

# 1.6

## CHAPTER

# Average, Mixture & Alligation

### Average

Average is a number which represents the general characteristics of a set of numbers. It is a very effective way of representing the entire group by a single value. Average of the group is defined as:

$$\text{Average} = \frac{\text{Sum of all items in the group}}{\text{No. of items}}$$

### Basic Points related with Average

- If the value of each item is increased by the same value  $P$ , then the average of the group or items will also increase by  $P$ .

#### Example 1.

Let us take a group of 5 numbers 25, 30, 15, 35, 40 and each number is increased by 3, then find out the new average.

#### Solution:

$$\text{Initial average} = \frac{25 + 30 + 15 + 35 + 40}{5}$$

$$= \frac{145}{5} = 29$$

$$\text{Final average} = \frac{20 + 33 + 18 + 38 + 43}{5}$$

$$= \frac{160}{5} = 32$$

So final average = initial average + 3

- If the group items are decreased by any common value then the average value will also decrease by same.
- If the group items are multiplied or divided by any constant value then the average value will also be multiplied or divided by the same.
- The average value will always lie between the smallest value of the group and the largest value of the group.

### Alternate way of Calculation of Average

Let us say that a group contains  $n$  numbers  $P_1, P_2, P_3, \dots$ . Then take a value which can be assumed as the mean value. Take the deviations of mean value 'x' from the given values. If deviations are  $Q_1, Q_2, Q_3, \dots, Q_n$ . Then the average will be

$$x + \frac{Q_1 + Q_2 + Q_3 + \dots + Q_n}{n}$$

#### Example 1.

6 Students have their weights as 60, 62, 63, 67, 69, 74 kg. Find their average weight.

#### Solution:

Let us assume the mean value as 67, then average will be

$$67 + \frac{-7 - 5 - 4 + 2 + 7}{6}$$

$$= 67 - \frac{7}{6} = 65.83 \text{ kg}$$

### Concept of Weighted Average

When we talk about the average of two different groups or more than two different groups. The average value of all groups taken together will not be just depending upon the average of groups. For example if we take two different groups of average weights as 60 & 70 kg respectively then the average of all the groups element taken together need not

be  $\frac{60 + 70}{2} = 65 \text{ kg}$  always. It can vary based on

the number of elements in the group. So in this case the numbers of group elements plays a very important role, let the first group has 20 persons while the second group has 30 persons. Then the average will be

$$\begin{aligned} \frac{\text{Total weight}}{\text{Total numbers}} &= \frac{20 \times 60 + 30 \times 70}{20 + 30} \\ &= \frac{1200 + 2100}{50} = \frac{3300}{50} = 66 \text{ kg} \end{aligned}$$

This sort of average is called as weighted average and weighted average is calculated as

$$\text{average} = \frac{n_1 A_1 + n_2 A_2 + n_3 A_3 + \dots}{n_1 + n_2 + n_3 + \dots}$$

where  $n_1, n_2, n_3, \dots$  are the number of elements in the groups. While  $A_1, A_2, A_3, \dots$  are the average of the groups.

Instead of exact value of numbers of elements we can also take the ratio of the number of elements.

### Example 1.

The average marks of students of class A is 37 while that of class B is 23. If the number of students in class A & B are 42 & 63 respectively then find out the average marks of all the students taken together.

**Solution:**

$$\text{Average} = \frac{2 \times 37 + 3 \times 23}{2 + 3}$$

( $\because$  since 42:63 = 2:3)

$$= \frac{74 + 69}{5} = \frac{143}{5} = 28.6$$

The weighted average has wide range of applications. The weightage need not be necessarily the number of elements. It can be any characteristic of group that affect the group's standing in the total. We will see some examples here.

### Example 2.

If two alloys having the ratio of copper & gold in the ratio 3 : 4 and 2 : 5 are mixed and 14 kg of first alloy is mixed with 21 kg of the second alloy. Find out the new ratio of gold and copper in the mixture.

**Solution:**

The ratio of mixing = 14 : 21 = 2 : 3

So this will be the weightage for the mixing.

Now if we talk, about the quantity of gold in both the alloy.

It is  $\frac{4}{7}$  and  $\frac{5}{7}$ .

So the amount of gold in the mixture

$$= \frac{\frac{2 \times 4}{7} + \frac{3 \times 5}{7}}{2 + 3} = \frac{23}{35}$$

So the ratio of gold to copper is 23 : 12.

## Mixture & Alligation technique

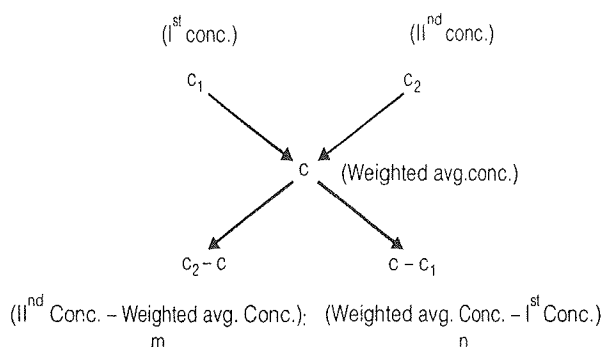
When it comes to the mixing of two different quantities. Weighted average comes into the picture. If two solutions of concentration  $c_1$  and  $c_2$  are mixed in the ratio  $m : n$ . Then the weightage concentration  $c$  will be

$$c = \frac{m \times c_1 + n \times c_2}{m + n}$$

or we can rearrange the formula as

$$\frac{m}{n} = \frac{c_2 - c}{c - c_1}$$

This is called as alligation formula. It can also be understood with pictorial representation.



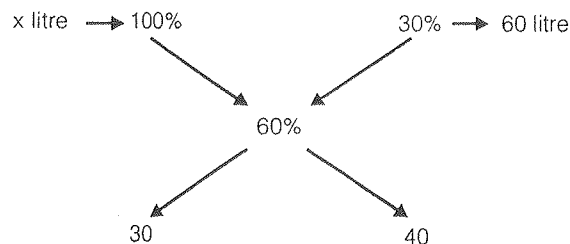
So it can be understood as the alligation technique provides us the ratio of mixing directly. Alligation technique has to be used when the weighted average is given & weighted average formula has to be used when weighted average is not given. Let us understand it better with some examples.

### Example 1.

How much water has to be added in 60 litre of 70% milk solution. To make it as 40% milk solution.

**Solution:**

The concentration of water will be 30% and 60% respectively.



So ratio of mixing is 3 : 4

$$\Rightarrow \frac{x}{60} = \frac{3}{4}$$

$$\Rightarrow x = 45 \text{ litres}$$

## Replacement

In case of replacement problem, one part of a solution is taken out and is replaced with another ingredient. We have to look for the ingredient having constant trend and the ingredient which is continuously decreasing will keep on decreasing with the same percentage value. Let us understand this with one example.

### Example 1.

A container has 100 litre of pure milk, after every 10 minutes 10 litre of the solution is taken out and is replaced with water find out what will be the net amount of milk, after 30 mins. in the solution?

#### Solution:

From 100 litre of the solution 10 litre of the solution is being replaced. Three such operations will be carried out in 30 mins. Let us understand this in an elaborate manner.

#### After 10 mins:

10 litre of the milk will be replaced with water. So in the solution there will be

Milk = 90 litre

Water = 10 litre

#### After 20 minutes:

Now when the 10 litre solution will be taken out, it will be having milk and water in ratio 9 : 1.

So out of 10 litre solution milk taken out is = 9 litre  
remaining amount of milk =  $90 - 9 = 81$  litre

the remaining portion will be water so the amount of water =  $100 - 81 = 19$  litre

Now ratio of milk and water = 81 : 19

#### After 30 minutes:

Now the 10 litre solution which is taken out will have milk and water in ratio 81 : 19

So amount of milk taken out

$$= 10 \times \frac{81}{81+19} = 8.1 \text{ litre}$$

the amount of milk remaining

$$= 81 - 8.1 = 72.9 \text{ litre}$$

the amount of water =  $100 - 72.9 = 27.1$  litre

Now let us take the amount of milk and water for the previous example.

Milk	Water	
100	0	
90	10	→ After 1 <sup>st</sup> replacement
81	19	→ After 2 <sup>nd</sup> replacement
72.9	27.1	→ After 3 <sup>rd</sup> replacement

Total volume of the solution = 100 litre

total replaced volume = 10 litre

Now we can understand in every cycle 10% of the total solution is being replaced.

Talking about the flow of ingredients, milk has on outward flow (only being taken out not being added) While water has both inward & outward flow. So it we see the trend of the single flow ingredient, the value of milk is continuously decreasing by 10% successively

$$90 = 100 (1 - 0.1)$$

$$81 = 100 (1 - 0.1)^2$$

$$72.9 = 100 (1 - 0.1)^3$$

Thus, it has to be kept in mind that

"During replacement if the solution that is being replaced is P% of the total solution, then the ingredient having single-directional flow will decrease by P% after every cycle."

This is the basic idea behind replacement.

### Example 2.

A person makes a profit of 15% on 20% of the quantity sold while on the rest he makes a profit of 5%. Find out the net profit percentage?

#### Solution:

Let us say the total quantity is  $x$

$$20\% \text{ of the quantity} = \frac{x}{5}$$

$$80\% \text{ of the quantity} = \frac{4x}{5}$$

$$\text{on } \frac{x}{5} \text{ the profit made} = \frac{15}{100} \times \frac{x}{5} = \frac{3x}{100}$$

$$\text{on } \frac{4x}{5} \text{ the profit made} = \frac{5}{100} \times \frac{4x}{5} = \frac{4x}{100}$$

$$\text{Net profit} = \frac{7x}{100} = 7\% \text{ of } x.$$

#### Alternate

The same problem can be taken as the two parts are 20% & 80% i.e. they are in the ratio 1 : 4 and he is making different profit so net profit percent

$$= \frac{1 \times 15 + 4 \times 5}{1 + 4} = \frac{35}{5} = 7\%$$

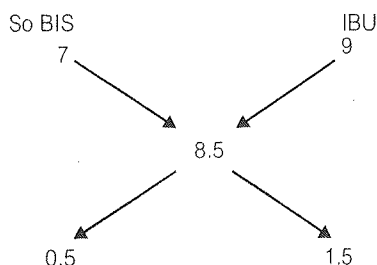
### Example 3.

Ramesh deposits some amount in BIS bank at 7% interest rate p.a. & some part of amount in IBU bank, at 9% p.a. & he gets Rs. 850 on Rs. 10000 yearly. Find out the amount invested in BIS bank.

### Solution:

850 out of 100000 means the net interest rate

$$= \frac{850}{10000} \times 100 = 8.5\%$$



So the amount invested are in the ratio 1 : 3 for BIS & IBU

$$\begin{aligned} \text{So the amount in BIS} &= \frac{1}{1+3} \times 10000 \\ &= \text{Rs. 2500} \end{aligned}$$

### Example 4.

A Jar contains solution having milk and water in the ratio 3 : 2. If out of 100 litres, 10 litre is taken out & is replaced with water in one cycle. Find out the amount of water after 2 cycles.

### Solution:

Out of 100 litre solution,

$$\text{Milk} = \frac{3}{5} \times 100 = 60 \text{ litre}$$

$$\text{Water} = \frac{2}{5} \times 100 = 40 \text{ litre}$$

Now percent of solution which is being replaced with water

$$= \frac{10}{100} \times 100 = 10\%$$

so amount of milk after 2 such cycles

$$\begin{aligned} &= 60 \times (1 - 0.1)(1 - 0.1) \\ &= 48.6 \text{ litre} \end{aligned}$$

Net amount of water

$$= 100 - 48.6 = 51.4 \text{ litre}$$



## Solved Example

- The average age of 24 students and the principal is 15 years. When the principal's age is excluded, the average age decreases by 1 year. What is the age of principal?

- (a) 38 (b) 40  
(c) 39 (d) Data inadequate

**Ans. (c)**

Average age of 24 students

$$= \frac{\text{sum of ages of 24 students}}{24}$$

$$\Rightarrow 14 = \frac{\text{sum of ages of 24 students}}{24}$$

$$\begin{aligned} \therefore \text{sum of ages of 24 students} &= 24 \times 14 \\ &= 336 \text{ years} \end{aligned}$$

Let the Age of principal be  $x$  year

Then, average age of 24 students and the principal

$$= \frac{\text{sum of ages of 24 students \& principal}}{25}$$

$$\Rightarrow 15 = \frac{336 + x}{25}$$

$$\Rightarrow x = 25 \times 15 - 336 = 39 \text{ years}$$

- The average weight of 3 men A, B and C is 84 kg. Another man D joins the group and the average now becomes 80 kg. If another man E, whose weight is 3 kg more than that of D, replaces A then the average weight of B, C, D and E becomes 78 kg. The weight of A is

- (a) 70kg (b) 72 kg  
(c) 79 kg (d) 78 kg

**Ans. (c)**

Sum of weights of A, B and C

$$= 3 \times 84 = 252 \text{ kg}$$

sum of weights of A, B, C and D

$$= 4 \times 80 = 320 \text{ kg}$$

$$\text{weight of D} = 320 - 252 = 68 \text{ kg}$$

$$\therefore \text{weight of E} = 68 + 3 = 71 \text{ kg}$$

Now, sum of weights of A, B, C, D and E

$$= 320 + 71 = 391 \text{ kg}$$

sum of weights of B, C, D and E

$$= 4 \times 78 = 312 \text{ kg}$$

$$\therefore \text{weight of A} = 391 - 312 = 79 \text{ kg}$$

3. Vijay Tendulkar has certain average for 9 innings. In the tenth inning, he scores 100 runs thereby increasing his average by 8 runs. His new average is

(a) 20 (b) 24  
(c) 28 (d) 32

**Ans. (c)**

Let the old average and new average be  $x$  and  $y$  respectively

$$\text{Then, } y = x + 8 \quad \dots(i)$$

$$\text{and } y = \frac{9x + 100}{10} \quad \dots(ii)$$

From (i) and (ii) we get

$$10(x + 8) = 9x + 100$$

$$\Rightarrow x = 20$$

$$\therefore y = 20 + 8 = 28$$

4. The average age of 8 persons in a committee is increased by 2 years when two men aged 35 years and 45 years are substituted by two women. Find the average age of the two women.

(a) 48 (b) 45  
(c) 51 (d) 42

**Ans. (a)**

Let the average age of 8 persons in the committee be  $x$  years

Let the sum of ages of two women be  $y$  years.

Then sum of ages of 6 persons excluding two men aged 35 and 45 years

$$= 8x - (35 + 45) = 8x - 80$$

$$\text{Again, } x + 2 = \frac{8x - 80 + y}{8}$$

$$\Rightarrow 8x + 16 = 8x - 80 + y$$

$$\Rightarrow y = 96$$

$\therefore$  average age of two women

$$= \frac{96}{2} = 48 \text{ years}$$

5. The speed of the train in going from Nagpur to Allahabad is 100 km/hr while when coming back from Allahabad to Nagpur, its speed is 150 km/hr. Find the average speed during the whole journey.

(a) 125 (b) 75  
(c) 135 (d) 120

**Ans. (d)**

Let the distance between Allahabad and Nagpur be  $x$  km.

$$\begin{aligned} \text{The average speed} &= \frac{2x}{\frac{x}{100} + \frac{x}{150}} \\ &= \frac{2 \times 100 \times 150}{250} = 120 \text{ km/hr.} \end{aligned}$$

6. The age of Mitali and Pooja is in the ratio 2 : 6. After 5 years, the ratio of their ages will become 6 : 8. Find the average of their ages after 10 years.

(a) 12 (b) 13  
(c) 17 (d) 24

**Ans. (a)**

Let the present age of Mitali and Pooja be  $2x$  and  $6x$  years respectively.

$$\text{After 5 years, } \frac{2x + 5}{6x + 5} = \frac{6}{8}$$

$$\Rightarrow 16x + 40 = 36x + 30$$

$$\Rightarrow 20x = 10$$

$$\therefore x = \frac{1}{2}$$

Hence Present ages are 1 and 3 years

After ten years, their ages will be 11 and 13 years.

$\therefore$  Average of their ages

$$= \frac{11 + 13}{2} = 12 \text{ years}$$

7. Find the average of the first 97 natural numbers.

(a) 47 (b) 37  
(c) 48 (d) 49

**Ans. (d)**

Sum of the first 97 natural members

$$= \frac{97(97 + 1)}{2} = 4753$$

$$\therefore \text{Their average} = \frac{4753}{97} = 49$$

8. Find the average of all prime numbers between 30 and 50.

(a) 39.8 (b) 38.8  
(c) 37.8 (d) 41.8

**Ans. (a)**

The prime number between 30 and 50 are

31, 37, 41, 43, 47

$\therefore$  Their average

$$= \frac{31 + 37 + 41 + 43 + 47}{5} = 39.8$$

9. The average of 5 consecutive number is  $n$ . If the next two numbers are also included, the average will.

- (a) increased by 1    (b) remain the same  
(c) increased by 1.4    (d) increased by 2

**Ans. (a)**

Let the five consecutive numbers be  $x, x+1, x+2, x+3$ , and  $x+4$ .

$$\text{Given, } n = \frac{x+x+1+x+2+x+3+x+4}{5}$$

$$\Rightarrow n = x+2$$

The average after including the next two numbers

$$= \frac{x+x+1+x+2+x+3+x+4+x+5+x+6}{7}$$

$$= x+3 = n-2+3$$

$$= n+1$$

Hence the average increases by 1.

10. The average of 50 numbers is 38. If two numbers, namely, 45 and 55 are discarded, the average of the remaining numbers is

- (a) 36.5                      (b) 37  
(c) 37.6                      (d) 37.5

**Ans. (d)**

Sum of 50 numbers

$$= 38 \times 50 = 1900$$

Sum of remaining numbers

$$= 1900 - (45 + 55) = 1800$$

average of remaining numbers

$$= \frac{1800}{48} = 37.5$$

11. The average weight of 5 men is decreased by 3 kg when one of them weighing 150 kg is replaced by another person. Find the weight of the new person?

- (a) 165                      (b) 135  
(c) 138                      (d) 162

**Ans. (b)**

Let the average weight of 5 men be  $x$  kg before replacement of one person.

Also, Let the weight of new person be  $y$  kg.

$$\text{Then, } 5x - 3 = \frac{5x - 150 + y}{5}$$

$$\Rightarrow 5x - 15 = 5x - 150 + y$$

$$\Rightarrow y = 135 \text{ kg}$$

12. The average age of the Indian cricket team playing the Nagpur test is 30. The average age of 5 of the players is 27 and that of another set of 5 players, totally different from the first five, is 29. If it is the captain who was not included in either of these two groups, then find the age of the captain.

- (a) 75  
(b) 55  
(c) 50  
(d) Cannot be determined

**Ans. (c)**

Let the age of the captain be  $x$  years

$$\text{Then, } 30 = \frac{27 \times 5 + x + 29 \times 5}{11}$$

$$\Rightarrow 330 = 135 + x + 145$$

$$\therefore x = 330 - 280 = 50 \text{ years}$$

13. Out of three numbers, the first is twice the second and three times the third. The average of the three numbers is 88. The smallest number is

- (a) 72                      (b) 36  
(c) 42                      (d) 48

**Ans. (d)**

Let the first number be  $n$ . then the other two numbers

$$\text{will be } \frac{n}{2} \text{ and } \frac{n}{3}$$

$$\text{Again, } 88 = \frac{n + \frac{n}{2} + \frac{n}{3}}{3}$$

$$\Rightarrow 88 = \frac{n}{3} \left( 1 + \frac{1}{2} + \frac{1}{3} \right)$$

$$\Rightarrow 88 = \frac{n}{3} \times \frac{11}{6}$$

$$\therefore \text{The smallest number} = \frac{n}{3} = \frac{144}{3} = 48$$

14. The average of first five multiples of 3 is

- (a) 3                      (b) 9  
(c) 12                      (d) 15

**Ans. (b)**

$$\text{Average} = \frac{3(1+2+3+4+5)}{5} = \frac{3 \times 15}{5} = 9$$

15. The average temperature of 1<sup>st</sup>, 2<sup>nd</sup> 3<sup>rd</sup> December was 24.4°C. The average temperature of the first two days was 24°C. The temperature on the 3<sup>rd</sup> of December was

- (a) 20°C                      (b) 25°C  
(c) 25.2°C                      (d) None of these

**Ans. (c)**

Let the temp. on 3<sup>rd</sup> of December be  $x$  C. Then

$$24.4 = \frac{2 \times 24 + x}{3} = 25.2^\circ \text{C}$$

16. The average of 20 results is 30 and that of 30 more results is 20. For all the results taken together, the average is

(a) 25 (b) 50  
(c) 12 (d) 24

Ans. (d)

The required average

$$= \frac{20 \times 30 + 30 \times 20}{50} = \frac{1200}{50} = 24$$

17. The average temperature on Monday, Tuesday and Wednesday was  $41^{\circ}\text{C}$  and on Tuesday, Wednesday and Thursday it was  $40^{\circ}\text{C}$ . If on Thursday it was exactly  $39^{\circ}\text{C}$ , then on Monday, the temperature was

(a)  $42^{\circ}\text{C}$  (b)  $46^{\circ}\text{C}$   
(c)  $23^{\circ}\text{C}$  (d)  $26^{\circ}\text{C}$

Ans. (a)

The sum of temp. on Tuesday and Wednesday  
 $= 3 \times 40 - 39 = 81^{\circ}\text{C}$

The sum of temp. on Monday, Tuesday, and Wednesday  $= 3 \times 41 - 81 = 42^{\circ}\text{C}$



## Average



### Practice Exercise: I

- There are 35 students in a hostel. If the number of students increased by 7, the expenses of the mess were increased by Rs. 42 per day while the average expenditure per head diminished by Rs. 1. Find the original expenditure of the mess.  
 (a) Rs. 480 (b) Rs. 440  
 (c) Rs. 520 (d) Rs. 420
- An aeroplane travels distances 2500 km, 1200 km and 500 km at the rate of 500 km/hr, 400 km, and 250 km/hr, respectively. The average is  
 (a) 420 km/hr (b) 410 km/hr  
 (c) 405 km/hr (d) 575 km/hr
- The average weight of 24 students of section A of a class is 58 kg whereas the average weight of 26 students of section B of the same class is 60.5 kg. Find the average weight of all the 50 students of the class.  
 (a) 57.4 Kg. (b) 59.3 kg  
 (c) 58.9 kg (d) 59.7 kg
- The average monthly salary of a staff of 9 persons is Rs. 2450. One member of the staff whose monthly salary is Rs. 2650. Find the average salary of the remaining 8 persons of the staff.  
 (a) Rs. 2425 (b) Rs. 2625  
 (c) Rs. 3025 (d) Rs. 2825
- 3 years ago the average age of a family of 5 members was 17 years. With the birth of a new baby the average remains the same even today. Find the age of the baby.  
 (a) 1 years (b) 3 years  
 (c)  $2\frac{1}{2}$  years (d) 2 years
- A batsmen in his 17th innings makes a score of 85, and thereby increases his average by 3. What is his average after the 17th innings? He had never been 'not out'.  
 (a) 47 (b) 37  
 (c) 39 (d) 43
- The sum of three numbers is 98. If the ratio between first and second be 2 : 3 and that between second and third be 5 : 8, then the second number is  
 (a) 30 (b) 20  
 (c) 58 (d) 48
- A number  $x$  equals 80% of the average of 5, 7, 14 and a number  $y$ . If the average of  $x$  and  $y$  is 26, the value of  $y$  is  
 (a) 13 (b) 26  
 (c) 39 (d) None of these
- The average age of 8 men is increased by 2 years. When two of them, whose ages are 20 years and 24 years respectively, are replaced by two women. What is the average age of these women?  
 (a) 36 years (b) 30 years  
 (c) 40 years (d) 42 years
- The average speed of a train running at a speed of 30 km/hr during the first 100 kilometers, at 40 km/hr during the second 100 kilometers and at 50 km/hr during the last 100 kilometers is nearly  
 (a) 38.5 km/hr (b) 38.3 km/hr  
 (c) 40.0 km/hr (d) 39.2 km/hr
- The average weight of 3 men A, B and C is 84 kg. Another men D joins the group and the average now becomes 80 kg. If another men E, whose weight is

- 3 kg more than that of D, replaces A, then average weight of B, C, D and E becomes 79 kg. The weight of A is
- (a) 70 kg                      (b) 72 kg  
(c) 75 kg                      (d) 80 kg
12. The average of marks obtained by 120 candidates was 35. If the average of marks of passed candidates was 39 and that of failed candidates was 15, the number of candidates who passed the examination is
- (a) 100                      (b) 110  
(c) 120                      (d) 150
13. In a class, there are 20 boys whose average age is decreased by 2 months, when one boy aged 18 years is replaced by a new boy. The age of the new boy is
- (a) 14 yrs. 8 months  
(b) 15 years  
(c) 16 yrs 4 months  
(d) 17 yrs. 10 months
14. The average daily wages of A, B and C is Rs. 120. If B earns Rs. 40 more than C per day and A earns double of what C earns per day, the wages of A per day is
- (a) Rs. 80                      (b) Rs. 120  
(c) Rs. 160                      (d) Rs. 100
15. With an average speed of 40km/hr a train reaches its destination on time. If it goes with an average speed of 35 km/hr, it is late by 15 minutes. The total journey is
- (a) 30 km                      (b) 40 km  
(c) 70 km                      (d) 80 km
16. In a competitive examination, the average marks obtained was 45. It was later discovered that there was some error in computerisation and the marks of 90 candidates had to be changed from 80 to 50 and the average came down to 40 marks. The total no. of candidates who appeared in examination is
- (a) 520                      (b) 550  
(c) 540                      (d) 525
17. A man whose bowling average is 12.4 takes 5 wickets for 26 runs and thereby decreases his average by 0.4. The number of wickets, taken by him before his last match is
- (a) 85                      (b) 78  
(c) 72                      (d) 64

18. The average age of a committee of 8 members is 40 years. A member, aged 55 years, retired and he was replaced by a member aged 39 years. The average age of the present committee is
- (a) 39 years                      (b) 38 years  
(c) 36 years                      (d) 35 years

□□□□

## Solutions

1. **Ans. (d)**

Let the original expenditure = Rs.  $x$

$$\text{Original average expenditure} = \frac{x}{35}$$

$$\text{New average expenditure} = \frac{x+42}{42}$$

$$\Rightarrow \frac{x}{35} - \frac{x+42}{42} = 1 \Rightarrow x = 420$$

$\therefore$  Original expenditure = Rs. 420

2. **Ans. (a)**

The total time taken can be calculated as shown below :

Distance	Speed	Time
25 km	500 km/hr	5 hrs.
1200 km	400 km/hr	3hrs.
500 km	250 km/hr	2hrs.
Total 4200 km		10hrs.

$$\text{Average speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$

$$\text{Average speed} = \frac{4200}{10} = 420 \text{ km/hr.}$$

3. **Ans. (b)**

Average weight of 24 students of section

$$A = 58 \text{ kg}$$

Total weight of 24 students of section

$$A = 58 \times 24 = 1392 \text{ kg}$$

Total weight of 26 students of section B(a) an

$$\text{Average of} = 60.5 \text{ kg} = 60.5 \times 26 = 1573$$

$$\text{Total weight of 50 student} = (1392 + 1573) \text{ kg} = 2965 \text{ kg}$$

Average weight of students of students in the class

$$= \frac{2965}{50} = 59.3 \text{ kg.}$$



4. Ans. (a)

Average salary of 9 persons = Rs. 2450

Total salary of 9 persons

$$= \text{Rs. } 2450 \times 9 = \text{Rs. } 22050$$

Salary of the person who is transferred

$$= \text{Rs. } 2650$$

Thus, the total salary of remaining 8 persons

$$= \text{Rs. } 22050 - 2650 = \text{Rs. } 19400$$

The average salary of the remaining 8 persons

$$= \text{Rs. } \frac{19400}{8} = \text{Rs. } 2425.$$

5. Ans. (d)

Present age of 5 members

$$= (5 \times 17 + 3 \times 5) \text{ years.}$$

$$= 100 \text{ years.}$$

Present age of 5 members and a baby

$$= 17 \times 6 = 102 \text{ yrs.}$$

$$\therefore \text{Age of the baby} = (102 - 100) \text{ yrs} = 2 \text{ years.}$$

6. Ans. (b)

Average score before 17<sup>th</sup> innings

$$= 85 - 3 \times 17 = 34$$

$\therefore$  Average score after 17<sup>th</sup> innings

$$= 34 + 3 = 37.$$

7. Ans. (a)

Let the number be  $x$ ,  $y$  and  $z$ . Then,

$$x + y + z = 98, \frac{x}{y} = \frac{2}{3} \text{ and } \frac{y}{z} = \frac{5}{8}$$

$$\therefore x = \frac{2y}{3} \text{ and } z = \frac{8y}{5}$$

$$\text{So } \frac{2y}{3} + y + \frac{8y}{5} = 98$$

$$\text{or, } \frac{49y}{15} = 98 \text{ or, } y = 30.$$

8. Ans. (c)

$$\text{Average of 5, 7, 14 and } y = \frac{5+7+14+y}{4}$$

Therefore,  $x = 80\%$  of

$$\frac{5+7+14+y}{4} = \frac{80}{100} \times \frac{26+y}{4}$$

$$\Rightarrow x = \frac{26+y}{5} \quad \dots(i)$$

$$\text{Also } \frac{x+y}{2} = 26 \quad \dots(ii)$$

From (i) and (ii), we get

$$52 - y = \frac{26+y}{5} \Rightarrow y = 39.$$

9. Ans. (b)

Let the average age of 8 men be  $x$  years

$\therefore$  Sum of the ages of 8 men =  $8x$  years

Now, according to the condition of the question, average age of (6 men + 2 women)

$$= (x + 2) \text{ years}$$

$\therefore$  Sum of the ages of (6 men + 2 women)

$$= 8(x + 2) = 8x + 16 \text{ years}$$

Hence, it is clear that on replacing two men by two women, sum of their ages increased by 16 years

Therefore, sum of the ages of two women

$$= (20 + 24) + 16 = 60 \text{ yrs}$$

$$\therefore \text{Average age of the women } \frac{60}{2} = 30 \text{ yrs}$$

10. Ans. (b)

Time taken to cover first 100 kilometres

$$= \frac{100}{30} = 3\frac{1}{3} \text{ hrs}$$

Time taken to cover second 100 kilometres

$$= \frac{100}{40} = 2\frac{1}{2} \text{ hrs}$$

Time taken to cover last 100 kilometres

$$= \frac{100}{50} = 2 \text{ hrs}$$

Total time taken

$$3\frac{1}{3} + 2\frac{1}{2} + 2 = \frac{10}{3} + \frac{5}{2} + 2 = \frac{47}{6} \text{ hrs.}$$

Total distance covered = 300 km

$$\therefore \text{Average speed} = \frac{300}{47/6}$$

$$= \frac{300 \times 6}{47} = 38.3 \text{ km/hr}$$

11. Ans. (c)

Weight of D =  $(80 \times 4 - 84 \times 3) \text{ kg} = 68 \text{ kg}$

Weight of E =  $(68 + 3) \text{ kg} = 71 \text{ kg}$

(B + C + D + E)'s

Weight =  $(79 \times 4) \text{ kg} = 316 \text{ kg}$

$$\therefore (B+C)'s \text{ weight} = [316 - (68 + 71)] \text{ kg}$$

$$= 177 \text{ kg}$$

Hence, A's weight =  $[(84 \times 3) - 177] \text{ kg} = 75 \text{ kg}$

**12. Ans. (a)**

Let the number of candidates who passed =  $x$ .

Then,  $39 \times x + 15 \times (120 - x) = 120 \times 35$

$$\therefore 24x = 4200 - 1800$$

$$\text{or, } x = \frac{2400}{24}, x = 100.$$

**13. Ans. (a)**

Total decrease =  $(20 \times 2)$  months

= 3 years 4 months

$\therefore$  Age of the new boy = 18 years - 3 years 4 months  
= 14 years 8 months.

**14. Ans. (c)**

Let daily wages of C =  $x$

Then, daily wages of A =  $2x$

and, daily wages of B =  $x + 40$

Hence, average daily wages of A, B and C

$$= \frac{x + 2x + x + 40}{3} = \frac{4x + 40}{3}$$

$$\therefore \frac{4x + 40}{3} = 120 \text{ or, } 4x + 40 = 360$$

$$\Rightarrow 4x = 320 \text{ or, } x = 80$$

$\therefore$  Wages of A per day =  $2 \times 80 = \text{Rs. } 160$ .

**15. Ans. (c)**

$$\frac{x}{35} - \frac{x}{40} = \frac{15}{60} \text{ or, } \frac{5x}{35 \times 40} = \frac{1}{4}$$

$$\text{or, } x = \frac{35 \times 40}{5 \times 4} = 70$$

**16. Ans. (c)**

Let the number of candidates be  $x$ . Then, total marks obtained by all the candidates =  $45x$

Total change in marks for 90 candidates

$$= 30 \times 90 = 2700$$

Total reduced marks =  $45x - 2700$

$$\text{Reduced average} = \frac{45x - 2700}{x}$$

$$\therefore 40 = \frac{45x - 2700}{x}$$

$$\text{or, } 40x = 45x - 2700$$

$$\Rightarrow 5x = 2700 \text{ or, } x = 540$$

**17. Ans. (a)**

Let the number of wickets taken before the last match =  $x$

$$\text{Then, } \frac{12.4x + 26}{x + 5} = 12 \Rightarrow x = 85$$

**18. Ans. (b)**

New average of the committee (in years)

$$= \frac{8 \times 40 - 55 + 39}{8} = \frac{320 - 16}{8} = \frac{304}{8}$$

= 38 years.

