GATE

Formulas & Shortcuts for General Aptitude

TIME AND DISTANCE -> IMPORTANT FACTS AND FORMULAE

- Speed = [Distance/Time], Time=[Distance/Speed], Distance = (Speed*Time)
- x km/hr = [x*5/18] m/sec.
- If the ratio of the speeds of A and B is a:b, then the ratio of the times taken by them to cover the same distance is 1/a : 1/b or b:a.
- x m/sec = [x*18/5] km/hr.
- Suppose a man covers a certain distance at x km/hr and an equal distance at y km/hr. then, the average speed during the whole journey is [2xy/x+y] km/hr.

TIME AND WORK

- Work from Days: If A can do a piece of work in n days, work done by A in 1 day = 1/n
- Days from Work: If A does 1/n work in a day, A can finish the work in n days.
- If M1 men can do W1 work in D1 days working H1 hours per day and M2 men can do W2 work in D2 days working H2 hours per day (where all men work at the same rate), then: M1 D1 H1 / W1 = M2 D2 H2 / W2
- If one person A takes "x" days to complete a work alone and another person B takes "y" days to complete the same work alone, then the number days both A and B take working together is : xy / (x + y)
- If three persons A, B and C take "x", "y" and "z" days respectively to complete a work working alone, then the number of days taken by all three working together is: xyz / (xy + yz + xz)
- If A is thrice as good as B in work, then
  Ratio of work done by A and B = 3 : 1, and
  Ratio of time taken to finish a work by A and B = 1 : 3
- To finish a same amount of work, if M1 men take D1 days and M2 men take D2 days, then: M1 × D1 = M2 × D2
- To finish the same amount of work, if M1 men take D1 days working H1 hours a day, and M2 men take D2 days working H2 hours a day, then : M1 × D1 × H1 = M2 × D2 × H2

NOTE:
-Men is always inversely Proportional to Number of days.
-Men is always Directly Proportional to Work.

AGE:

- If the present age is A, then n times the age is nA.
- If the present age is M, then age x years later /hence = M+x
- If the current age is B, then age X year ago = B-X
- Age in ratio X:Y will be XA and YA
- If the present age is A, then 1/n of the ages is A/n.

PROFIT AND LOSS

- Cost Price : The price at which an article is purchased, is called its cost price, abbreviated as C.P.
- Selling Price : The price at which an article is sold, is called its selling price, abbreviated as S.P.
- Profit or Gain : If S.P. is greater than C.P., the seller is said to have some profit.
- Loss: If S.P is less than C.P., the seller is said to have incurred a loss.
- Gain = (S.P.) - (C.P.)
- Loss or gain is always reckoned on C.P.
- gain% = [Gain*100/C.P.]
- Loss = (C.P.) - (S.P.)
- Loss% = [Loss*100/C.P.]
- S.P. = (100+Gain%)/100 * C.P.
- S.P. = (100-Loss%)/100 * C.P.
- C.P. = 100/(100+Gain%) * S.P.
- C.P. = 100/(100-Loss%) * S.P.
- If an article is sold at a gain of say, 35%, then S.P. = 135% of C.P.
- If an article is sold at a loss of say, 35%, then S.P. = 65% of C.P.

BOATS AND STREAMS

- Stream: Moving water of the river is called stream.
- Still Water: If the water is not moving then it is called still water.
- In water, the direction along the stream is called downstream.
- The direction against the stream is called upstream.
- If the speed of a boat in still water is u km/hr and the speed of the stream is v km/hr, then : Speed downstream = (u + v) km/hr , and Speed upstream (u - v) km/hr.
- If the speed downstream is a km/hr and the speed upstream is b km/hr, then: Speed in still water = 1/2 (a + b) km/hr . and Rate of stream = 1/2 (a - b) km/hr.

VOLUME AND SURFACE AREA

I. CUBIOD : Let length = l, breadth = b and height = h units. Then,
- Volume = (l x b x h) cubic units.
- Surface area = 2 (lb + bh + lh)

II. CUBE : Let each edge of a cube be of length a. Then,
- Volume = a^3 cubic units.
- Surface area = $6a^2$ sq. units.
- Diagonal = $\sqrt{3}$ a units.

III. CYLINDER: Let radius of base = r and Height (or length) = h Then,
- Volume = ($\Pi r^2 h$) cubic units.
- Curved surface area = ($2\Pi rh$) sq. units.
- Total surface area = ($2\Pi rh + 2\Pi r^2$ sq. units) = $2\Pi r$ (h + r) sq. units.

IV. CONE: Let radius of base = r and Height = h. Then,
- Slant height, l = $\sqrt{h^2 + r^2}$ units.
- Volume = [1/3 $\Pi r^2 h$] cubic units.
- Total surface area = ($\Pi rl + \Pi r^2$) sq.units.

V. SPHERE: Let the radius of the sphere be r. Then,
- Volume = [4/3 Πr3] cubic units.
- Surface area = ($4\Pi r^2$) sq. units.

VI. HEMISPHERE: Let the radius of a hemisphere be r. Then,
- Volume = [2/3 Πr3] cubic units.
- Curved surface area = ($3\Pi r^2$) sq. units.
- Total surface area = ($3\Pi r^2$) sq. units.

SIMPLE INTEREST:

- Principal: The money borrowed or lent out for a certain period is called the principal of the sum.
- Interest: Extra money paid for using other's money is called interest.
- Simple Interest (S.I.): If the interest on a sum borrowed for a certain period is reckoned uniformly, then it is called simple interest.

Let Principal = P, Rate = R% per annum (p.a.) and Time = T years, Then,
(i) S.I. = [P * R * T / 100]
(ii) P = [100 * S.I. / R * T]
R = [100 * S.I / P * T] and T = [100 * S.I. / P * R]

Numbers:

- Natural Numbers : Counting numbers 1, 2, 3, 4, 5,..... are called natural numbers.
- Whole Numbers: All counting numbers together with zero form the set of whole numbers. Thus, (i) 0 is the only whole number which is not a natural number. (ii) Every natural number is a whole number.
- Integers: All natural numbers, 0 and negatives of counting numbers i.e., {…, - 3, - 2, - 1, 0, 1, 2, 3,...} together form the set of integers.
  (i) Positive Integers: {1, 2, 3, 4, …} is the set of all positive integers.
  (ii) Negative Integers: {- 1, - 2, - 3,…} is the set of all negative integers.
  (iii) Non-Positive and Non-Negative Integers: 0 is neither positive nor negative. So, {0, 1, 2, 3,….} represents the set of non-negative integers, while {0, - 1 , - 2 , - 3 ,.....} represents the set of non-positive integers.
- Even Numbers: A number divisible by 2 is called an even number, e.g., 2, 4, 6, 8, 10, etc.
- Odd Numbers: A number not divisible by 2 is called an odd number. e.g., 1, 3, 5, 7, 9, 11, etc.
- Prime Numbers: A number greater than 1 is called a prime number, if it has exactly two factors, namely 1 and the number itself.
  Prime numbers upto 100 are: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, and 97.
- Composite Numbers: Numbers greater than 1 which are not prime are known as composite numbers, e.g., 4, 6, 8, 9, 10, 12.
  Note:
  (i) 1 is neither prime nor composite.
  (ii) 2 is the only even number which is prime.
  (iii) There are 25 prime numbers between 1 and 100.
- Co-primes : Two numbers a and b are said to be co-primes, if their H.C.F. is 1. e.g., (2, 3), (4, 5), (7, 9), (8, 11), etc. are co-primes.
- (1 + 2 + 3 + ...+ n) = n (n + 1) / 2
- (1 2 + 22 + 32 + ... + n2) = n (n + 1) (2n + 1) / 6
- (1 3 + 23 + 33 + ... + n3) = n2 (n + 1)2 / 4

$(a + b)(a - b) = (a^2 - b^2)$

$(a + b)^2 = (a^2 + b^2 + 2ab)$

$(a - b)^2 = (a^2 + b^2 - 2ab)$

$(a + b + c)^2 = a^2 + b^2 + c^2 + 2(ab + bc + ca)$

$(a^3 + b^3) = (a + b)(a^2 - ab + b^2)$

$(a^3 - b^3) = (a - b)(a^2 + ab + b^2)$

$(a^3 + b^3 + c^3 - 3abc) = (a + b + c)(a^2 + b^2 + c^2 - ab - bc - ac)$

When $a + b + c = 0$, then $a^3 + b^3 + c^3 = 3abc$.

SURDS ADN INDICES

1. LAWS OF INDICES:
- $a^m * a^n = a^{m+n}$
- $a^m / a^n = a^{m-n}$
- $(a^m)^n = a^{mn}$
- $(ab)^n = a^n b^n$
- $(a/b)^n = a^n / b^n$
- $a^0 = 1$

2. SURDS : Let a be rational number and n be a positive integer such that a(1/n) = n√a

3 LAWS OF SURDS :
- n√a = $a^{(1/n)}$
- n√(ab) = n√a x n√b
- n√(a/b) = n√a / n√b
- $(n\sqrt{a})^n = a$

PROBLEMS ON TRAINS

- a km/hr = [a * 5/18]m/s.
- a m/s = [a * 18/5] km/hr.
- Time taken by a train of length l metres to pass a pole or a standing man or a signal post is equal to the time taken by the train to cover l metres.
- Time taken by a train of length l metres to pass a stationary object of length b metres is the time taken by the train to cover (l + b) metres.
- Suppose two trains or two bodies are moving in the same direction at u m/s and v m/s, where u>v, then their relatives speed = (u - v) m/s.
- Suppose two trains or two bodies are moving in opposite directions at u m/s and v m/s, then their relative speed is = (u + v) m/s
- If two trains of length a metres and b metres are moving in opposite directions at u
- If two trains of length a metres and b metres are moving in the same direction at u m/s and v m/s, then the time taken by the faster train to cross the slower train = (a + b)/(u - v) sec.
- If two trains (or bodies) start at the same time from points A and B towards each other and after crossing they take a and b sec in reaching B and A respectively, then (A's speed) : (B's speed) = (√b : √a).