

GATE

**Formulas & Shortcuts for
General Aptitude**

TIME AND DISTANCE -> IMPORTANT FACTS AND FORMULAE

- Speed = [Distance/Time], Time=[Distance/Speed], Distance = (Speed*Time)
- $x \text{ km/hr} = [x*5/18] \text{ m/sec.}$
- 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 $b:a$.
- $x \text{ m/sec} = [x*18/5] \text{ km/hr.}$
- Suppose a man covers a certain distance at $x \text{ km/hr}$ and an equal distance at $y \text{ km/hr}$. then, the average speed during the whole journey is $[2xy/x+y] \text{ km/hr.}$

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 M_1 men can do W_1 work in D_1 days working H_1 hours per day and M_2 men can do W_2 work in D_2 days working H_2 hours per day (where all men work at the same rate), then: $M_1 D_1 H_1 / W_1 = M_2 D_2 H_2 / W_2$
- 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 M_1 men take D_1 days and M_2 men take D_2 days, then: $M_1 \times D_1 = M_2 \times D_2$
- To finish the same amount of work, if M_1 men take D_1 days working H_1 hours a day, and M_2 men take D_2 days working H_2 hours a day, then : $M_1 \times D_1 \times H_1 = M_2 \times D_2 \times H_2$

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.
- $\text{Gain} = (\text{S.P.}) - (\text{C.P.})$
- Loss or gain is always reckoned on C.P.
- $\text{gain}\% = [\text{Gain} \times 100 / \text{C.P.}]$
- $\text{Loss} = (\text{C.P.}) - (\text{S.P.})$
- $\text{Loss}\% = [\text{Loss} \times 100 / \text{C.P.}]$
- $\text{S.P.} = (100 + \text{Gain}\%) / 100 \times \text{C.P.}$
- $\text{S.P.} = (100 - \text{Loss}\%) / 100 \times \text{C.P.}$
- $\text{C.P.} = 100 / (100 + \text{Gain}\%) \times \text{S.P.}$
- $\text{C.P.} = 100 / (100 - \text{Loss}\%) \times \text{S.P.}$
- 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. CUBOID : Let length = l , breadth = b and height = h units. Then,

- Volume = $(l \times b \times h)$ 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 = $[4/3 \pi r^3]$ cubic units.
- Surface area = $(4\pi r^2)$ sq. units.

VI. HEMISPHERE: Let the radius of a hemisphere be r . Then,

- Volume = $[2/3 \pi r^3]$ 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,

$$(i) \text{ S.I.} = [P * R * T / 100]$$

$$(ii) P = [100 * \text{S.I.} / R * T]$$

$$R = [100 * \text{S.I.} / P * T] \text{ and } T = [100 * \text{S.I.} / P * R]$$

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.
- $(1 + 2 + 3 + \dots + n) = n(n + 1) / 2$
- $(1^2 + 2^2 + 3^2 + \dots + n^2) = n(n + 1)(2n + 1) / 6$
- $(1^3 + 2^3 + 3^3 + \dots + n^3) = n^2(n + 1)^2 / 4$

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

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

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

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

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

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

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

$$\text{When } a + b + c = 0, \text{ then } a^3 + b^3 + c^3 = 3abc.$$

SURDS AND INDICES

1. LAWS OF INDICES:

- $a^m \times a^n = a^{m+n}$
- $a^m / a^n = a^{m-n}$
- $(a^m)^n = a^{mn}$
- $(ab)^n = a^n b^n$
- $(a/b)^n = a^n / b^n$
- $a^0 = 1$

2. SURDS : Let a be a rational number and n be a positive integer such that $a^{1/n} = \sqrt[n]{a}$

3 LAWS OF SURDS :

- $\sqrt[n]{a} = a^{1/n}$
- $\sqrt[n]{ab} = \sqrt[n]{a} \times \sqrt[n]{b}$
- $\sqrt[n]{a/b} = \sqrt[n]{a} / \sqrt[n]{b}$
- $(\sqrt[n]{a})^n = a$

PROBLEMS ON TRAINS

- $a \text{ km/hr} = [a \times 5/18] \text{ m/s}$.
- $a \text{ m/s} = [a \times 18/5] \text{ km/hr}$.
- 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 $u \text{ m/s}$ and $v \text{ m/s}$, where $u > v$, then their relative speed = $(u - v) \text{ m/s}$.
- Suppose two trains or two bodies are moving in opposite directions at $u \text{ m/s}$ and $v \text{ m/s}$, then their relative speed is = $(u + v) \text{ m/s}$.
- 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 $u \text{ m/s}$ and $v \text{ m/s}$, then the time taken by the faster train to cross the slower train = $(a + b)/(u - v) \text{ sec}$.
- 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 $(A's \text{ speed}) : (B's \text{ speed}) = (\sqrt{b} : \sqrt{a})$.