of A. One car starts from A and another from B at the same time. If they move towards each other, then they meet after one hour. If they both move towards east, then they meet in seven hrs. The difference between their speeds, in km per hour, is **(CAT 2018)**

119. A jar contains a mixture of 175 ml water and 700 ml alcohol. Gopal takes out 10% of the mixture and substitutes it by water of the same amount. The process is repeated once again. The percentage of water in the mixture is now **(CAT 2018)**

(a) 20.5

(b) 30.3

(c) 25.4

(d) 35.2

120. The arithmetic mean of x, y and z is 80, and that of x, y, z, u and v is 75, where $u = (x + y)/2$ and $v = (y + z)/2$. If $x \geq z$, then the minimum possible value of x is **(CAT 2018)**

121. A tank is emptied everyday at a fixed time point. Immediately, thereafter, either pump *A* or pump *B* or both start working until the tank is full. On Monday, *A* alone completed filling the tank at 8 PM. On Tuesday, *B* alone completed filling the tank at 6 PM. On Wednesday, A alone worked till 5 PM, and then *B* worked alone from 5 PM to 7 PM, to fill the tank. At what time was the tank filled on Thursday if both pumps were used simultaneously all along?

(CAT 2018)

(a) 4 : 12 PM

(b) 4 : 24 PM

(c) 4 : 48 PM

(d) 4 : 36 PM

122. Points *A* and *B* are 150 km apart. Cars 1 and 2 travel from *A* to *B*, but car 2 starts from *A* when car 1 is already 20 km away from *A*. Each car travels at a speed of 100 kmph for the first 50 km, at 50 kmph for the next 50 km, and at 25 kmph for the last 50 km. The distance, in km, between car 2 and *B* when car 1 reaches *B* is **(CAT 2018)**

123. Train *T* leaves station *X* for station *Y* at 3 PM. Train *S*, travelling at three quarters of the speed of *T*, leaves *Y* for *X* at 4 PM. The two trains pass each other at a station *Z*, where the distance between *X* and *Z* is three-fifths of that between *X* and *Y*. How many hours does train T take for its journey from *X* to *Y*? **(CAT 2018)**

124. Two types of tea, A and B, are mixed and then sold at ₹40 per kg. The profit is 10% if A and B are mixed in the ratio 3: 2, and 5% if this ratio is 2: 3. The cost prices, per kg, of A and B are in the ratio **(CAT 2018)**

(a) 18 : 25

(b) 17 : 25

(c) 21 : 25

(d) 19 : 24

125. A CAT aspirant appears for a certain number of tests. His average score increases by 1 if the first 10 tests are not considered, and decreases by 1 if the last 10 tests are not considered. If his average scores for the first 10 and the last 10 tests are 20 and 30, respectively, then the total number of tests taken by him is **(CAT 2018)**

126. Point P lies between points A and B such that the length of BP is thrice that of AP. Car 1 starts from A and moves towards B. Simultaneously, car 2 starts from B and moves towards A. Car 2 reaches P one hour after car 1 reaches P. If the speed of car 2 is half that of car 1, then the time, in minutes, taken by car 1 in reaching P from A is **(CAT 2018)**

127. John borrowed ₹2, 10,000 from a bank at an interest rate of 10% per annum, compounded annually. The loan was repaid in two equal instalments, the first after one year and the second after another year. The first instalment was interest of one year plus part of the principal amount, while the second was the rest of the principal amount plus due interest thereon. Then each instalment, in ₹ is **(CAT 2018)**

128. In an examination, the maximum possible score is N while the pass mark is 45% of N. A candidate obtains 36 marks, but falls short of the pass mark by 68%. Which one of the following is correct? **(CAT 2018)**

(a) $N \leq 200$

(b) $243 \leq N \leq 252$

(c) $N \geq 253$

(d) $201 \leq N \leq 242$

129. In an apartment complex, the number of people aged 51 years and above is 30 and there are at most 39 people whose ages are below 51 years. The average age of all the people in the apartment complex is 38 years. What is the largest possible average age, in years, of the people whose ages are below 51 years? **(CAT 2018)**

(a) 25

(b) 26

(c) 27

(d) 28

130. The distance from A to B is 60 km. Partha and Narayan start from A at the same time and move towards B. Partha takes four hours more than Narayan to reach B. Moreover, Partha reaches the mid-point of A and B two hours before Narayan reaches B. The speed of Partha, in km per hour, is **(CAT 2018)**

(a) 5

(b) 3

(c) 4
(d) 6

131. Humans and robots can both perform a job but at different efficiencies. Fifteen humans and five robots working together take thirty days to finish the job, whereas five humans and fifteen robots working together take sixty days to finish it. How many days will fifteen humans working together (without any robot) take to finish it? **(CAT 2018)**

(a) 36

(b) 40

(c) 45

(d) 32

132. A trader sells 10 litres of a mixture of paints *A* and *B*, where the amount of *B* in the mixture does not exceed that of *A*. The cost of paint *A* per litre is ₹8 more than that of paint *B*. If the trader sells the entire mixture for ₹264 and makes a profit of 10%, then the highest possible cost of paint *B*, in ₹ per litre, is **(CAT 2018)**

(a) 26

(b) 22

(c) 20
(d) 16

133. Raju and Lalitha originally had marbles in the ratio 4 : 9. Then Lalitha gave some of her marbles to Raju. As a result, the ratio of the number of marbles with Raju to that with Lalitha became 5 : 6. What fraction of her

original number of marbles was given by Lalitha to Raju? **(CAT 2018)**

(a) 6/19

(b) 7/33

(c) 1/5

(d) 1/4

134. A wholesaler bought walnuts and peanuts; the price of walnut per kg being thrice that of peanut per kg. He then sold 8 kg of peanuts at a profit of 10% and 16 kg of walnuts at a profit of 20% to a shopkeeper. However, the shopkeeper lost 5 kg of walnuts and 3 kg of peanuts in transit. He then mixed the remaining nuts and sold the mixture at ₹166 per kg, thus making an overall profit of 25%. At what price, in ₹ per kg, did the wholesaler buy the walnuts? **(CAT 2018)**

(a) 84

(b) 96

(c) 86

(d) 98

135. The average of 30 integers is 5. Among these 30 integers, there are exactly 20 which do not exceed 5. What is the highest possible value of the average of these 20 integers? **(CAT 2019)**

(a) 3.5

(b) 5

(c) 4.5

(d) 4

136. Amal invests 12000 at 8% interest, compounded annually, and 10000 at 6% interest, compounded semi-annually, both investments being for one year. Bimal invests his money at 7.5% simple interest for one year. If Amal and Bimal get the same amount of interest, then the amount, in Rupees, invested by Bimal is **(CAT 2019)**

137. Two ants A and B start from a point P on a circle at the same time, with A moving clock-wise and B moving anti-clockwise. They meet for the first time at 10:00 AM when A has covered 60% of the track. If A returns to P at 10:12 AM, then B returns to P at **(CAT 2019)**

(a) 10:25 AM

(b) 10:45 AM

(c) 10:18 AM

(d) 10:27 AM

138. The strength of a salt solution is p% if 100 ml of the solution contains p grams of salt. Each of three vessels A, B, C contains 500 ml of salt solution of strengths 10%, 22%, and 32%, respectively. Now, 100 ml of the solution in vessel A is transferred to vessel B. Then, 100 ml of the solution in vessel B is transferred to vessel C. Finally, 100 ml of the solution in vessel C is transferred to vessel A. The strength, in percentage, of the resulting solution in vessel A is **(CAT 2019)**

(a) 15

(b) 13

(c) 12

(d) 14

139. A cyclist leaves *A* at 10 AM and reaches *B* at 11 AM. Starting from 10:01 AM, every minute a motorcycle leaves *A* and moves towards *B*. Forty-five such motorcycles reach *B* by 11 AM. All motorcycles have the same speed. If the cyclist had doubled his speed, how many motorcycles would have reached *B* by the time the cyclist reached *B*? **(CAT 2019)**

(a) 22

(b) 23

(c) 15

(d) 20

140. John jogs on track *A* at 6 kmph and Mary jogs on track *B* at 7.5 kmph. The total length of tracks *A* and *B* is 325 metres. While John makes nine rounds of track *A*, Mary makes five rounds of track *B*. In how many seconds will Mary make one round of track *A*? **(CAT 2019)**

141. In 2010, a library contained a total of 11500 books in two categories - fiction and nonfiction. In 2015, the library contained a total of 12760 books in these two categories. During this period, there was 10% increase in the fiction category while there was 12% increase in the non-fiction category. How many fiction books were in the library in 2015? **(CAT 2019)**

(a) 6160

(b) 6600

(c) 6000

(d) 5500

142. A shopkeeper sells two tables, each procured at cost price p, to Amal and Asim at a profit of 20% and at a loss of 20%, respectively. Amal sells his table to Bimal at a profit of 30%, while Asim sells his table to Barun at a loss of 30%. If the amounts paid by Bimal and Barun are x and y, respectively, then $(x - y)/p$ equals **(CAT 2019)**

(a) 1

(b) 1.2

(c) 0.50

(d) 0.7

143. Mukesh purchased ten bicycles in 2017, all at the same price. He sold six of these at a profit of 25% and the remaining four at a loss of 25%. If he made a total profit of 2000, then his purchase price of a bicycle, in Rupees, was **(CAT 2019)**

(a) 6000

(b) 8000

(c) 4000

(d) 2000

144. In an examination, the score of A was 10% less than that of B, the score of B was 25% more than that of C, and the score of C was 20% less than that of D. If A scored 72, then the score of D was **(CAT 2019)**

145. The salaries of Ramesh, Ganesh and Rajesh were in the ratio 6:5:7 in 2010, and in the ratio 3 : 4 : 3 in 2015. If Ramesh's salary increased by 25% during 2010–2015, then the percentage increase in Rajesh's salary during this period is closest to **(CAT 2019)**

(a) 10

(b) 7

(c) 9

(d) 8

146. Anil alone can do a job in twenty days while Sunil alone can do it in forty days. Anil starts the job, and after three days, Sunil joins him. Again, after a few more days, Bimal joins them and they together finish the job. If Bimal has done 10% of the job, then in how many days was the job done? **(CAT 2019)**

(a) 12

(b) 13

(c) 14

(d) 15

147. In an examination, Rama's score was one-twelfth of the sum of the scores of Mohan and Anjali. After a review, the score of each of them increased by 6. The revised scores of Anjali, Mohan, and Rama were in the ratio 11 : 10 : 3. Then Anjali's score exceeded Rama's score by **(CAT 2019)**

(a) 26

(b) 32

(c) 35

(d) 24

148. Two cars travel the same distance starting at 10:00 AM and 11:00 AM, respectively, on the same day. They reach their common destination at the same point of time. If the first car travelled for at least six hours, then the highest possible value of the percentage by which the speed of the second car could exceed that of the first car is **(CAT 2019)**

(a) 20

(b) 30

(c) 25

(d) 10

149. The income of Amala is 20% more than that of Bimala and 20% less than that of Kamala. If Kamala's income goes down by 4% and Bimala's goes up by 10%, then the percentage by which Kamala's income would exceed Bimala's is nearest to **(CAT 2019)**

(a) 31

(b) 29

(c) 28

(d) 32

150. In a race of three horses, the first beats the second by 11 metres and the third by 90 metres. If the second beats the third by 80 metres, what was the length, in metres, of the racecourse? **(CAT 2019)**

151. Amala, Bina, and Gouri invest money in the ratio 3 : 4 : 5 in fixed deposits having respective annual interest rates in the ratio 6 : 5 : 4. What is their total interest income (in rupees) after an year, if Bina's interest income

exceeds Amala's by 250?

(CAT 2019)

(a) 6350

(b) 6000

(c) 7000

(d) 7250

152. One can use three different transports which move at 10, 20, and 30 km/h, respectively. To reach from *A* to *B*, Amal took each mode of transport 1/3 of his total journey time, while Bimal took each mode of transport 1/3 of the total distance. The percentage by which Bimal's travel time exceeds Amal's travel time is nearest to **(CAT 2019)**

(a) 22

(b) 20

(c) 19

(d) 21

153. Meena scores 40% in an examination and after review, even though her score is increased by 50%, she fails by 35 marks. If her post-review score is increased by 20%, she will have 7 marks more than the passing score. The percentage score needed for passing the examination is **(CAT 2019)**

(a) 60

(b) 80

(c) 70

(d) 75

154. A person invested a total amount of 15 lakhs. A part of it was invested in a fixed deposit earning 6% annual interest, and the remaining amount was invested in two other deposits in the ratio 2 : 1, earning annual interest at the rates of 4% and 3%, respectively. If the total annual interest income is 76000, then the amount (in lakh) invested in the fixed deposit was **(CAT 2019)**

155. At their usual efficiency levels, *A* and *B* together finish a task in 12 days. If *A* had worked half as efficiently as she usually does, and *B* had worked thrice as efficiently as he usually does, the task would have been completed in 9 days. How many days would A take to finish the task if she works alone at her usual efficiency? **(CAT 2019)**

(a) 36

(b) 24

(c) 18

(d) 12

156. In a class, 60% of the students are girls and the rest are boys. There are 30 more girls than boys. If 68% of the students, including 30 boys, pass an examination, the percentage of the girls who do not pass is **(CAT 2019)**

157. On selling a pen at 5% loss and a book at 15% gain, Karim gains ₹7. If he sells the pen at 5% gain and the book at 10% gain, he gains ₹13. What is the cost price of the book in Rupees? **(CAT 2019)**

(a) 95

(b) 85

(c) 80

(d) 100

158. A chemist mixes two liquids 1 and 2. One litre of liquid 1 weighs 1 kg and one litre of liquid 2 weighs 800 g. If half litre of the mixture weighs 480 g, then the percentage of liquid 1 in the mixture, in terms of volume, is **(CAT 2019)**

(a) 80

(b) 70

(c) 85

(d) 75

159. Ramesh and Gautam are among 22 students who write an examination. Ramesh scores 82.5. The average score of the 21 students other than Gautam is 62. The average score of all the 22 students is one more than the average score of the 21 students other than Ramesh. The score of Gautam is **(CAT 2019)**

(a) 53

(b) 51

(c) 48

(d) 49

160. Three men and eight machines can finish a job in half the time taken by three machines and eight men to finish the same job. If two machines can finish the job in 13 days, then how many men can finish the job in 13 days? **(CAT 2019)**

ANSWER KEY

1. (c)
2. (b)
3. (a)
4. (d)
5. (b)
6. (b)
7. (a)
8. (b)
9. (a)
10. (b)
11. (c)
12. (a)
13. (c)
14. (c)
15. (b)
16. (b)
17. (b)
18. (a)
19. (a)
20. (c)
21. (c)
22. (b)
23. (d)
24. (c)

25. (a)
26. (a)
27. (b)
28. (b)
29. (b)
30. (a)
31. (a)
32. (a)
33. (b)
34. (d)
35. (a)
36. (b)
37. (c)
38. (d)
39. (b)
40. (b)
41. (b)
42. (c)
43. (d)
44. (b)
45. (d)
46. (a)
47. (c)
48. (c)
49. (c)
50. (b)

51. (a)
52. (c)
53. (c)
54. (c)
55. (d)
56. (c)
57. (a)
58. (b)
59. (c)
60. (d)
61. (a)
62. (c)
63. (c)
64. (c)
65. (c)
66. (b)
67. (b)
68. (d)
69. (c)
70. (d)
71. (b)
72. (a)
73. (c)
74. (d)
75. (b)

76. (b)

77. (d)

78. (e)

79. (c)

80. (b)

81. (b)

82. (b)

83. (d)

84. (b)

85. 1900

86. (b)

87. (c)

88. (b)

89. (c)

90. (b)

91. (a)

92. (a)

93. (c)

94. (c)

95. (b)

96. (a)

97. (c)

98. 20

99. 15

100. 11

101. 20

102. 70,000

103. (d)

104. (b)

105. (a)

106. (d)

107. (a)

108. (b)

109. (d)

110. 48 min

111. (c)

112. 4000

113. (c)

114. (a)

115. (d)

116. (a)

117. (b)

118. 50kmph

119. (d)

120. 105

121. (b)

122. 5 km

123. 15 h

124. (d)

125. 60

126. 12 min

127. 121000

128. (b)

129. (d)

130. (a)

131. (d)

132. (c)

133. (b)

134. (b)

135. (c)

136. (20,920)

137. (10.27 AM)

138. (d)

139. (c)

140. 48 seconds

141. (b)

142. (a)

143. (c)

144. 80

145. (b)

146. (b)

147. (b)

148. (a)

149. (a)

150. 880

151. (d)

152. (a)

153. (c)

154. 9

155. (c)

156. 20

157. (c)

158. (a)

159. (b)

160. 13 men

Solutions

1. Since the number of goats at the end is the same as the number of goats at the start, the value of p would be greater than q (since the percentage increase is always greater in value than the percentage decrease.) For instance 100 is increased by 25% to go to 125, it needs to be dropped by 20% to get back to 100 (the increase is always greater than the decrease percentage), option (c).

2. The equation that will fit the situation is: $S = 42 - K\sqrt{n}$. At $n = 9$, $S = 24$. Thus, putting these values in the equation we get: $24 = 42 - 3K$. Hence, $K = 6$. So the equation becomes $42 - 6\sqrt{n}$. At $n = 49$, the value of S would become equal to 0, thus, the railway engine can carry a maximum of 48 compartments, option (b).

3. For 25 boarders, the total cost is ₹17,500 and for 50 boarders, the total cost is 30000. Thus, the cost is increasing by ₹12,500 when 25 new boarders are added to the boarding house. Thus, the variable cost is ₹500

per boarder (12500/25). So for 100 boarders, the total cost would be ₹30000 + ₹25000 = ₹55000. The required average is 55000/100 = ₹550

Alternately, you can solve this through equations as follows:

Let 'a' be the fixed cost and 'b' the variable cost

According to the question:

$700 \times 25 = a + 25b(1)$

$600 \times 50 = a + 50\,b(2)$

Solving the equation (1) and (2), we get

$a = 5000, b = 500$

Let the average expense of 100 boarders be 'X'.

Then

$100 \times X = 5000 + (500 \times 100)$

$\therefore X = 550$

4. Forty per cent are men and 60 per cent are women. Out of the men category, 75 per cent earn more than 25000 per year. Thus, a total of 30 per cent of the total employees of the company are males who earn more than 25000 per year. Since, there are a total of 45 per cent of the employees who earn more than 25000 per year, it means that out of the 60 per cent who are women 15 per cent earn more than 25000 and 45 per cent earn ₹25000 or less than that per year. Thus, the required ratio is 3/4, option (d).

5. The distance between Ahmedabad and Baroda being 100 kms, it is evident that by 7:30 am, Navjivan Express would have covered 50 kms (travelling @ 50 kmph for 1 hour), while the Howrah-Ahmedabad Express would

have covered 20 kms (travelling 40 kmph for 30 minutes). Thus, the distance between the two trains would be 30 kms at 7:30 am. Since their relative speed is 90 kmph, the remaining distance of 30 kms would be covered in 1/3rd of an hour – or 20 minutes. Option (b)is correct.

6. If we mix 8 grams of sucrose to 1 gram of saccharine, we would have 9 grams with a sweetness quotient of 683. The average sweetness would be 683/9 = 75.88 which is greater than 100 times the sweetness of sucrose. If we mix 9 grams of sucrose to 1 gram of saccharine, the average would be below 74. Hence, Option (b) is the required answer.

7. The average sweetness of the mixture as defined would be: (1 × 0.74 + 2 × 1 + 3 × 1.7)/6 = 7.84/6 = 1.306. Thus, option (a) is correct.

8. As D is the midpoint of AC. So $AD = DC$

   Y covers two equal distances AD and CD with speeds 45 kmph and 55 kmph respectively. Therefore the average speed of y must be $\frac{2 \times 45 \times 55}{45 + 55}$ = 49.5 kmph.

   Alternately, you could also think of this as:

   The average speed for Y would be the weighted average of 45 and 55 in the ratio 55 : 45 (as the distance on both the segments AD and DC are equal). The value would be 49.5, option (b).

9. According to the question X and Y reach C at the same time therefore:

$$\frac{100 + BC}{61.875} = \frac{AC}{49.5}$$

$$BC = \sqrt{AC^2 - 100^2}$$

$$\frac{100+\sqrt{AC^2-100^2}}{61.875}=\frac{AC}{49.5}$$

Now put the value of *AC* from the option and check. We get that for *AC* = 105, LHS = RHS.

Alternately, you could think as follows.

Since *ABC* is a right triangle, and *D* is the midpoint of the hypotenuse *BD*, it would be half the length of the hypotenuse. Question 8 is asking for the length of *AC*, while question 9 is asking for the length of *BD*. Looking at the information contained in the question, it is evident that these distances would not come under the cannot be determined category. Thus, we can solve questions 8 and 9simultaneously by looking at a value for the answer to 9, which should be half the answer to question 8. Thus, the answer to question 8 is :105 km (as that is the only value that fits).

10. *AC* = 105 km and *D* is the midpoint of *AC*. So, *AD* = *DC* = *BD* = 105/2 = 52.5 km
11. The distance between City *A* and City *B* would be 45 × 2 + 35 × 2 = 160 kms (as per Rajiv's movement plan). Aditi would cover this distance in three equal parts of 53.33 kms @ of 30 kmph, 40 kmph and 50 kmph respectively.

    Petrol consumed by Aditi = 53.33/16 + 53.33/24 + 53.33/16 = 160/48 + 160/72 + 160/48 = 640/72 = 8.9 liters, option (c).

12. The distance between City *A* and City *B* would be 45 × 2 + 35 × 2 = 160 kms (as per Rajiv's movement plan). Aditi would cover this distance in three equal parts of 53.33 kms @ of 30 kmph, 40 kmph and 50 kmph respectively.

In order to minimise the amount of petrol consumed, the journey should be traversed at 40 kmph (since the Highest mileage for the car is at that speed). Thus, the amount of fuel required would be 160/24 = 6.67 liters, option (a).

13. We can use the principle of set theory here directly.

    78 = 50% + 30% + 20% – (I intersection II) – (I intersection III) – (II intersection III) + 5%

    Hence, (I Intersection II) + (I Intersection III)+ (II Intersection III) = 27%
    Hence, people who favored exactly 2 would be 27 – 5 – 5 – 5 = 12%.

    People favoring more than one = 12 + 5 = 17%.

14. If the fuel efficiency at 50 km/h is 19.5 km/liter, then at 70 km/h, the fuel efficiency would be 15 km per liter (since it uses 30% more fuel when it travels at 70 km/h as compared to traveling at 50 km/h). @ 15 km/liter, the truck would travel 150 kms in 10 liters of fuel.

15. The average of the 5 consecutive integers is the middle integer which is third integer, and the average of the 7 consecutive integers is the middle integer which is the fourth integer. Hence, it is one more than the average of five consecutive integers.
    This can be verified experimentally by taking any 7 consecutive integers and checking for the averages of the first five and all 7 respectively. You can easily see that the average of all 7 would always be 1 more than the average of the first five of these integers.

16. We can solve this problem by taking the weight of the heaviest box from the options.

Option (a): If the weight of the heaviest box is 60 kg then to arrive at 121 kg, the other box will have to weigh 61 kg so this option can never be true.

Option (c): If the weight of the heaviest box is 64 then to get a total of 121 kg, the other weight will have to be 57 and to get a total 120 kg, the next box shall have a weight 63 kg. In this case the maximum possible total weight of the two boxes would be 64 + 63 = 127, which is again not possible.

Option (b): If the weight of the heaviest box is 62 kg then second heaviest box = 121 – 62 = 59 kg.

Other possible combinations are 120 = 62 + 58, 118 = 62 + 56, 117 = 59 + 58, 116 = 62 + 54, 115 = 59 + 56, 113 = 59 + 54, 112 = 58 + 54, 110 = 56 + 54.

Thus, the weights of five boxes are 62, 59, 58, 56, 54 kg.

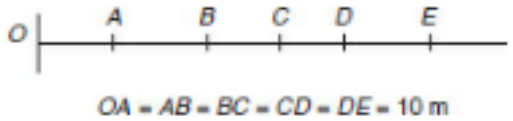
Hence, Option (b) is correct.

17. Number of people below 35 years = 30 + 17.75 + 17 = 64.75% of total population = 400 million

Total population = 617.76 million

Population below 15 years = 30% of 617.76 million = 185.32 million

Number of females in the below 15 age group = $\frac{0.96}{1.96} \times 185.32 = 90.8$ million

18. 

After receiving the message from *A* and *D* the robot begins to move to give material to machine *A* and then to machine *D*, it thus covers 10 + 30 = 40. It will take 4 seconds to reach *D*.

Then it returns back to the origin and covers 40 m again. When it arrives at the origin (after 8 seconds from beginning), the messages of *B* and *C* are already there, thus it moves to give the material to *B* and *C* and returns back to origin, for which it covers 30 + 30 = 60 m in total.

Hence, the total distance travelled by the robot (when it notices the message of *E*) will be 40 m + 40 m + 60 m = 140 m.

19. The robot's travel would be from *A* to *D* to second raw material station (as that would be closer), a distance of 60 meters covered by the end of the sixth second. It would see the messages from *C* and *B* when it reaches the second station and move towards *C* and then *B* and then go on to the origin. *A* total of 120 meters would be traversed before it sees the message from *E*.

20. Since his marks are in the ratio 6 : 7 : 8 : 9 : 10, we can assume the values of the numbers to be $6x$, $7x$, $8x$, $9x$ and $10x$. The average would be 8x and since the average is 60%, $x = 7.5\%$. Hence, he would get over 50 per cent marks in four subjects.

21. The following table can be constructed for solving this question:
We also know that $x + 8542 - 2x = 2910$. Solving for x, we get $x = 5632$.
Hence, Option (c) is correct

22. This question has to be seen from the perspective of the work done by the escalator. Since the ratio of speeds of walking of Shyama and Vyom is 3 : 2, when Shyama take 25 steps, Vyom would take 16.66 steps. Let us say that the escalator would do x steps of work in this time. The value of x would be such that $25 + x$ would be equal to the total number of steps. We also know that when Vyom walks up the escalator he does 20 steps. Hence, in the time Vyom does 20 steps, the escalator should do $1.2x$ steps. So $20 + 1.2x$ should also give us the same value for the total number of steps. This means that the work done by the escalator should be 20 per cent higher when Vyom reaches the top than the work that was done when Shyama reached the top. From this point you can go in two ways:

    (i) By equating $25 + x = 20 + 1.2x \rightarrow x = 25$. Hence, the escalator has 50 steps.

    (ii) By going through options, we can easily see that if the escalator had 50 steps, then there would be a coverage of 25 steps for Shyama and 30 for Vyom which represents the required increase of 20 per cent.

23. A's work is 25 per cent, B's work is 12.5 per cent, C's work is 6.25 per cent and D's work is 3.125 per cent. It is evident that if we take A and D together, they would take two-thirds the time of the other pair since the work ratio would be 3 : 2.

24. Solving through options, the most convenient option to check is option (c). Since we are going to do percentage calculations— the vision you need to see this comes from the first information itself, which says that Asit takes 6 hours more than all the three take working together. If you were to take 40 minutes as the value, Asit would be 400 giving conve-

nient percentage values of the work done by each person. You should realise that no other value gives as convenient values as this—hence at least this should be the first option to check for. Testing this option we get—Work done by all three per minute = 2.5% of the work.

Time taken by Asit = 400 minutes. Hence, work done per minute = 0.25%

Time taken by Arnold = 100 minutes.

Hence, work done per minute = 1%

Time taken by Afzal = 80 minutes. Hence, work done per minute = 1.25%

We can see that 2.5 = 0.25 + 1 + 1.25. Hence, this is the correct option.

It is a moot point that the first option we tried itself worked!! Were we lucky?? Not really. Try changing the other incorrect options forcefully and putting in whatever option you might want to insert. Can you create an option within a reasonable range of values where all the three times for Asit, Arnold and Afzal would be a convenient number so that the percentage values fit in?? Chances are you might not be able to find another single value which creates such 'convenient' decimals!!

25. Solve using sum of APs to get 93,300.

26. In a normal year, for the same, date the day of the week is advanced by 1, while for leap years the same is advanced by 2 days. Calculating backwards, we get 30 + 8 = 38. Gives 38/7 = + 3 giving us a Thursday.

27. At 60 kmph she consumes 4 liters per hour or goes 15 km per liter. Hence, she would use 200/15 = 13.33 liters of petrol for the journey.

28. The fuel consumption at 40 km/h = $\frac{200}{40} \times 2.5 = 12.5$ L

The fuel consumption at 60 km/h = $\frac{200}{60} \times 4 = 13.33$ L

The fuel consumption at 80 km/h = $\frac{200}{80} \times 7.9 = 19.75$ L

So, Manisha has to decrease the speed.

The fuel efficiency per liter can be seen to be 15 kmpl at speeds of 60 km/h – This has to be interpreted as: In one hour she travels 60 km (@60 km/h) and consumes 4 liters of fuel. Hence, her fuel consumption is 15 kmpl. If she increases her speed from 60 km/h, the graph clearly shows that her fuel consumption goes down. However, if she reduces her speed, her fuel efficiency goes up to 16 kmpl. Hence, she should reduce her speed.

29. Solve through options using unitary method. If the race was 36 meters long, the ratio of distances would be 36:24:18. This would not translate to a winning distance of 8 meters for *B* over *C*. For the second option, if the race was 48 meters, the ratio would be 48 : 36 : 30. This would translate into a ratio of *B* : *C* as 48 : 40 giving *B* a win by 8 meters as required in the problem. Hence, this answer is correct.

30. It can be seen that in effect the train *Y* is starting at 11:15 AM. In the 15 minutes that *Y* is stopping, only *X* would be covering some distance. That distance would be equal to 17.5 km. Hence, the remaining distance of 162.5 km would have to be covered by them together at a relative speed of 120 kmph. This would take 162.5/120 hours. The distance from A would then be given by: 17.5 + (162.5/120) × 70 = 112 km approx.

31. In both the cases, the price of the painting would reduce by the same percentage value. Going through the options, it is evident that options

(b) and (d) would not be correct since, if we start with those options, we would find that a drop of 441 itself would take the value lower than 1944.81 (which we need after 2 such drops). Even on trying to reduce 2500 consecutively in such a manner that it reduces by 441 the first time and replicating the same percentage change the second time too—our end value would be much lower than the required 1944.81. Hence, the only possible answer, which fits the situation is 2756.25, which is the correct answer.

32. As the value of average of remaining numbers has 17 in the denominator so the value of the number of the remaining numbers must be an integer multiple of 17 and the average of these numbers must be greater than 35.

So the original number of numbers must be $17k + 1$ (18, 35, 52, 69.....)

Average of n consecutive numbers = $\frac{n+1}{2}$

For n = 18, 35, 52 the average would be 9.5, 18 and 26.5 respectively. So we can rule out these possibilities.

Now check for n = 69 the sum of total 69 numbers = $\frac{69(69+1)}{2}$ = 2415.

Sum of remaining 68 numbers = $35\frac{7}{17} \times 68 \times 68 = 2408$

This gives us that the number to be erased must be 7.

33. Given that the average of X and Y is 79, the ratio of the number of students in the two classes would be 3 : 4. (Using Alligation) Also, the ratio of number of students in Y and Z would be 4 : 5. Hence, the overall average would be 3 : 4 : 5.

Using weighted average the required average = $\frac{3\times83+4\times76+5\times85}{3+4+5}$ = 81.5

34. Efficiency is inversely proportional to the time taken to complete the work. So if B takes double the time taken by A, his efficiency is half that of A. Let the efficiencies of D, C, B and A are X, $2X$, $4X$ and $8X$ respectively.

According to the question, one pair takes two-thirds the time needed by the second pair to complete the work. It means, one pair has $\frac{1}{2} = \frac{3}{2}$ times the efficiency of the second pair.

The combined efficiency of A and $D = X + 8X = 9X$.

The combined efficiency of B and $C = 2X + 4X = 6X$.

Hence, A and D is the first pair.
Alternate solution:

A's work is 25 per cent, B's work is 12.5 per cent, C's works 6.25 per cent and D's works 3.125 per cent. It is evident that if we take A and D together, they would take two-thirds the time of the other pair since the work ratio would be 3 : 2.

35. Let there be a total of n people the college will ask for donations.

Amount raised from the people solicited = $600 \times 0.6n = 360n$

Let the total amount be x then $360n$ = 75% of x.

Hence 25% of $x = 120n$.

$\therefore$ Average donation from remaining people = $\frac{120\,n}{0.4n} = 300$

Alternative approach: According to the question 60% of the people have contributed 75% of the amount. Thus, each person has contributed 1.25% of the total amount.

Rest of the 40% of the people have to contribute 25% of the amount.

Thus, each person has contributed 0.625 % of the total amount (against 1.25% of first 60% people). Hence, the average contribution per person = 600/2 = ₹300.

36. Let x be the speed of Rahul, and v be the rate of current (in mph.)

$$\frac{12}{x-v}-\frac{12}{(x+v)}=6 \Rightarrow \frac{v}{x^2-v^2}=\frac{1}{4} \qquad (1)$$

$$\frac{12}{2x-v}-\frac{12}{(2x+v)}=1.2 \Rightarrow \frac{v}{4x^2-v^2}=\frac{1}{20} \qquad (2)$$

By solving equations (1) and (2) we get speed of current = 1.33 or 4/3 mph.

37. In 20 kg of fresh grapes –water = 18 kg and grape = 2 kg. The grape becomes 80 per cent of the total in the dried grape. Hence, the required weight is 2.5 kg.

38. *BA* is higher than MBA_2, but we can't set a relation in between *BA* and MBA_1. Hence, the correct answer is option (d).

39. Since only runs are getting added without any addition of innings, the value of *BA* will definitely increase. However, for MBA_2 in a ratio of 50, we are adding a ratio of 45 (less than 50) it definitely decreases. This will definitely reduce the value of MBA_2. Hence, Option (b) is the correct.

40. Let the initial distance between train and point *A* be x and speed of train and cat be t & c respectively.

Now according to the question: $\frac{x}{t}=\frac{\frac{3d}{8}}{c}$ or

$$x = \frac{\left(\frac{3d}{8}\right)t}{c} \ldots \quad (1)$$

$$\text{and} \quad \frac{x+d}{t} = \frac{\frac{5d}{8}}{c} \text{ or } x + d = \frac{\left(\frac{5d}{8}\right)t}{c} \quad (2)$$

By subtracting equation 2 from equation 1 we get $d = \frac{\left(\frac{2d}{8}\right)t}{c}$ or $\frac{t}{c} = \frac{4}{1}$. Option (b).

Alternate solution: Assume the distance of the tunnel to be $8x$. Initially the cat is at $3x$ from A and $5x$ from B. Now if you were to use the options, to check which option fits the situation, you would realize the following with Option (b) – speed ratio is 4 : 1:

For the meeting at A: cat travels $3x$, train travels $12x$.

For the meeting at B: cat travels $5x$, train travels $12x + 8x = 20x$. This matches the given 4 : 1 ratio and hence is the correct answer.

(**Note:** If you try this with the other options, the meeting at B would not match the given ratio.)

41. Efficiency of three small pumps = Efficiency of two large pumps

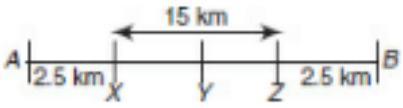
Efficiency of (Three small + One large pumps) = Efficiency of three large pumps

∴ 1/3rd of the total time is taken by the large pump alone.

Alternately, you could think of this as follows:

Efficiency of the small pump = 2, Efficiency of the large pump = 3.

Efficiency of 3 small pumps and 1 large pump = 9 (is three times the efficiency of a large pump alone). Hence, the time taken would be 1/3rd of the time.

42. 

Let X, Y and Z be the three gutters let XY be $x/2$ km and YZ be x km.

According to the question $\frac{AX}{30} = \frac{5}{60}$ or AX = 2.5 km

$AX + x/2 + x + BX$ = 20 km

$2.5 + 3x/2 + 2.5$ = 20 km

$3x/2$ = 15 km

After crossing the gutter 1 he doubled his speed so final speed was 60 kmph.

Time taken to cover distance XZ and ZA = $\frac{(15 + 17.5)\text{ km}}{2 \times 30\text{ km/hr}} = \frac{32.5}{60} \times 60 = 32.5$ minutes

The patient reaches the hospital in a total of (32.5 + 5) = 37.5 minutes

Maximum time that the doctor gets to attend the patient = 40 – 37.5 – 1 = 1.5 minutes.

43. Check the options

Option (b): Speed ratio is 4 : 1. If the north bound train takes 12 min then the south bound train would take 48 minutes. As per the questions on that particular day the north bound train is late by 20 minutes, there are only 40 minutes left to complete the journey for both the trains. If the super fast doubles the speed then it would take only 6 minutes to com-

plete the journey. So, the second train would take 40 – 6 = 34 minutes. Hence the required ratio of the speed is 6: 34 ≡ 1 : 6.

44. The result of increasing the average by 1.8 is that the sum goes up by 18. This would happen because the one number which is tampered with would go up by 18. This can only happen if $b - a = 2$. (Interpret this as: the number is such that it increases by 18 when the digits are interchanged.)

45. Sixty man-hours are required. At 5 pm, 24 man-hours would be left which would be provided as 7 + 8 + 9 between 5 – 6, 6 – 7 and 7 – 8 respectively. The server gets completed at 8 pm.

Solutions for Questions 46 to 48:

The paths traversed by the three people can be seen to be $6r$, $6r + 3r\sqrt{3}$ and $6r + 6r\sqrt{3}$.

(**Note:** These are derived by using the properties of 30 – 60 – 90 triangles. For instance, if you connect $A2$ with $B2$ and make a perpendicular from $A2$ to the path connecting $B2B3$, you would get a 30 – 60 – 90 triangle. You would get similar triangles at each of the corners.

46. It can be clearly seen that $b - a = c - b = 3r\sqrt{3}$. Hence, option (a) is correct.

47. Assume the value of r to be 30. Then, total time taken by the first sprinter A would be: $\frac{180}{3+2+4}$ = 9 hours. In 9 hours, B would also come back to her starting point as she would cover a distance of $180 + 90\sqrt{3}$ at a speed of $20 + 10\sqrt{3}$. Hence, B would be at her starting point $B2$. In the same time, C would be able to cover 2 parts of her three part journey. This can be thought of as: she has to cover a distance of $60 + 60\sqrt{3}$ on each side and

her speed for the first two sides is $13.33 + 13.33\sqrt{3}$. Hence, she would take $60/13.33 = 4.5$ hours per side. Thus, C would be at C_3. Hence, option (c) is correct i.e. B is at B_2 and C at C_3.

48. The ratio of squares of the speeds is given as the ratio of the areas of the respective triangles. Since all the three triangles are equilateral triangles, their areas would be proportional to the squares of the sides. Hence, $u_2 : v_2 : w_2 = 4 : (2 + \sqrt{3})_2 : 4(1 + 2\sqrt{3})_2$.

    Thus, $u : v : w = 2 : (2 + \sqrt{3}) : 2(1 + 2\sqrt{3})$. Also, we know that one side of B's triangle is: $r(2 + \sqrt{3})$. So, in the time B reaches $B3$ after covering one side, A would also cover one side and reach A_2, while C would reach C_2. Hence, option (c) is correct.

49. The following thought structure would give us the answer—

    100(2001 start) → 50 → 150 (2002 start) → 75 → 225(2003 start) → 112.5 → 337.5(2004 start).

    Thus, in this context, we can see that we expect a destruction of 168.75 huts, which is less than the total number of huts destroyed in 2002 and 2003. Option (c) is correct.

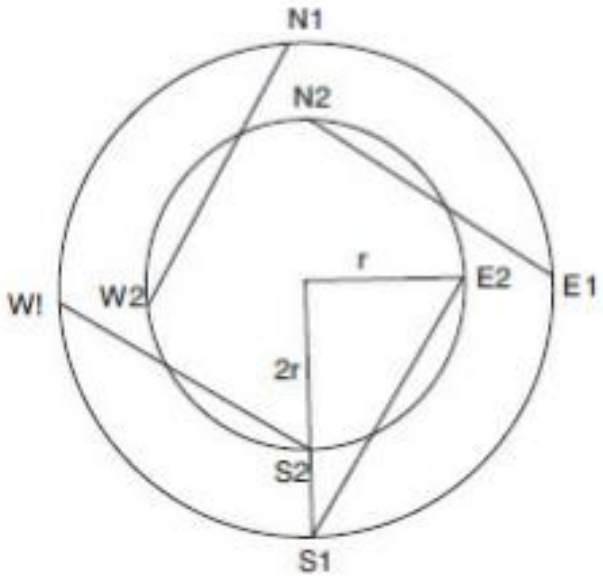
50. Draw triangle ABC with angle $BAC = 120_0$, $AB = 12$, $AC = 8$.
    By cosine formula, BC = root(304).

    Time difference = $[(CB + BA)/2] - [(BC + CA)/3]$

    This gives the answer as option (b).

51. The third and fourth options do not match the production constraints on machine B. Option (a) gives a profit of $75 \times 20 + 80 \times 30 = 3900$, while option (b) gives a profit of $100 \times 20 + 60 \times 30 = 3800$. Hence, option (a) is correct.

Solutions for Questions 52 to 54: The given figure would show the road network described in the question.



52. From the figure it is clear that the length of the chord road is $r\sqrt{5}$, which means that the length of the four chord roads is $4r\sqrt{5}$, while the length of OR is $4pr$. Hence, the required ratio would be $\sqrt{5}/p$, option (c).

53. The total distance on the chord road would be $r\sqrt{5}$, while on the OR it would be pr. If we take the value of the radius of the outer ring road as 30 (from the options, we would see that he would require 1 hour on the chord road and 30 minutes on the outer ring road—to give 90 minutes. Hence, Option (c) is correct.

54. Since the value of r is 15 for the previous question, the distance covered on the chord road will be $15\sqrt{5}$ while the distance of the inner ring road would be 15π. The total time taken would be 1 hour + 30 minutes = 90 minutes, option (c).

55. Since *R* has paid only 2 Euros (an equivalent of 92 bahts), he would have to further pay 324 Bahts more. Option (d) is correct.

56. The total cost of the three perfumes would be 520 + 364 + 364 = 1248. Thus, each person would have to pay 1248/3 = 416 bahts. *M* has paid 4 Euros + 27 bahts which adds up to 211 bahts. So he has to pay 205 Bahts to *S*. This would convert to 5 US Dollars, option (c).

57. If he sells 25 liters of the mixture of milk and water, he would be left with 15 and 60 liters respectively. When 25 liters of water of is mixed in this, the quantities would become 40 and 60. Thus the required ratio = 40 : 60 = 2 : 3

58. The given situation can be interpreted as: When he increases his speed by 50 per cent, the time taken reduces by 33.33 per cent. So, the time reduction of 2 hours (Reaching the destination at 11 a.m. instead of 1 p.m.) represents a 33.33 per cent reduction from the original time required. Hence the original time was 6 hours. Now if the man wants to reach at noon he wants a reduction of 1 hour, which would mean a drop of 16.66 per cent in the time required. This can be achieved by increasing the speed by 20 per cent. Hence, the required speed to reach at noon would be 12 km/hr option (b).

59. Relative speed of the boats = 5 + 10 = 15 kmph

    Distance between boats 1 minute before collision = $\frac{1}{60} \times 15 = \frac{1}{4}$km.

60. Since Karan beats Arjun by 10 meters in a 100 meter race, it means that their ratio of speeds is 10:9. Hence, when Karan has 110 meters to move, Arjun would do 99 meters. Hence, Karan would still beat Arjun by 1 meter option (d).

61. It can be seen that if Group *C* has 2 questions, then at least 60 per cent marks criteria for Group *A* cannot be fulfilled. The scenario works out as:

Group *B* = 23 questions, 46 marks, Group *C* = 2 questions, 6 marks, Group *A* = 75 questions, 75 marks. Percentage of marks in Group *A* = 75/127 < 60.

However, if we take *C* = 1 question, the condition is fulfilled.

Group *B* = 23 questions, 46 marks, Group *C* = 1 question, 3 marks, Group *A* = 76 questions, 76 marks. Percentage of marks Group *A* = 76/125 > 60.

Hence, we will mark option (a).

62. The following scenarios can get worked out. First test for 12 questions in group B.

	Number of Questions	*Number of marks*	*% of marks*
Group *A*	80	80	> 60
Group *B*	12	24	< 20
Group *C*	8	24	
Total	100	128	

Conditions not satisfied, hence reject both options (a) and (b).

Now test for 13 questions in Group *B*.

	Number of Questions	*Number of marks*	*% of marks*
Group *A*	79	79	> 60
Group *B*	13	26	> 20
Group *C*	8	24	
Total	100	129	

Hence, the third option is correct.

It can be reasoned that for 15 questions in Group *B*, the Group *A* marks condition (at least 60 per cent marks in group *A*) is rejected.

63. In every time segment, the sprinter would run pr/2 meters. Hence, the sprinter would take 4 time segments to run one round. So, if for one round she takes 1 + 2 + 4 + 8 = 15 minutes, for the next she would take 16 + 32 + 64 + 128 = 240 minutes. Hence, the required ratio of time would be 1 : 16, option (c).

64. The first machine would make 1000 nuts in 10 minutes and then be cleaned for 5 minutes (a gross block of 15 minutes), while the other machine would make 1500 bolts in 20 minutes and would be cleaned for 10 minutes (a gross block of 30 minutes). For 9000 nuts you would require 8 blocks of 15 minutes and 10 minutes more of production – a total of 130 minutes while for 9000 bolts you would require 5 blocks of 30 minutes and 20 minutes more – a total of 170 minutes. Hence, 170 minutes would be required to make the required 9000 pairs of nuts and bolts, option (c).

65.

Tank	Net inflow/ outflow (In Liter/ minute)
A	Inflow (60)
B	Inflow (30)
C	Outflow (40)
D	Outflow (50)

So, tank *D* would get emptied first and it would take 1000/50 = 20 minutes.

66. At 10 AM, Ram is at point *B* and Shyam is 2.5 km away from *A*.

Distance between Ram and Shyam at 10 AM = 2.5 km

Now Ram starts running toward *A* and Shyam continues his movement towards *B*.

So, they are running in opposite direction with relative speed = 5 + 10 = 15 kmph.

Hence, they meet each other after 10 minutes or at 10:10 AM.

67. When Ram turns around at 10AM, Shyam is still moving towards *B*. Shyam reaches *B* at 10:15 and then turns back to start catching up on Ram. At 10:15, Ram would be 1.25 kilometers into his return journey – and there on their relative speed would be 5 kmph.

    The time at which Shyam overtake Ram = 1.25/5 = 0.25 hours OR 15 minutes (after 10:15 AM).

    Hence, Shyam overtakes Ram at 10:30 AM.

68. It is obvious that the female operators are cheaper—₹300 + ₹10 × 50 = ₹800 for 50 calls (per call cost of ₹16). For male operators, this cost = ₹250 + 15 × 40 = ₹850 for 40 calls. Hence, the service provider should employ as many female operators as possible—and consequently,he should hire all the 12 female operators available for the job. These operators would take care of 12 × 50 = 600 calls, which means that the remaining calls have to be handled by the male operators. Since there are residual 400 calls left, there should be 400/40 = 10 male operators, option (d).
69. If Arun started at 12 noon, Barun starts at 2 pm and will catch up at 8 pm. So, we need to see which of the options will give us an exact 8 pm meeting point for Arun and Kiranmala.

If Kiranmala starts at 4 pm, then the gap with Arun would be 120 km and would be covered in exactly 4 hours so that Kiranmala would overtake Arun at 8 pm. Hence, option (c) is correct.

70. Let the free allowed luggage be X. As Praja is charged exactly double than that of Raja. It means if Raja carries Y kg of excess luggage (OR $X + Y$ kg of total luggage) then Praja carries $2Y$ kg (or $X + 2y$ kg of total luggage).

    Total luggage = $X + Y + X + 2Y = 2X + 3Y$. The excess luggage charges are 1200 and 2400, which means that for Y kgs of extra luggage we are charged ₹1200 extra. Thus, if only one person traveled, the excess luggage would be $5400/1200 = 4.5Y$.

    Thus, $2X + 3Y = X + 4.5Y \rightarrow X = 1.5Y$. Also, the total luggage is $2X + 3Y = 6Y = 60$ (given). Hence, $Y = 10$ and $X = 1.5Y = 15$.

    Hence, Praja's luggage would be $X + 2Y = 15 + 20 = 35$.

71. The free luggage allowance is $X = 15$ kg. Option (c).

72. $a = 1 \times 2 \times 1 \times 3 \times 1 = 6$.

    $b = 3 \times 2 \times 1 \times 3 \times 1 = 18$

    $c = 3 \times 1 \times 1 \times 3 \times 1 = 9$

    $d = 3 \times 1 \times 2 \times 3 \times 1 = 18$

    $e = 3 \times 1 \times 2 \times 1 \times 1 = 6$

    $f = 3 \times 1 \times 2 \times 1 \times 4 = 24$

    Thus $abc/def = 6 \times 18 \times 9/18 \times 6 \times 24 = 3/8$, option (a). Estimated time for solution 55 – 65 seconds.

73. From statement 1: W_I = 44.5kg, W_{II} = 45.5 kg

After using statement *B* we get the weight of Deepak = 70 kg. So, this is sufficient to get the weight of Poonam using the given statements. Option (c) is correct.

Solutions for Questions 74 and 75: Experience tells us that most students got stuck in this problem because they got stuck in equation creation and the infeasible thought processes. The correct thought process would give you the solution to this question in less than 45 seconds after reading the question fully. For this process, you need to get the following reactions:

Deduction 1: Since the plane flies at 8 am from City *B* and lands back at 8 pm the same day, the round trip takes 12 hours, out of which 1 hour is spent at City *A* (where it lands at 3 pm local time and takes off at 4 pm local time). Hence, the total flying time is 11 hours.

Deduction 2: Go into the options for question 51. Since the distance is 3000 and the speed of the wind is 50 kmph, options (a), (c) and (d) cannot give you an answer. WHY?? Simply because for option (a) to work we would need 3000/650 + 3000/750 to be equal to 11 hours. Leave alone 11, this will not even give us an integral answer hence we do not need to check this option' Similarly options (d) and (c) will not work as they would not give integral values for the above expression. Checking option (b), we get 3000/500 + 3000/600 = 11 hours. Hence, the cruising speed of the plane would be 550.

Deduction 3: Since we are now equipped with the answer to question 51, we can easily go back to question 50 and realise that the plane would take six hours to reach City A from City *B*. Thus, the time difference would be 1 hour, option (d).

76. According to the question when we increase the production from 20 to 40 then daily production cost increases by 66.66%. It means

$$\frac{(240 + 40b + 40^2c) - (240 + 20b + 20^2c)}{240 + 20b + 20^2c} = \frac{2}{3} \qquad (1)$$

It is also given that when we increase the production from 40 to 60 then daily production cost increases by 50 %.

$$\frac{(240 + 60b + 60^2c) - (240 + 40b + 40^2c)}{240 + 40b + 40^2c} = \frac{1}{2} \qquad (2)$$

By solving equation 1 and equation 2 we get $c = \frac{1}{10}$ and $b = 10$

Cost for production of x units = $240 + 10x + \frac{x^2}{10}$

Profit earned from x units = $\left(30x - 240 - 10x - \frac{x^2}{10}\right)$

To maximize the profit, $x - 100$ should be equal to 0.

$\Rightarrow x = 100$

77. Maximum profit = 760, option (d).

78. Solve this question while reading the statements (and react as you read).

Ten years ago, the ages of the members of a joint family of eight people added up to 231 years. **Reaction:** 10 years ago, total age is 231. Three years later, one member died at the age of 60 years and a child was born during the same year.

Reaction: 7 years ago, total age would be 231 + 24 – 60 = 195

After another three years, one more member died, again at 60, and a child was born during the same year.

Reaction: 4 years ago, total age would be 195 + 24 – 60 = 159

The current average age of this eight member joint family is nearest to

Reaction: Total age today is 159 + 32 = 191.

Hence, the average age is 191/8 = 24 (approx) (a) 23 years (b) 22 years (c) 21 years (d) 25 years (e) 24 years Thus, option (e) is correct.

Solutions for Questions 79 and 80: To solve this question, proceed from Question 74. **Note:** This is a very common structure used in the CAT, where you have a set of two questions and starting from the second has a lot of advantages. Question 74 asks us to identify the investment scheme that would give us the maximum value of the minimum guaranteed return. For this purpose we need to see the minimum return which each investment ratio will give us, and compare this across different options. **Note:** The minimum guaranteed return would be the least return to be expected in the worst case scenario for a particular investment ratio. Although the amount of working in this question might seem to be high, you should realise that the value of the minimum guaranteed return which we would discover through this question would also answer the previous question for us. Thus, we are playing for 6 marks when we are solving this question. The following thought process ensues:

(a) 100% in option *A* – Return 0.1%

(b) 36% in option *B* and 64% in option *C* – If stock market rises:

Return = 0.05 × 36 – 0.025 × 64 = 36/20 – 64/40 = 1.8–1.6 = 0.2% If stock market falls:

Return = –0.03 × 36 + 0.02 × 64 = 1.28–1.08 = 0.2% Thus, in both cases the minimum guaranteed return is 0.2% for this option (the lower value has to be taken).

(c) 64% in Option (b) and 36% in option (c) If stock market rises:

Return = 0.05 × 64 – 0.025 × 36 = 64/20 – 36/40 = 3.2–0.9 = 2.3% If stock market falls:

Return = –0.03 × 64 + 0.02 × 36 = 0.72– 1.92 = –1.2%

Thus, for this case, the minimum guaranteed return is negative at –1.2%

(d) 1/3 in each of the three options If stock market rises:

Return = 0.05 × 33.33 + 0.001 × 33.33 – 0.025 × 33.33 = The return is less than 0.2% (Can be seen without calculating—with a little bit of weighted average thinking. Since this value is less than 0.2% even if the next value is higher than 0.2%, it would not raise the minimum guaranteed return in this case to over 0.2%.

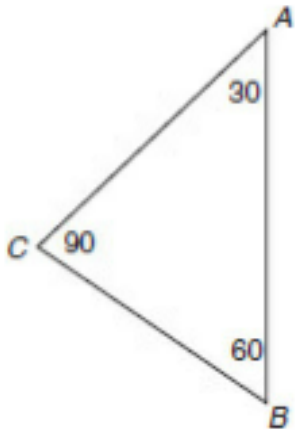
Hence, this option will not give the maximum value of the minimum guaranteed return.)

(e) 30% in option *A*, 32% in option *B* and 38% in option (c) If stock market rises: Return = 0.001 × 30 + 0.05 × 32 – 0.025 × 38 = 0.03 + 1.6 – 0.95 = 0.68 If stock market falls:

Return = 0.001 × 30 – 0.03 × 32 + 0.02 × 38 = 0.03 + 0.76 – 0.96 = negative return

Thus, Option (b) is the correct answer for 74. From Question 74 we also get the answer to question 73 as the value of the minimum guaranteed return is 0.2% (as seen in Option (b) of Question 74). Thus, Option (c) is the right answer for question 73.

81. The following figure will emerge for the triangle *ABC*. The triangle is a 30 – 60 – 90 triangle. Thus, *BC* would be 250 and *AC* would be $250\sqrt{3} = 432.5$ (approx). Since the train leaves *B* at 8 am, it would reach *C* at 1 pm and hence Rahim has to reach *C* by 12:45 pm—and he has to cover approximately 432.5 kms @ 70 kmph. This would take him around 6 hours 10 minutes + . In order to reach at 12:45 pm he should leave A at approximately 6:30, option (b).



82. The value of x must be odd because only with an odd value of x would you keep getting integers if you halved the value of rice and took out the another half of 1 kg from the shop store.

    Now let's start checking the options:

    Option (b): $x = 7$ kg

    $7 \rightarrow 3 \rightarrow 1 \rightarrow 0$

    It means $x = 7$ kg satisfies the given conditions. So this option is correct.

    Similarly, we can check the other options as well and see only Option (b) is correct.

83. Let x be the production of tea and y be the production of coffee.

    It is given that $x = 3y$.

$7 \rightarrow 3 \rightarrow 1 \rightarrow 0$

It means $x = 7$ kg satisfies the given conditions. So this option is correct.

Similarly, we can check the other options as well and see only Option (b) is correct.

83. Let x be the production of tea and y be the production of coffee.

It is given that $x = 3y$.

Also, $x(100 + a) + y(100 + b) = (x + y)(100 + 5c)$

$\Rightarrow x(a - 5c) = y(5c - b)$ i.e. $3a - 15c = 5c - b$ i.e. $3a + b = 20c$

Also, $x(100 + b) + y(100 + a) = (x + y)(100 + 3c)$

$\Rightarrow x(b - 3c) = y(3c - a)$i.e. $3b - 9c = 3c - a$ i.e. $a + 3b = 12c$ (ii) Eqn. (i) – 3 × Eqn. (ii) given, $3a + b = 20c$ $a + 3b = 12c$

$-8b = -16c$ i.e. $b = 2c$

$3a = 18c$ fi $a = 6c$

$a/b = 6c/2c = 3/1$

Hence, Option (d) is correct.

84. Solve through trial and error. Option (b) is correct.

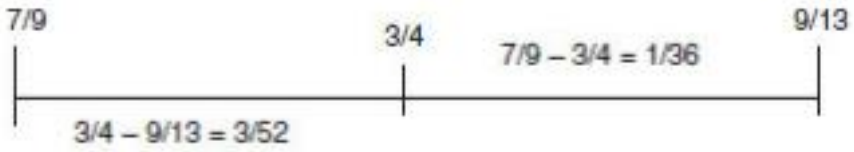
85. Ratio of speeds of A and B = 10 : 9

Ratio of speeds of B and C = 10 : 9

Ratio of speeds of A, B and C = 100 : 90 : 81

In 100 meters race A beats C by 100 – 81 = 19 m. Therefore, in a 10 km race A beats C by 1900 m.

86.



3/52: 1/36 = 108: 52 = 27: 13

87. Check the options: If he travels total 65 miles then he travelled 30 miles in his onward journey and 35 miles in his return journey.

For Option (c) time taken in onward journey = 30/60 = 30 minutes

Time taken in the return journey $= \frac{15}{25} + \frac{20}{50} = \frac{50}{50} = 1$ hour

Hence, this option is correct.

88. If we take the total number of shirts produced as 100, 15 would be defective and another 17 would be sold in the domestic market.

Hence 68 of the 100 shirts are exported– this number is given to us as 8840. Hence, total shirts produced is 13000.

89. Let the average height of the 22 toddlers be x inches. When the 2 toddlers are excluded, the average of the group increases by 2, i.e. it becomes $x + 2$. Also, given, that the average height of the 2 toddlers is one-third of the average height of the 22 toddlers or $x/3$.

$$\frac{\left[20(x+2)+2\cdot\frac{x}{3}\right]}{22} = x$$

$$22x = 20x + 40 + \frac{2x}{3}$$

$$\frac{4x}{3} = 40$$

Upon solving, $x = 30$ inches.

Average height of remaining 20 toddlers = $x + 2 = 30 + 2 = 32$ inches.

90. 100---------110---------143---------143 + 71.5 = 214.50% = 4290

100% = 2000

91. Let the capacity of the tank be 40 liters. Efficiency of the inlet pipe = 40/8 = 5 l/hr.

Efficiency of the outlet + inlet = 40/10 = 4 l/hr

Efficiency of the outlet pipe = 5 – 4 = 1 l/hr

Required time = (40/2)/1 = 20 hours.

92. Let him buy 'x' dozens of each type of candies. Then according to the question:

$16.50 \times 2x - 15x - 12x = 150$

$x = 25$

$2x = 50$ dozens.

93. Let initial production and population be 100, x respectively and the final production and population be 140 and y respectively. According to the question per capita production increases by 27%. Hence,

$$\frac{140}{y} = 1.27 \text{ of } \frac{100}{x}$$

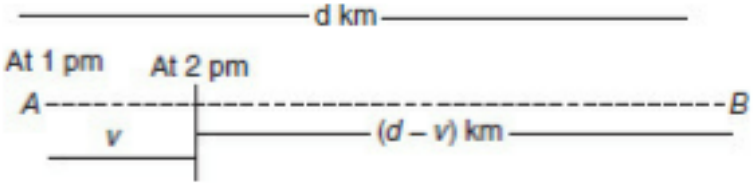
$$\frac{y}{x} = \frac{140}{127} \approx 1.10$$

Required percentage = 10%.

94. $a : b : c = 3 \times 2 : 4 \times 2 : 4 \times 1 = 6 : 8 : 4 = 3 : 4 : 2$

$3x + 4x + 2x = 9x$. Hence, the sum must be multiple of 9. Only option (c) is a multiple of 9. Hence, this option is correct.

95. Let the speeds of the motorbike at A and car at B be 'v' and '$2v$' respectively and the distance between A and B is 'd'. In the first hour between 1 to 2, the bike would cover 'v' km.



After 2 PM, Relative speed = $v + 2v = 3v$ kmph.

Total time required to meet = $\frac{d-v}{3v} = 1\frac{2}{3} = \frac{5}{3}$

$\frac{d-v}{v} = 5$ or $d = 6v$ or $v = d/6$.

Total distance travelled by bike = $\left(1\frac{2}{3}+1\right)\times v = \frac{8v}{3}$

= 168

v = 63 kmph

Total distance travelled by car = $1\frac{2}{3}\times 2v = \frac{10v}{3}$

= 210 KM

Total distance between A and B = 168 + 210

= 378 km.

96. Let the total work be 40 units. Let the efficiencies of Amal, Bimal and Kamal be a, b and c respectively. Then, $a = 40/10 = 4$, $b = 40/8 = 5$, $a + b + c = 40/4 = 10$

On solving we get, $c = 1$.

Kamal's share = $\frac{1}{1+4+5} \times 1000 = ₹100$

97. 4 liters of mixture A would have $\frac{4}{3}$liters of water and $\frac{8}{3}$liters of liquid A.

3 liters of mixture B would have $\frac{3}{4}$liters of water and $\frac{9}{4}$liters of liquid B.

2 liters of mixture C would have $\frac{2}{5}$liters of water and $\frac{8}{5}$liters of liquid C.

Total amount of water = $\frac{4}{3}+\frac{3}{4}+\frac{2}{5}=\frac{149}{60}$Liters.

Only option (c) is correct.

98. Let the ages of Arun and Barun be 4 and 10 years respectively. After 2 years Arun age will be half of the Barun's age. The required percentage = $\frac{2}{10} \times 100$

= 20%.

99. Let the total work = 120 units

Efficiency of each person = 120/120 = 1unit per day

Total work done on day 1 = 1

Total work done on day 2 = 1 + 1 = 2

Total work done on day n = 1 + 1 + 1....n times = n (Let the total work is finished in 'n' days)

$1 + 2 + 3 + ... + n = 120$

$\frac{n(n+1)}{2}=120$

$n(n + 1) = 240$ or $n = 15$ days.

100. Let the maximum possible number of people is 'n'.

To maximize the value of n we assume that only one person weighs 57 kg and rest of the persons weigh 53 kg.

$57 + (n-1)53 = 630$ or $(n-1)$

$$= \frac{630-57}{53} = \frac{573}{53} = 10.81$$

Therefore maximum possible value of $n-1 = 10$ or $n = 11$ persons.

101. Let's assume if the man travels at a speed of 'v' kmph and reaches station in time (in t minutes). Let the distance between station and home is 'd' km.

According to the question:

$$\frac{d}{12} = \frac{d}{v} + \frac{10}{60} \quad (1)$$

$$\frac{d}{15} = \frac{d}{v} - \frac{10}{60} \quad (2)$$

$$\frac{d}{12} - \frac{d}{15} = \frac{10}{60} + \frac{10}{60} = \frac{20}{60}$$

On solving we get: $d = 20$ km

Alternate method: The speed of walking is increasing by 25%, hence the time reduction would be 20% (as the distance is constant). This time reduction is 20 minutes and hence, the original time would be 100 minutes. The distance would be $12 \times \frac{100}{60} = 20$ km.

102. Of every 100 saving, Ravi would deposit 50 in an *FD*, 15 in stocks and 35 in his bank account. Hence, the total savings deposited in bank would be 85%, which is given to us as 59500.

Total monthly savings = $\frac{59500}{85} \times 100 = 70,000$

103. Using the *PCG* logic, it is quite clear that if the cost price is 100 and the retail price is 120, giving a discount of 15% would mean selling at 102 – and this would give a profit of 2%.
Thus, to get a profit of 20%, he must sell at retail price.

104. Let the speed of the river be v and the speed of the boat be u and the distance between the home of the man and his office be 'd' km and 't' is the initial time taken.

$$t = \frac{d}{u-v} + \frac{d}{u+v} \qquad (1)$$

$$\frac{t}{4} = \frac{d}{2u-v} + \frac{d}{2u+v} \qquad (2)$$

From equations (1) and (2) we get:

$$\frac{2u}{u^2-v^2} = \frac{16u}{4u^2-v^2}$$

$$4u^2 - v^2 = 8u^2 - 8v^2$$

$$4u^2 = 7v^2$$

$$\frac{u^2}{v^2} = \frac{7}{4} \text{ or } \frac{u}{v} = \sqrt{7} : 2$$

105. $C1 : C2 : C3 = 9 : 10 : 8 = 162 : 180 : 144$

$C2 : C4 : C5 = 18 : 19 : 20 = 180 : 190 : 200$

$C1 : C2 : C3 : C4 : C5 = 162 : 180 : 144 : 190 : 200$

If 200 – 162 = 38 → 19 crore

Then, (162 + 180 + 144 + 190 + 200 = 876) → $\frac{19}{38} \times 876 = 438$ crore.

106. Let 200 girls and 100 boys be appearing for the admission test. 60 girls and 45 boys get admission.

Total candidates who do not get admission = 200 + 100 – 60 – 45 = 195.

Required percentage = $\frac{195}{300} \times 100 = 65\%$.

107. Let the number of large, super, and jumbo packets of popcorn in its stock are $7x$, $17x$, $16x$ and the number of large, super, and jumbo packets of chips in its stock are $6y$, $15y$, $14y$.

$7x + 17x + 16x = 6y + 15y + 14y$

$40x = 35y$

$x : y = 7 : 8$

Required ratio = $16x : 14y = \frac{16}{14} \times \frac{7}{8} = 1 : 1$.

108. Let the price of good mangoes be ₹100 per kg.

Cost price = $80 \times 100 + 40 \times \frac{100}{2} = 10{,}000$

Selling price = $120 \times 90 = 10800$

Percentage profit = $\frac{800}{10{,}000} \times 100 = 8\%$.

109. If we take the Cost price of the 60 toys as 100, the marked price should be such that after a 40% discount on the marked price, the selling price of the items should be 120. A little bit of Percentage change graphic thinking explained in the chapter of percentages, would easily give you that the marked price should be 200. Since, 10 toys are destroyed, it means that 1/6th of the toys are destroyed. Thus, the marked price of the toys

on sale would be: 166.6666. To sell these at 120, we can find out what percent of 166.6666 is 120: Since: 120/166.666 = 360/500 = 0.72, this means that she should give a discount of 28%.

Alternately, you could also solve this question going through mathematical equations as follows – but this would take significantly more time:

Let the marked price of one toy be ₹X and the cost price be ₹Y.

According to the question:

$0.6X = 1.2Y$

$X = 2Y$

Cost price of 60 toys = $60Y$

After destruction of 10 toys only 50 are remaining.
(If 'p' is the offered discount), then:

Then, $X(1 - p) \times 50 = 72Y$

$1 - p = 0.72$ or $p = 28\%$.

110. Let the efficiency of inlet of type A and inlet of type B be 'a' and 'b' respectively and the capacity of tank be 'c'.

According to the question:

$(10a + 45b) \times \frac{1}{2} = 8a + 18b \rightarrow$

$a = 1.5b$.

Thus, the total work in terms of 'b' would be $8a + 18b = 12b + 18b = 30b$.

If seven inlets of A and 27 inlets of B are open, it means that effectively 10.5 inlets of B and 27 inlets of B are open → 37.5 inlets of B are open.

To fill a tank requiring $30b$ to fill, with $37.5b$ as the filling rate one would take: 30/37.5 = 4/5 hours = 48 minutes.

111.

AP = 100 km, PQ = 100 km, QB = 100 km

Let the speed of car 1, car 2 and car 3 be $V1$, $V2$ and $V3$ respectively.

According to the question:

$200/V1 = 100/V3 \rightarrow V1 : V3 = 2 : 1$ and

$100/V2 = 200/V3 \rightarrow V2 : V3 = 1 : 2$

Thus, $V1 : V2 : V3 = 4 : 1 : 2$

Hence, $V2 : V1 = 1 : 4$

Hence, option (c) is correct.

112. The net interest retained by Gopal in the original case = 2% of X + 10% of Y. This is given to be the same as the interest earned by Ankit = 8% of X. Equating we get:

2% of X + 10% of Y = 8% of $X \rightarrow$ 6% of X = 10% of $Y \rightarrow 0.06 \times X = 0.1 \times Y \rightarrow \frac{X}{Y} = \frac{5}{3}$.

In the second case, it is given to us that the net interest retained by Gopal = (2% of X + 20% of Y) and this value is 150 greater than the net interest retained by Gopal in the first situation, i.e. (2% of X + 10% of Y). Thus,

$(0.02X + 0.2Y) - (0.02X + 0.1Y) = 150 \rightarrow Y = 1500$ and since $X: Y = 5:3$, $X = 2500$. Hence, $X + Y = 4000$.

113. Let the initial scores of Amal and Bimal be $11x$ and $14x$ respectively. If their scores were increased by a, then, according to the question:

$$\frac{(11x + a)}{14x + a} = 47 : 56$$

$616x + 56a = 658x + 47a$

$9a = 42x \rightarrow a = 14x/3$

Bimal's new score: his old score = $\frac{(14x + \frac{14x}{3})}{14x} = \frac{56x}{42x}$

= 4:3. Hence, option (c) is correct.

114. Let the strength of A, B and C be a, b and c respectively.

Let us take 100 ml, 200 ml and 300 ml of A, B and C.

According to the question: $a + 2b + 3c$ = 20% of (100 + 200 + 300)

$a + 2b + 3c = 120$ (1)

$3a + 2b + c$ = 30% of (100 + 200 + 300)

$3a + 2b + c = 180$(2)

Eqn. (2) eqn. (1) = $a - c = 30$ or $c = a - 30$.

$a + 2b + 3(a - 30) = 120$ or $4a$

$= 210 - 2b$ or $b = 105 - 2a$

Concentration of D = $\frac{2b + 7c}{9} = \frac{2 \times (105 - 2a) + 7(a - 30)}{9}$

$$\frac{3a}{9} = \frac{a}{3}$$

Hence, the required ratio = $d : a = 1 : 3$. Hence, option (a) is correct.

115. Let the concentration of the unknown concentration solution is s%.

Let us take 100 ml of first and 300 ml of the second solution and this mixture is mixed with 400 ml of 20% solution.

According to the question:

(20% of 100 + s% of 300 + 20% of 400) = 31.25% of (100 + 300 + 400)

$20 + 3s + 80 = 250$ or $s = 50$. Hence, option (d) is correct.

116. Think of the mixtures in terms of percentage concentrations. Drum 1 has 72% of paint A, drum 2 has an unknown percentage, while combined in the ratio 3 : 4 the mixture has a 65% of paint A. This can be seen on an alligation picture as follows:

In the figure: $4 \rightarrow 7$ (i.e. $72 - 65$). Hence, $3 \rightarrow 5.25$ and hence, $X = 65 - 5.25 = 59.75$ (using alligation).

59.75% of paint A, means 40.25% of paint B. The required ratio = 59.75:40.25 = 239:161. Hence, option (a) is correct.

117. Let the efficiencies of Ramesh and Ganesh be R and G respectively. Let the total work = W units.

According to the question:
$W = 16 \times (R + G)$ and $W = 7 \times (R + G) + 10 \times (0.7R + G) = 14R + 17G$. Since the work is equal, we get:

$16 \times (R + G) = 14R + 17G$

$2R = G$ OR $R:G = 1:2$. Hence, Ramesh is half as efficient as Ganesh.

Let the efficiencies of Ramesh and Ganesh be one unit per day and two units per day respectively.

$W = 16 \times (1 + 2) = 48$ units
Total work done in seven days $= 7 \times (1 + 2) = 21$ units.

Remaining work $= 48 - 21 = 27$ units.

Required time to finish the remaining work $= 27/2 = 13.5$ days. Hence, option (b) is correct.

118. Let the speed of the car which starts from point A is a kmph and the car which starts from point B is b kmph.

According to the question:

$350 = 1 \times (a + b)$ and $350 = 7 \times (a - b)$

On solving the above two equations, we get $a = 200$ kmph and $b = 150$ kmph.

Hence, the required difference $= 200 - 150 = 50$ kmph.

119. Final quantity of alcohol in the mixture

$$= 700 \times \left(1 - \frac{10}{100}\right)^2 = 567 \text{ ml.}$$

Final amount of water in the mixture $= 700 + 175 - 567 = 308$ ml.

Required percentage $= \frac{308}{875} = 35.2\%$

Hence, option (d) is correct.

120. $\frac{x+y+z}{3} = 80, x + y + z = 240(1)$

$\frac{x+y+z+u+v}{5} = 75, x + y + z + u + v = 375\ (2)$

From equations (1) and (2), we get $u + v = 135$.

$$u+v=\frac{(x+y)}{2}+\frac{(y+z)}{2}$$

$u + v = 120 + y/2 = 135$ or $y = 30$.

Put $y = 30$ in equation (1), we get:

$x + z = 210$

As $x \geq z$, then minimum possible value of x will occur when we take $x = z$. This value would be 105 for x and z each. Hence, minimum value of $x = 105$.

121. From the starting information, it should be clear to you that pump *B* takes two hours less than pump *A* to empty the tank. This gives rise to various possibilities for how many hours each pump takes to empty the tank, as well as when the pumps are opened originally. For instance, if you assume the values of four hours (for pump *A* to empty) and two hours for pump *B* to empty, it would mean that the emptying of the tank is started every day at 4 PM. Also, *A* empties 25% per hour, while *B* empties 50% per hour. We need to check whether this condition is fulfilled for Wednesday. We are told that *A* alone worked till 5 PM and *B* worked from 5 to 7 PM. But in two hours, *B* would empty the tank completely by itself. Hence, this cannot be the correct scenario.

Checking with three hours for *B* and five hours for *A*, we get 33.33% work per hour for *B* and 20% per hour for *A*. Also, the normal time for opening the pumps is 3 PM. For Wednesday, pump *A* is open for two

hours (3 PM to 5PM) and pump *B* is open for two hours (5 PM to 7 PM). We can see that: $2 \times 33.33 + 2 \times 20 \neq 100$. Hence, this scenario is also not true.

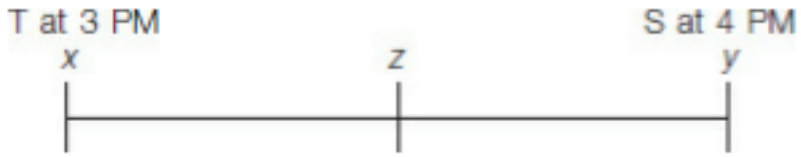
Checking with four hours for *B* and six hours for *A*, we get 25% work per hour for *B* and 16.66% per hour for *A*. Also, the normal time for opening the pumps is 2 PM. For Wednesday, pump *A* is open for three hours (3 PM to 5PM) and pump *B* is open for two hours (5 PM to 7 PM). We can see that: $3 \times 16.666 + 2 \times 25 = 100$. Hence, this scenario is true.

Thus, their combined work together = 25 + 16.66 = 41.66% per hour. To do 100% of the work, they would take 100/41.66 = 300/125 = 2.4 hours or 2 hours 24 minutes. Starting from 2 PM, they would empty the tank completely at 4:24 PM. Hence, option (b) is correct.

122. Total time taken by car 1 to reach at *B* = $\frac{50}{100}+\frac{50}{50}+\frac{50}{25}=3.5$ hours or 3 hours 30 minutes.

Time taken by car 1 to travel 20 km = 20/100 = 0.2 hours or 12 minutes. This means that car 2 is 12 minutes behind car 1. Since, their speeds are equal in all phases; car 2 would also take a total of 3.5 hours to reach *B*. The last part of the journey by both the cars is done at 25 kmph and the last 12 minutes would be spent in the last part of the journey only, we can deduce that after car 1 reaches *B*, car 2 would take 12 minutes @ 25kmph, to reach *B*. Thus, the distance from *B* for car 2 = 25 kmph × 0.2 = 5 km.

123.



The speeds of T and S are 'V' and '$3V/4$' respectively.

Let $XY = d$.

$$XZ = \frac{3d}{5}, ZY = \frac{2d}{5}$$

According to the question:

$$\frac{\frac{3d}{5}}{V} = \frac{\frac{2d}{5}}{\frac{3v}{4}} + 1$$

$$\frac{3d}{5V} = \frac{8d}{15V} + 1$$

On solving the above equation, we get: $d/V = 15$ hours.

124. Let the cost price of A and B are ₹a per kg and ₹b per kg, respectively.

When A and B are mixed in 3: 2, then the cost price of the mixture would be:

$$\frac{3a+2b}{3+2} = \frac{40}{1.1} \quad (1)$$

When A and B are mixed in 2: 3 then:

$$\frac{2a+3b}{2+3} = \frac{40}{1.05} \quad (2)$$

Equation (a)/ equation (2):

$$\frac{3a+2b}{2a+3b} = \frac{1.05}{1.1}$$

On solving the above equation, we get: $a : b = 19 : 24$. Hence, option (d) is correct.

125. Let the number of tests he has appeared for, be 'n' and his average score for 'n' tests be 'x'.

According to the question:

$$\frac{[nx-20\times10]}{n-10}=x+1$$

$nx - 200 = nx - 10x + n - 10$

$10x - n = 190$ (1)

$$\frac{[nx-30\times10]}{n-10}=x-1$$

$nx - 300 = nx - 10x - n + 10$

$10x + n = 310$(2)

On solving equation (1) and (2), we get: $x = 25$, $n = 60$. Hence, 60 is the correct answer.

126. Let $AB = 4d$

$AP = d$ and $BP = 3d$

Let the speed of car 1 be 'V' kmph and the speed of car 2 be $V/2$ kmph.

According to the question:

$$\frac{d}{V}=\frac{3d}{\frac{V}{2}}-1$$

$$\frac{d}{V}=\frac{6d}{V}-1$$

$$\frac{5d}{V}=1$$

$\frac{d}{V}=\frac{1}{5}$ hour or 12 minutes is the time taken by car 1 to reach P from A.

127. Let 'p' be the instalments.

After one year, the net amount = 210000 + 10% of 210000 – p

At the end of the second year, net amount to be paid = 210000 + 10% of 210000 – p + 10% of (210000 + 10% of 210000 – p) = p

210000 + 21000 – p + 23100 – 0.1p = p

2.1p = 254100 or p = ₹121000

Hence, each instalment is equal to ₹121000.

128. According to the question:

0.45N = 36 + 68% of 0.45N

32% of 0.45N = 36

$N=\frac{36}{0.32\times0.45}$

$243 \le N \le 252$. Hence, option (b) is correct.

129. To maximise the largest possible age of those who are below 51 years, we need to minimise the total age of the persons whose ages are not below 51. So, to maximise the largest possible age of those persons who are below 51 years, the age of rest of the persons must be 51 years.

According to the question:

51 × 30 + 39a = 69 × 38 (where 'a' is the largest possible average age of all those people who are below 51 years).

Or a = 28 years. Hence, option (d) is correct.

130. Check the options:

Option (a): If the speed of Partha = 5 kmph

Time taken by Partha to reach at B = 60/5 = 12 hrs.

Time taken by Narayan to reach at B = 12 – 4 = 8 hrs.

Speed of Narayan = 60/8 = 7.5 kmph.

Time taken by Partha to travel 30 km = 30/5 = 6 hours.

Time taken by Narayan to travel 60 km = 8 hours

Time difference = 8 – 6 = 2 hours, thus, meeting the requirement of the question.

Hence, option (a) is correct.

131. Let the efficiencies of human and robot are 'h' and 'r' respectively. Let the total work = W

According to the question: $30 \times (15h + 5r) = W(1)$

$60 \times (5h + 15r) = W(2)$

$30 \times (15h + 5r) = 60 \times (5h + 15r)$

$15h + 5r = 10h + 30r$

$5h = 25r \rightarrow r = h/5$

$W = 30 \times (15h + 5r) = 30 \times \left(15h + \frac{5h}{5}\right) = 480 \times h$

Required time to finish the job by 15 humans = $\frac{480h}{15h}$ 32 days. Hence, option (d) is correct.

132. Let the amounts of paints A and B are 'a' litres and 'b' litres respectively.

Let the cost of paints B is ₹'x' per litre and cost of paint A is ₹'$x + 8$' per litre.

Cost of the ten litres mixture = 264/1.1 = ₹240

$$\frac{[a(x+8)+bx]}{a+b}=\frac{240}{10}$$

$$x+\frac{8a}{a+b}=24$$

To minimise the value of x, $a = b$.

$$x+\frac{8a}{a+a}=24$$

x = 20 per litre.

Hence, option (c) is correct.

133. Let Raju and Lalitha originally had $4n$ and $9n$ marbles respectively and Lalitha gave 'x' marbles to Raju.

$\frac{4n+x}{9n-x}=\frac{5}{6}$ or $24n + 6x = 45n - 5x \rightarrow 11x = 21n$ or $\frac{x}{n}=\frac{21}{11}$

We need to find the value of $\frac{x}{9n}=\frac{21}{9\times11}=\frac{7}{33}$

Hence, option (b) is correct.

134. The question should be looked at from the shopkeeper's perspective.

Let the purchase price of the wholesaler be 3 and 1 respectively, for the walnuts and the peanuts. Then, the shopkeeper would have purchased his items for: 8 × 1.1 + 16 × 3.6 = 66.4. While selling he had only 11 kg of walnuts and 5 kg of peanuts with him. Since he mixes them, he is selling

16 kg overall. For an overall cost of 66.4, a profit of 25% means that the revenue generated by the shopkeeper would be 1.25 × 66.4 = 83. This, revenue in actual terms is 166×16 = 2656. Thus, in our assumptions, 83 → 2656. Hence, 1 = 32 and 3 = 96. The price of walnuts would be ₹96.

135. The sum of the 30 integers would be 150. Exactly 20 numbers do not exceed 5, means that 10 numbers would definitely exceed 5. For maximising the average of the 20 numbers, the averages of the 10 numbers that exceed 5 have to be minimised. This would be done if we take all these 10 numbers to be as small as possible, i.e. 6 each. Thus, the total of these 10 numbers would be 60. Consequently, the total of the remaining 20 numbers would be 150 – 60 = 90 and hence, their average would be 90/20 = 4.5 (maximum possible average of the 20 numbers). Option (c) is correct.

136. Let 'x' be the amount invested by Bimal.

$$8\% \text{ of } 12000 + 10000 \times \left(1+\frac{3}{100}\right)^2 - 10000 = 7.5\% \text{ of } x$$

$960 + 609 = 0.075 \times x$

$x = 1569/0.075 = ₹20{,}920$

137. According to the question, A covered 40% of the track in 12 minutes. Hence, A covered 100% track in 30 minutes. It means both A and B started their journey at 9:42 AM.

A and B met first time at 10:00 AM and A covered 60% of the track which means by 10:00 AM, B covered 40% of the distance. Hence, B covered

means by 10:00 AM, *B* covered 40% of the distance. Hence, *B* covered 40% of the track in 18 minutes or it covered 100% distance in 45 minutes. Hence, *B* returns to *P* at 10:27 AM. Option (d) is correct.

138. Each of three vessels *A*, *B*, *C* contains 500 ml of salt solution of strengths 10%, 22%, and 32%, respectively.

The amount of salt in vessels *A*, *B*, *C* = 50g, 110g, 160g respectively.

The amount of water in vessels *A*, *B*, *C* = 450 ml, 390 ml, 340 ml respectively.

Now, 100 ml of the solution in vessel *A* is transferred to vessel *B*. In this 100 ml of the solution, 10 g salt and 90 mls water will be transferred. After this, there will be 120 g salt and 480 g water in vessel *B*. Then, when 100 ml of the solution in vessel *B* is transferred to vessel *C*, there would be 20 g salt and 80 ml water going to vessel *C*. Vessel *C's* new condition would become: 180 g salt and 420 ml water, i.e. it would contain 30% salt. Finally, when 100 ml is taken back to vessel *A* (which would have 400 ml solution containing 40 g salt and 360 ml water), there would be an addition of 30 g of salt and 70 ml of water. Thus, at the end of the transfers there would be 70 g salt and 430 ml water in 500 ml of the solution in vessel *A*. This means 14% of salt concentration. Hence, option (d) is correct.

139. From the events described in the problem, we can see that the last motorcyclist will leave point *A* at 10:45 AM and the last motorcyclist reaches *B* at 11:00 AM. Hence, it will take 15 minutes to complete the journey. If *A* doubles his speed then it will reach *B* at 10: 30 AM.

By 10:30, exactly 15 motorcyclists will reach at B (the last motorcyclist that would reach point B would be the motorcyclist that left at 10:15 AM).

Hence, option (c) is correct.

140. Let the track lengths of A and B are 'a' and 'b' respectively.

According to the question: $a + b = 325$ (1)

$(9a/6) = (5b/7.5) => a:b = 4:9$ (2)

On solving, we get: $a = 100$ m, $b = 225$ m

Required time = $\frac{100}{7.5\times\frac{5}{18}} = 48$ s

141. Let there were 'a' fiction and 'b' nonfiction books in the library in 2010.

$a + b = 11500$ (1)

$1.1a + 1.12b = 12760$ (2)

On solving, we get $a = 6000$, $b = 5500$

Hence, there were total $1.1 \times 6000 = 6600$ fiction books in the library in 2015.

142. Let the CP be 100 each. Then the shopkeeper sells to Amal at 120 and sells to Asim at 80. Amal sells at a profit of 30% to Bimal – hence, Bimal purchases at 156. Likewise, Asim sells to Barun at a loss of 30%, hence Barun purchases at 56. $(x - y)/p = (156 - 56)/100 = 1$.

Hence, option (a) is correct.

143. Let the cost of each cycle be 100. Then the cost of ten cycles is 1000. Selling price of six bicycles would be 125 each, while the selling price of four bicycles would be 75 each. Hence, total revenue is $125 \times 6 + 75 \times 4 = 1050$. The profit is 50, which is on the basis of an assumption of 1000 for the total cost of ten bicycles. This profit is actually given to us as 2000 – which means that if $50 \rightarrow 2000$, then $100 \rightarrow 4000$. Option (c) is correct.

Alternately, you could also do this by assuming $100x$ as the cost price of one bicycle. According to the question: $6 \times 125x + 4 \times 75x - 10 \times 100x = 2000$

$50x = 2000$ or $100x = ₹4000$

Hence, option (c) is correct.

144. Let the score of D was $100x$.

Score of $C = 100x - 20\%$ of $100x = 80x$

Score of $B = 80x + 25\%$ of $80x = 100x$

Score of $A = 100x - 10\%$ of $100x = 90x$

$90x = 72$ or $100x = 80$

145. Let the salaries of Ramesh, Ganesh and Rajesh in 2010 be, 6, 5 and 7, respectively. Then, since it is known that Ramesh's salary increased by 25%, his salary would be 7.5 in 2015. Also, in 2015, the ratio of the salaries of the three was 3 : 4 : 3. Hence, the salary of Rajesh would also be 7.5 in 2015. Thus, Rajesh's salary has increased from 7 to 7.5 – an increase of around 7%. Hence, option (b) is correct.

146. Let the total work be 40 units.

Efficiency of Anil = 40/20 = 2 units per day.

Efficiency of Sunil = 40/40 = 1 unit per day.

Bimal has done 10% of 40 units = 4 units of work.

Work done by Anil in the first 3 days = 6 units.

Thus, the rest of the 40 – 4 – 6 = 30 units of work would be done by Anil and Bimal together.

Total time taken by Anil and Bimal together to finish the job = 30/ (2 + 1) = 10 days.

Hence, it would take total 10 + 3 = 13 days to complete the job. Hence, option (b) is correct.

147. Let the scores of Rama, Mohan and Anjali be 'r', 'm' and 'a' respectively.

$r = \frac{1}{12} \times (m + a)$. After the review, their scores would be a + 6, m + 6 and r + 6 for Anjali, Mohan and Rama respectively. Thus, $(a + 6) : (m + 6) : (r + 6) = 11 : 10 : 3$

Let $a + 6 = 11x$, $m + 6 = 10x$ and $r + 6 = 3x$

Or $a = 11x - 6$, $m = 10x - 6$, $r = 3x - 6$

$$3x - 6 = \frac{1}{12} \times (11x - 6 + 10x - 6)$$

On solving the above equation, we get x = 4. Their respective scores would be: Anjali = $11x - 6 = 38$, Mohan = $10x - 6 = 34$; Rama = $3x - 6 = 6$. Difference between Anjali and Rama is 38 – 6 = 32. Hence, option (b) is correct.

148. The highest possible percentage value by which the speed of the second car would exceed the first car, will occur when both the cars take the least amount of time. Thus, we would need to consider the travel times for both to the least possible. Since, the first car travels at least six hours then the second car would travel at least five hours. Thus, their time ratio would be 6:5. Since, the distance is constant; their speed ratio would be in the ratio of 5:6. Thus, the second car's speed would exceed the first car's speed by a maximum of 20%. Hence, option (a) is correct.

149. Let the income of Bimala be ₹100.

Income of Amala = ₹120

Income of Kamala = ₹150

After 4% reduction, Kamala's income = 150 – 6 = 144.

After 10% increment of Bimala's income = 100 + 10 =110. Thus, Kamala's income is greater than Bimala's income by: $\frac{144-110}{144}\times 100 \approx 31\%$

Hence, option (a) is correct.

150. Let the length of the racecourse = x metres

Race of speeds of 1st, 2nd and 3rd horses = $x: x-11: x-90$

Ratio of speeds of 2nd and 3rd horses = $x: x-80$

Hence, $\frac{x-11}{x-90}=\frac{x}{x-80}$

On solving the above equation, we get x = 880 m.

151. Let the investments of Amala, Bina and Gouri are $3x$, $4x$ and $5x$ respectively, and their interest rates are $6y$, $5y$ and $4y$ respectively.

According to the question: $\left(4x \times \frac{5y}{100}\right) - \left(3x \times \frac{6y}{100}\right)$

$= 250$

$\frac{2xy}{100} = 250$ or $\frac{xy}{100} = 125$

Total interest $= 3x \times \frac{6y}{100} + 4x \times \frac{5y}{100} + 5x \times \frac{4y}{100} = \frac{58xy}{100}$

$= 58 \times 125 = ₹7250$

Hence, option (d) is correct.

152. Assume that Amal travelled for three hours at each speed. He would take a total of nine hours. He would cover 30 + 60 + 90 = 180 km and that would be the total distance to be covered by Bimal. Bimal would, thus, cover 60 km at each speed. He would take: 60/10 + 60/20 + 60/30 = 6 + 3 + 2 = 11 hours. Bimal's travel time exceeds Amal's by 2/9 = 22.22%. Hence, option (a) is correct.

153. Let the maximum marks in the exam was 100 x.

Meena scored 40x and after the review, her score became 40x + 50% of 40x = 60x.

Passing marks = 60x + 35 (1)

When her post review score is increased by 20%, she would score: 60x + 20% of 60 x = 72x

72x = passing marks + 7 (2)

On solving equation (1) and (2), we get: x = 3.5. Hence, the passing marks = 60x + 35 = 245 and the total marks = 350.

Passing percentage = $\frac{245}{350} \times 100$. Hence, Option (c) is correct.

154. Let the amount invested in fixed deposit was ₹x.

6% of $x + 4\%$ of $\frac{(15,00,000 - x) \times 2}{3} + 3\%$ of $\frac{(15,00,000 - x) \times 1}{3} = 76000$

On solving the above equation, we get: x = ₹9,00,000 = 9 lakh.

Hence, the correct answer must be 9.

155. Let the efficiencies of A and B is '$2a$' and 'b' respectively.

Total work = $12 \times (2a + b) = 24a + 12b$

Total work = $9 \times (a + 3b) = 9a + 27b$

Equating, we get: $15a = 15b \rightarrow a = b$. Thus, the total work would be: $24a + 12a = 36a$. If A works at her normal speed of $2a$, she would take $36a/2a = 18$ days.

Hence, option (c) is correct.

156. Since there are 60% girls, there would be 40% boys. Also, since there are 30 girls more than boys, it means that $20\% = 30 \rightarrow 100\% = 150$, i.e. there are a total of 150 students in the class, with 60% (90 girls) and 40% boys (60 boys). If 68% pass, it means that $68 \times 1.5 = 102$ pass, out of which 30 being boys, means that there are 72 girls who pass. Out of 90, 72 gives us 80% pass percentage. Hence, 20% of the girls do not pass.

157. Let the cost prices of 1 pen and 1 book are $100x$ and $100y$ respectively.

$95x + 115y - (100x + 100y) = 7$

$15y - 5x = 7(1)$

$(105x + 110y) - 100x - 100y = 5x + 10y = 13(2)$

On solving equation (1) and (2), we get: $x = 1, y = 0.8$

Cost price of book = $100y$ = ₹80.

158. Weight/volume for liquid 1 = 1000/1000 = 1 kg/litre

Weight/volume for liquid 2 = 800/1000 = 0.8 kg/litre. The average weight/volume of the mixture is 0.96 (480 g in 500 ml). Hence, the ratio of mixing would be 4:1 for the first and second liquids. Thus, liquid 1 would be 80% of the mixture.

Hence, option (a) is correct.

159. Let the average score of 20 students other than Gautam and Ramesh is x.

$20x + 82.5 = 21 \times 62$

$20x = 1219.50$

$x = 60.975$

Let Gautam scores 'p' marks in the test.

According to the question:

$$\frac{20x+p}{21}+1=\frac{20x+p+82.5}{22}$$

On solving the above equation, we get: $p = 51$. Hence, option (b) is correct.

160. Let the efficiencies of one man and one machine be 'a' and 'b' respectively.

According to the question: $(3a + 8b) = 2 \times (3b + 8a)$

$3a + 8b = 6b + 16a$

$13a = 2b$ or $a:b = 2:13$

BLOCK IV
GEOMETRY

BACK TO SCHOOL...

The word GEOMETRY is derived from two words—GEO meaning earth and METRY meaning measurement. Hence, it is quite evident that geometry as a mathematical science developed mainly due to the human need of measuring land masses and distances. The major developments in the fields of Geometry and Mensuration are mainly credited to the ancient Egyptian and Greek civilisations. (In fact, this is one of the reasons why all formulae and theorems primarily carry Greek names.)

Key Geometrical Concepts

Point: The point should be visualised as a singular dot. In physical terms, a point can be defined as a single dot that can be created on a plain paper by a very sharp pencil. It could also be visualised as a singular prick on a piece of paper by a very sharp nail or pin.

Line: Mathematically, lines are defined as a group of points which are straight one after another. All lines are supposed to extend infinitely in two directions.

Segment of a line

If a part of a line is cut out, we get a segment of a line.

Physically, the closest representations of a segment of a line would be a tight thread or the straight crease of a piece of paper.

Plane: The surface of a smooth wall or a table top is the closest representation of a portion of a plane.

Some Geometrical Properties

1. Lines Between Points: Let us take two distinct points in a plane. You can easily verify that an infinite number of lines can be drawn in the plane passing through any one of these two points. However, if you wanted to draw a line which passes through both the points, you will be able to draw only one line. This is an important result in Geometry.

Property: Given any two distinct points in a plane, there exists one and only one line containing both the points. Alternately, we can state that two distinct points in a plane determine a unique line.

2. Collinearity of Points: Collinear or non-collinear points are only defined in the context of three or more points.

Consider the situation of three points. There can only be two cases with respect to three points:

(a) All the points lie on the same line. (Here, the points are said to be collinear).

(b) All the three points do not lie on the same line (In this case, the points are said to be non-collinear).

(Note: It is quite evident that we will discuss collinear or non-collinear points only if the number of points is more than two. Obviously, if there are only two points they would always lie on one line.)

3. Points in Common Between Distinct Lines: In the case of distinct lines, there can only be two cases:

(a) There is one point in common: In such a case, the common point is called the point of intersection, and the two lines are called as intersecting lines.

(b) There is no point in common: In such a case, the two lines are non-intersecting and are also called as parallel lines.

The property can, thus, be stated as:

Property: Two distinct lines in a plane cannot have more than one point in common.

4. Lines and Points:

Property: Given a line and a point in the same plane, such that the point is not on the line, there is one and only one line which passes through the point and is parallel to the given line.

5. Lines:

Property: Two intersecting lines cannot be parallel to the same line.

6. Multiple Lines: There can be four distinct possibilities in such a case.

(a) No two lines intersect each other

(b) Some lines intersect

(c) Every line intersects all other lines, but their respective points of intersection are different from each other.

(d) Every pair of lines is intersecting and all the points of intersection coincide

The reader is required to visualise the figures for each of these situations.

The remaining formulae and results for geometry have been given within the chapter. You are required to move to the respective formulae. However, an important note while you are doing this.

Important Note

One of the least understood issues with respect to this block is:

How does a person move from:

"Cannot Solve Geometry and Mensuration!" to "Can Solve Geometry and Mensuration"?

In fact, this transition should be your sole aim while studying and solving this block of chapters.

As you are already aware, mere knowledge of formulae does not guarantee this movement. Then in that case what should a person do if he/she has to engineer this transition of abilities?

Well, the answer is really quite simple and for understanding the same, you need to move out of conventional mathematical study processes. In your mind you need to create an awareness of how to think while solving a geometry/mensuration question. Here are a few tips that will help you through this transition:

1. Some Formulae are More Important than Others: For the CAT (and indeed, all other MBA and aptitude examinations) your concentration should not be on memorising complex formulae. A close study of the past trends for questions from this block will show you that the formulae themselves can be graded into the important and the not so important formulae. In fact, if you study over 200 questions from this block that have been asked in the CAT in the past decade or more, you will realise that over 98% of the questions are simply based on a small subset of geometrical formulae and results. This important set of formulae is listed below for your convenience:

Lines: Properties related to intersecting lines and angles formed

Polygons: Basic properties of regular polygons

Triangles: Pythagoras theorem, 30-60-90 triangle, 45-45-90 triangle, Sine rule, properties of exterior angles of a triangle, equilateral triangle, isosceles triangle

Quadrilaterals: Areas, perimeters, diagonals and angles between diagonals for all standard quadrilaterals.

Hexagon: A hexagon can be divided into six equal triangles.

2. Length/Area/Volume Measuring Formulae versus Angle Measuring Formulae: In your mind, divide the formulae into length/area/volume measuring formulae on the one hand and angle measuring formulae on the other hand. This will be very helpful, since most questions in this block can be clearly segregated as length or angle measuring questions. In such a scenario, in case you have a question requiring angle measurements, you will only require to think of angle measuring formulae.

(Note: There are very few formulae that connect lengths with angles. (e.g. Sine rule and Cosine rule in the context of triangles).

3. Use of Reverse Flowcharting for Solving Questions: All questions in geometry and mensuration ask you to find a particular value. Very often, it makes the question much more convenient to solve if instead of trying to find what is asked, you try to find a value which is related to the required value.

Thus, for example, if in a triangle ABC angle A is given to be 40° and angle B is asked for and you are not getting a clear strategy for getting the value of angle B, then it might be wise to try to derive the value of angle C. If you can get C, then B will be obtained by 140-C.

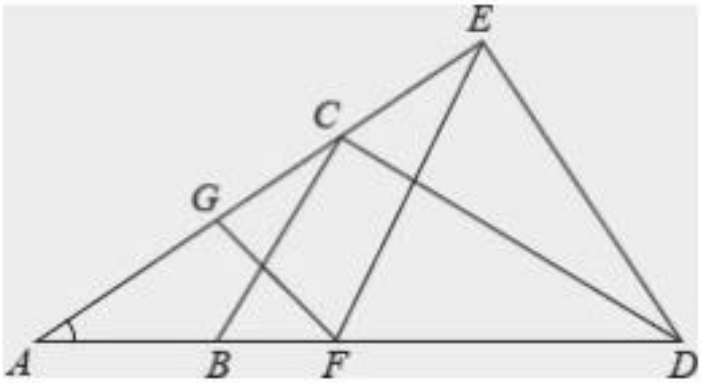
This process is called as reverse flowcharting and is an extremely crucial process for solving questions in geometry.

In other words, it can also be seen to be a deflection of the original question into a more convenient question.

(**Note:** You are advised to concentrate on the special note for solving CAT questions provided prior to the LOD I Questions while studying this block.)

CAT Scan 1

1. In the figure below, $AB = BC = CD = DE = EF = FG = GA$. Then, $\angle DAE$ is approximately



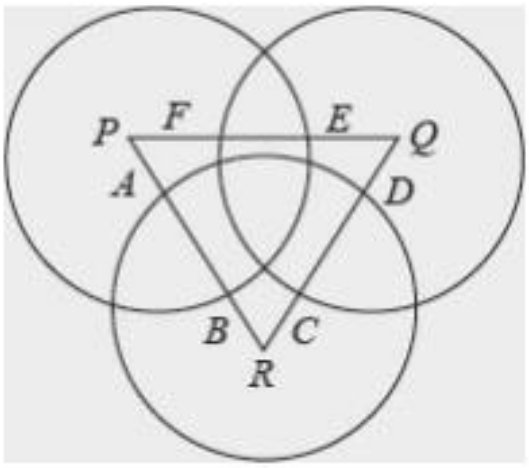
(a) 15°

(b) 20°

(c) 30°

(d) 25°

2. The figure below shows three circles, each of radius 25 and centres at P, Q and R respectively. Further $AB = 6$, $CD = 12$ and $EF = 15$. What is the perimeter of the triangle PQR?



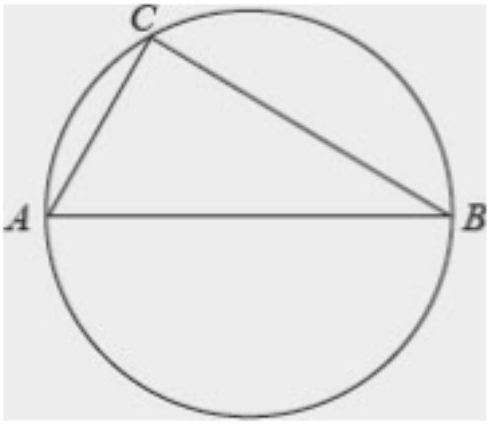
(a) 117

(b) 116

(c) 113

(d) 121

3. The figure shows a circle which has a diameter AB and a radius 13. If chord CA is 10 cm long, then find the area of $\angle ABC$.



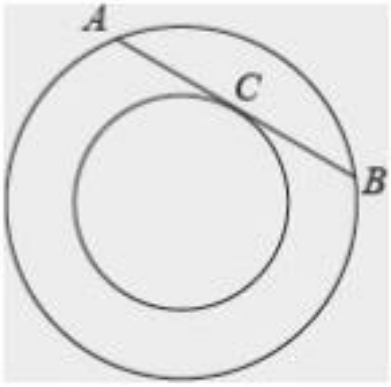
(a) 240 sq.cm

(b) 120 sq.cm

(c) 160 sq.cm

(d) None of these

4. The line AB is 12 metres in length and is tangent to the inner one of the two concentric circles at point C. It is known that the radii of the two circles are integers. The radius of the inner circle is



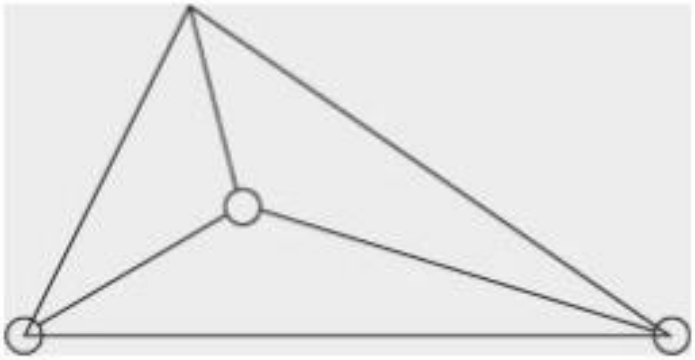
(a) 5 metres

(b) 8 metres

(c) 6 metres

(d) 3 metres

5. Four cities are connected by a road network as shown in the figure. In how many ways, can you start from any city and come back to it without travelling on the same road more than once?



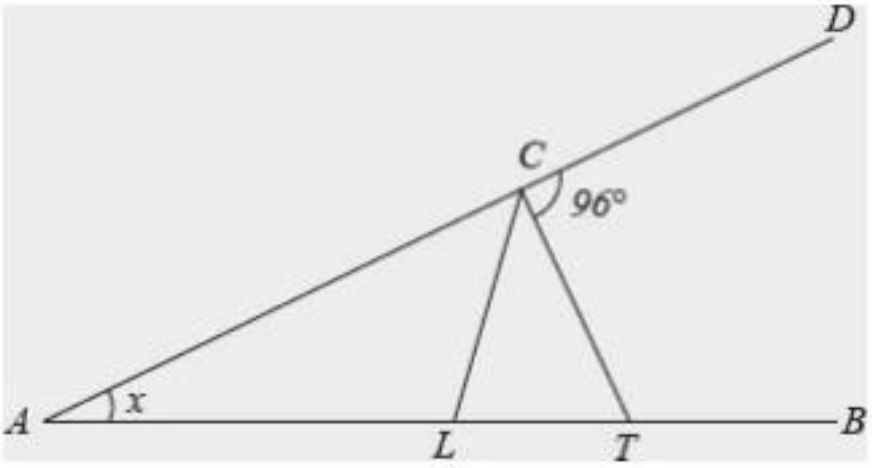
(a) 14

(b) 12

(c) 10

(d) 15

6. In the figure (not drawn to scale) given below, if $AL = LC = CT$, and $\angle TCD = 96°$. What is the value of the $\angle LTC$?



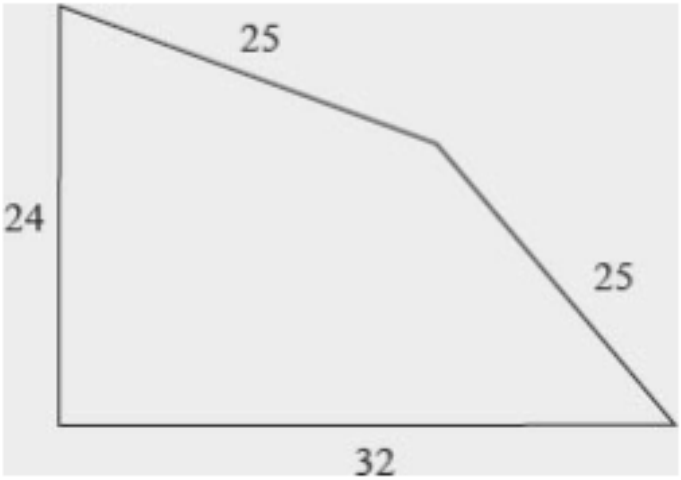
(a) 32°

(b) 84°

(c) 64°

(d) Cannot be determined

7. Two sides of a plot measure 32 metres and 24 metres and the angle between them is a perfect right angle. The other two sides measure 25 metres each and the other three angles are not right angles.



What is the area of the plot (in m^2)?

(a) 768

(b) 534

(c) 696.5

(d) 684

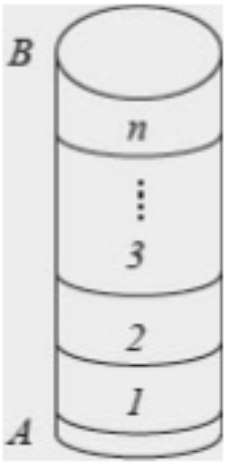
CAT Scan 2

Directions for Questions 1 to 3: Answer the questions on the basis of the information given below.

Directions for Questions 1 to 3: Answer the questions on the basis of the information given below.

Consider a cylinder of height h cm and radius $r = 2/\pi$ cm as shown in the figure (not drawn to scale). A string of a certain length, when wound on its cylindrical surface, starting at point A and ending at point B, gives a maximum of n turns (in other words, the string's length is the minimum length required to wind n turns).

1. What is the vertical spacing in cm between two consecutive turns?



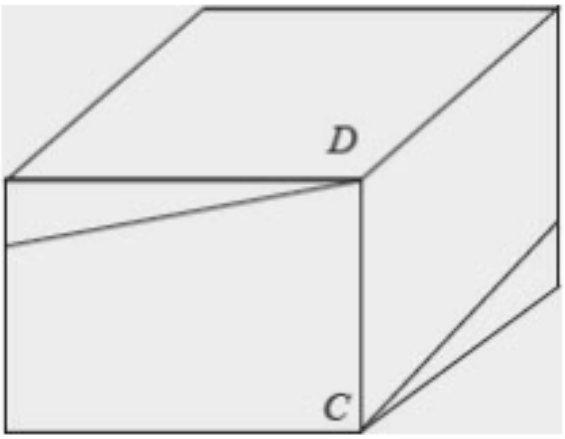
(a) h/n

(b) $h/\sqrt{n}$

(c) $h/n2$

(d) Cannot be determined with given information

2. The same string, when wound on the four exterior four walls of a cube of side n cm, starting at point C and ending at point D, can give exactly one turn (as shown in the figure). The length of the string, in cm, is



(a) $\sqrt{2}\,n$

(b) $\sqrt{17}\,n$

(c) n

(d) $\sqrt{13}\,n$

3. In the setup of the previous two questions, how is h related to n?

(a) $h = \sqrt{2}\,n$

(b) $h = \sqrt{17}\,n$

(c) $h = n$

(d) $h = \sqrt{13}\,n$

4. Let *LMNOPQ* be a regular hexagon. What is the ratio of the area of the triangle *LNP* to that of the hexagon *LMNOPQ*?

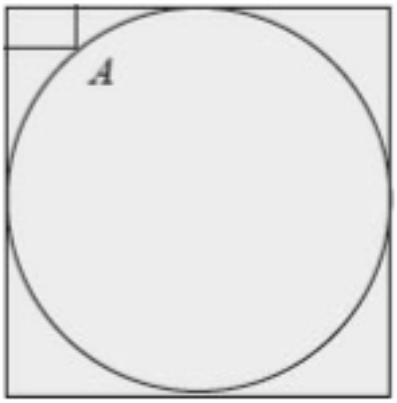
(a) 1/3

(b) 1/2

(c) 2/3

(d) 5/6

5. In the figure below, a circle is inscribed inside a square. In the gap between the circle and the square (at the corner), a rectangle measuring 20 cm × 10 cm is drawn such that the corner A of the rectangle is also a point on the circumference of the circle. What is the radius of the circle in cm?



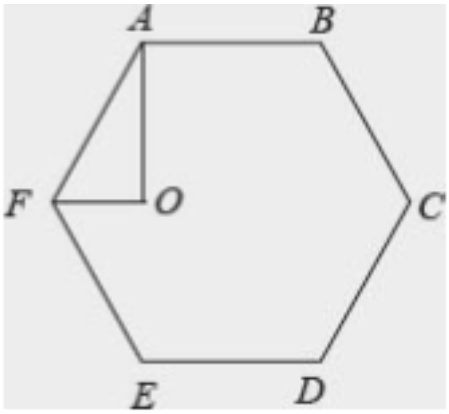
(a) 30 cm

(b) 40 cm

(c) 50 cm

(d) None of these

6. In the figure below $ABCDEF$ is a regular hexagon. The $\angle AOF = 90°$ and FO is parallel to ED. What is the ratio of the area of the triangle AOF to that of the hexagon $ABCDEF$?



(a) 1/12

(b) 1/8

(c) 1/24

(d) 1/18

7. Sherry, a naughty boy, after a lot of convincing from his mother has agreed to mow the farm lawn, which is a 30 m by 40 m rectangle. The mower mows a 1 m wide strip. If Sherry starts at one corner and mows around the lawn towards the centre, about how many times would he go round before he has mowed half the lawn?

   (a) 4.3

   (b) 4.5

   (c) 4.9

   (d) 5.0

CAT Scan 3

1. Euclid has a triangle in mind. Its longest side has length 20 and another of its sides has length 10. Its area is 80 sq. cm. What is the exact length of its third side?

   (a) $\sqrt{260}$

   (b) $\sqrt{250}$

   (c) $\sqrt{240}$

   (d) $\sqrt{270}$

2. Consider a circle with unit radius. There are seven adjacent sectors, S_1, S_2, S_3,....., S_7, in the circle such that their total area is 1/16 of the area of the circle. Further, the area of j_{th} sector is twice that of the $(j-1)_{th}$ sector, for $j = 2$....., 7. What is the angle, in radians, subtended by the arc of S_1 at the centre of the circle?

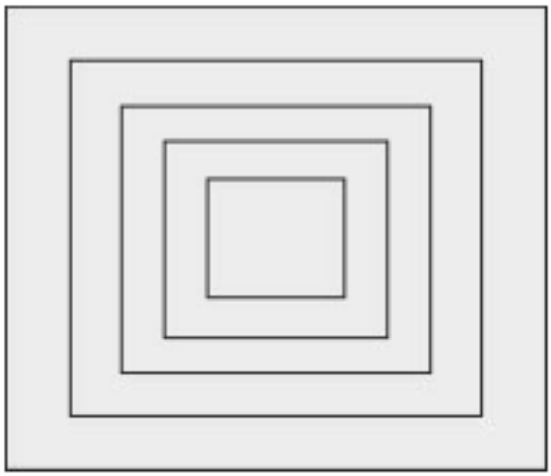
   (a) $\pi/508$

   (b) $\pi/2040$

   (c) $\pi/1016$

   (d) $\pi/2032$

3. The figure below shows a set of concentric squares. If the diagonal of the innermost square is 2 units, and if the distance between the corresponding corners of any two successive squares is l unit, find the difference between the areas of the sixth and the seventh squares, counting from the innermost square.



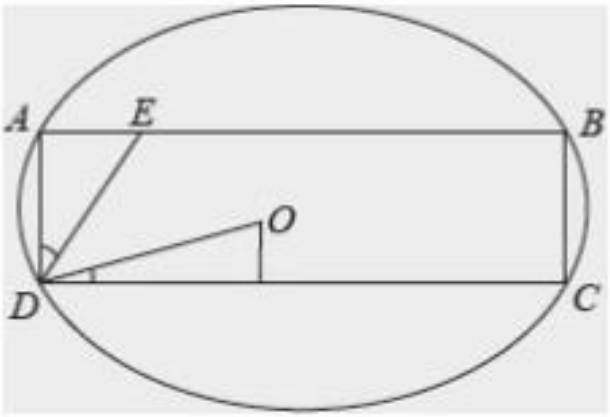
   (a) $\sqrt{2}$ sq. units

   (b) 26 sq. units

   (c) 30 sq. units

(d) None of these

4. In the figure (not drawn to scale), rectangle $ABCD$ is inscribed in the circle with centre at O. The length of side AB is greater than that of side BC. The ratio of the area of the circle to the area of the rectangle $ABCD$ is $\pi : \sqrt{3}$. The line segment DE intersects AB at E such that $\angle ODC = \angle ADE$. What is the ratio AE: AD?



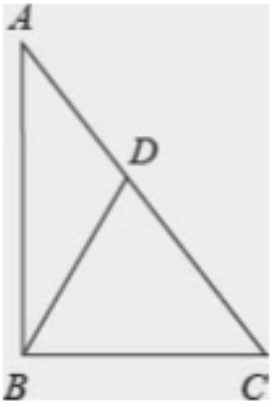
(a) $1 : \sqrt{3}$

(b) $1 : \sqrt{2}$

(c) $\sqrt{3} : 1$

(d) 1 : 2

5. In $\angle ABC$, $\angle B$ is a right angle, AC = 16 cm and D is the mid-point of AC. The length of BD is



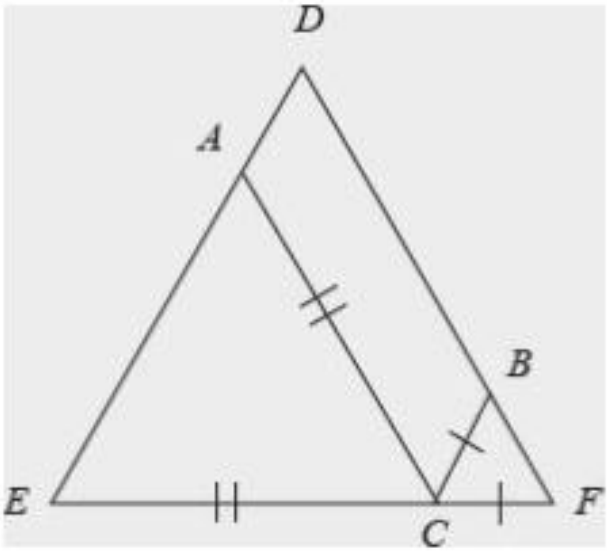
(a) 10 cm

(b) $\sqrt{15}$ cm

(c) 8 cm

(d) 7.5 cm

6. In triangle DEF shown below, points A, B, and C are taken on DE, DF and EF respectively such that $EC = AC$ and $CF = BC$. If angle $D = 50$ degrees, then what is angle ACB in degrees?



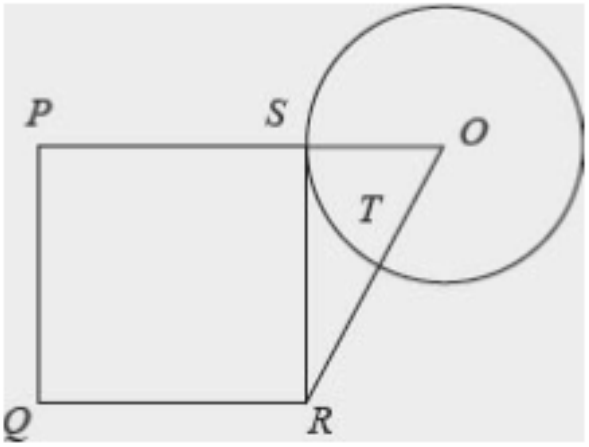
(a) 120

(b) 80

(c) 90

(d) None of these

7. $PQRS$ is a square. SR is a tangent (at point S) to the circle with centre O and $TR = OS$. Then, the ratio of area of the square to the area of the circle is



(a) $\pi/3$

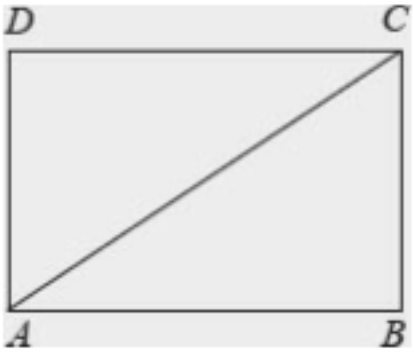
(b) $11/7$

(c) $3/\pi$

(d) $7/11$

CAT Scan 4

1. In the adjoining figure, $AC + AB = 5\,AD$ and $AC - AD = 8$. Then, the area of the rectangle $ABCD$ is



(a) 45

(b) 50

(c) 60

(d) Cannot be answered

2. The figure shows the rectangle *ABCD* with a semicircle and a circle inscribed inside it as shown. What is the ratio of the area of the circle to that of the semicircle?

   (a) $(\sqrt{2}-1)^2 : 1$

   (b) $2(\sqrt{2}-1)^2 : 1$

   (c) $(\sqrt{2}-1)^2 : 2$

   (d) None of these

3. A right circular cone of height h is cut by a plane parallel to the base and at a distance $h/3$ from the base then the volumes of the frustum of the cone and the resulting cone are in the ratio

   (a) 1 : 3

   (b) 8 : 19

   (c) 19 : 8

   (d) 7 : 1

4. Three identical cones with base radius m are placed on their bases so that each is touching the other two. There will be one and only one circle that would pass through each of the three vertices. What can be said about the radius of this circle?

   (a) It will be smaller than m

   (b) It will be equal to m

(c) It will be larger than m

(d) Depends on the height of the cones

5. In triangle ABC, we have angle $A = 100$ degree and $B = C = 40$. The side AB is produced to a point D so that B lies between A and D and $AD = BC$. Then $\angle BCD$ =?

   (a) 20°

   (b) 10°

   (c) 30°

   (d) 40°

6. The sides of a cyclic quadrilateral are 9, 10, 12 and 16. If one of its diagonals is 14, then find the other diagonal.

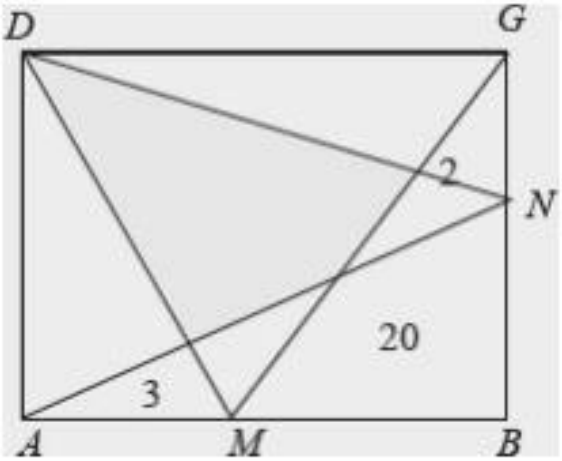
   (a) 16

   (b) 17

   (c) 18

   (d) 19

7. Segments starting with points M and N and ending with vertices of the rectangle $ABCD$ divide the given figure into eight parts (see the figure). The areas of three parts of the rectangle are indicated in the picture. What is the area of the shaded region?



(a) 25

(b) 40

(c) 29

(d) 20

ANSWER KEY

CAT Scan 1

1. (d)
2. (a)
3. (b)
4. (b)
5. (b)
6. (c)
7. (d)

CAT Scan 2

1. (a)
2. (b)

3. (c)

4. (b)

5. (c)

6. (a)

7. (c)

CAT Scan 3

1. (a)

2. (c)

3. (b)

4. (a)

5. (c)

6. (b)

7. (c)

CAT Scan 4

1. (c)

2. (b)

3. (c)

4. (c)

5. (b)

6. (c)

7. (a)