Aptitude

* Prime Numbers : 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97

25 prime no b/w 1 — 100

* Test of prime No. : $\boxed{n^2 \geq P}$ P = given No

check P is divisibly by any of prime no. less than or equal to n.
if No then it is a prime no.

* Divisibility :-

* Divisibility by 4 :- its last two digit is divisible by 4.
* Divisibility by 8 :- if hundred, ten and unit digit divisible by 8.
* Divisibility by 11 :- if difference b/w the sum of its digits at odd places and the sum of its digits at even places is either 0 or a number divisible by 11.

Series formulae :

(i) $1 + 2 + 3 + \cdots + n = \boxed{\frac{1}{2} n(n+1)}$

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Series formulae :

(i) $1+2+3+\cdots+n = \boxed{\frac{1}{2}n(n+1)}$

(ii) $1^2+2^2+3^2+\cdots+n^2 = \frac{1}{6}n(n+1)(2n+1)$

(iii) $1^3+2^3+3^3+\cdots+n^3 = \frac{1}{4}n^2(n+1)^2$

(iv) Arithmetic progression (A.P) : $a, a+d, a+2d, a+3d \ldots$

⇒ n^{th} term $= a+(n-1)d$

⇒ sum of n terms $= \frac{n}{2}[2a+(n-1)d]$

⇒ sum of n terms $= \frac{n}{2}(a+l)$, l = last term

(v) Geometric progression (G.P) :- $a, ar, ar^2, ar^3 \ldots$;

⇒ n^{th} term $= ar^{n-1}$

⇒ sum of n term $= \begin{cases} \frac{a(1-r^n)}{(1-r)}, & \text{if } r<1 \\ \frac{a(r^n-1)}{(r-1)}, & \text{if } r>1 \end{cases}$

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Imp.

$1 + r + r^2 + r^3 + \dots$

$(r<1)$

* Sum of infinite G.P $\Rightarrow$ $\boxed{S_\infty = \dfrac{a}{1-r}}$

* $\boxed{\text{Dividend} = (\text{Divisor} \times \text{Quotient}) + \text{Remainder}}$

Divisor) Dividend (Quotient
↓
Remainder

* (x^n+1) will be divisible by $(x+1)$ only when n is odd

* (x^n-1) will be divisible by $(x+1)$ only when n is even.

* for every Natural no. n, (x^n-a^n) is always divisible by $(x-a)$

* when n is even, (x^n-a^n) is completely divisible by $(x+a)$
* when n is odd, (x^n+a^n) is always divisible by $(x+a)$

# H.C.F = Highest common factor
L.C.M = Least common multiple

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L.C.M = Least common multiple

* Product of two number = product of their H.C.F and L.C.M
* H.C.F & L.C.M of fractions :-

$$\left(\text{H.C.F} = \frac{\text{H.C.F of Numerators}}{\text{L.C.M of Denominators}} \right), \quad \text{L.C.M} = \frac{\text{L.C.M of Numerator}}{\text{H.C.F of Denominator}}$$

* Basic formulae :

1) $(a^2 - b^2) = (a+b)(a-b)$
2) $(a+b)^2 = a^2 + b^2 + 2ab$, $(a-b)^2 = a^2 + b^2 - 2ab$
3) $(a+b+c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$
4) $(a^3 + b^3) = (a+b)(a^2 - ab + b^2)$
5) $(a^3 - b^3) = (a-b)(a^2 + ab + b^2)$
6) $(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$
7) $(a-b)^3 = a^3 - 3a^2b + 3ab^2 - b^3$

$(x-y) = \sqrt{(x+y)^2 - 4xy}$

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* Distance b/w two point ! : If going speed s_1 & return speed s_2 time taken is T hr,

$D = T \cdot S$ $\boxed{\text{distance} = T\left(\frac{s_1 s_2}{s_1 + s_2}\right)}$

* BODMAS Rule :: correct sequence in which operations are executed,

B → Bracket, D → Division, M → multiplication, A → Addition & S → Subtraction

* Remove in the order ! ( ) { } and [ ]

* Modulus of a Real Number $|a| = \begin{cases} a & \text{if } a > 0 \\ -a & \text{if } a < 0 \end{cases}$

* square Root = $\sqrt{x}$, $x^{1/2}$ Cube root $\sqrt[3]{x}$, $(x)^{1/3}$

* Average speed :- A man covers a certain distance at x kmph and equal distance at y kmph, then,

Imp

the Average speed during the whole journey is $\boxed{\frac{2xy}{x+y}}$ kmph

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Percentage :-

1) If the price of a commodity increase by R %, then the reduction in consumption so as not to increase the expenditure is $\left[\frac{R}{(100+R)} \times 100\right]$ %

* If price decrease by R % then the increase in consumption so as not to increase the expenditure is $\left[\frac{R}{(100-R)} \times 100\right]$ %

2)* Result on Population :- Let the population of a town be P now and suppose it increase at the rate of R % per annum, then

(I) Population after (बाद) n years $= P\left(1+\frac{R}{100}\right)^n$

(II) Population n years ago $= \frac{P}{\left(1+\frac{R}{100}\right)^n}$

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At a actual price P, the successive discount on d_1 and d_2 then the selling price

$$\boxed{S.P = P\left(\frac{100-d_1}{100}\right)\left(\frac{100-d_2}{100}\right)}$$

3) Result on Depreciation :- Let present value of machine be P, suppose it depreciates at rate R % per annum, then :-

(I) value of machine after n year (बाद) $= P\left(1-\frac{R}{100}\right)^n$

(II) Value of machine n year ago $= \dfrac{P}{\left(1-\frac{R}{100}\right)^n}$

4) If A is R % more than B, then B is less than A by

$$\left[\frac{R}{(100+R)} \times 100\right]\%$$

If A is R % less than B, then B is more than A by

$$\left[\frac{R}{(100-R)} \times 100\right]\%$$

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profit & loss ⇒

$\boxed{\text{gain} = S.P - C.P}$, sp = selling price
c.p = cost price

* Loss or gain is always reckoned on c.p

* $\boxed{\text{Gain \%} = \left(\frac{\text{Gain} \times 100}{c.p}\right)}$, $\boxed{\text{Loss \%} \left(\frac{\text{Loss} \times 100}{c.p}\right)}$

* $\boxed{S.P = \frac{(100 + \text{Gain \%})}{100} \times C.P}$

* 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

* When a person sells two similar items, one at gain of say x% and the other at a loss of x%, then the seller always incurs a loss given by $\boxed{\text{Loss \%} = \left(\frac{\text{common loss and gain}}{10}\right)^2 = \left(\frac{x}{10}\right)^2}$

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* If a trader professes to sell his goods at cost price, but uses false weights, then

$$\boxed{\text{Gain\%} = \left[\frac{\text{Error}}{(\text{True value} - \text{Error})} \times 100\right]\%}$$

* **Proportion**: $a : b = c : d$

if $\frac{a}{b} = \frac{c}{d}$ then $\boxed{\frac{a+b}{a-b} = \frac{c+d}{c-d}}$ (componendo and dividendo)

* $\left(\frac{\text{A's share of profit}}{\text{B's share of profit}} = \frac{x}{y}\right)$ ← investment by A

→ —— by B

Chain Rule :-

1) Direct proportion :-

→ cost is directly proportional to the number of articles

more articles ; more cost

→ Work done is directly proportional to no. of men working on it.

more men, more work.

2) Indirect proportion :-

→ More speed, Less is the time to cover a distance

→ More persons, Less is the time taken to finish a job

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Time and Work !

* if A can do a piece of work in n days, then

$$\boxed{A\text{'s } 1 \text{ day's work} = \frac{1}{n}}$$

* If A is thrice as good a workman as B, then

Ratio of work done by A and B = 3 : 1

Ratio of time taken by A and B to finish a work = 1 : 3

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Pipes and cisterns :→

(1) If a pipe can fill a tank in x hours, then,
part filled in 1 hour = $\boxed{\frac{1}{x}}$

(2) If a pipe can empty a full tank in y hours, then
part emptied in 1 hour = $\boxed{\frac{1}{y}}$

(3) If a pipe can fill a tank in x hours and another pipe can empty the full tank in y hours (where $y > x$), then on opening both the pipes, the net part filled in 1 hour = $\left(\frac{1}{x} - \frac{1}{y}\right)$

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Time and Distance :-

$$\boxed{\text{Speed} = \frac{\text{Distance}}{\text{time}}}$$

$\frac{1000}{3600} = \frac{5}{18}$

$\boxed{x \text{ km/hr} = \left(x \times \frac{5}{18}\right) \text{ m/sec}}$, * $x \text{ m/sec} = \left(x \times \frac{18}{5}\right) \text{ km/hr}$

* 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 $\left(\frac{1}{a} : \frac{1}{b}\right)$ or $(b : a)$

Problem on Trains :-

* Time taken by a train of length l meters to pass a pole or a standing man or a signal post is equal to the time taken by the train to covers l meters.

* Time taken by a train of length l meters to pass a stationary object of length b meters is the time taken by the train to cover $(l + b)$ meters.

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* suppose two trains or two bodies are moving in the same direction ~~of~~ at u m/s and v m/s. where $u > v$, then their relatives speed $= (u-v)$ m/s

* suppose two ~~trains~~ trains or two bodies are moving in opposite directions at u m/s and v m/s. then their relatives speed $= (u+v)$ m/s

* If two trains of length a meters and b metres are moving in opposite directions at u m/s and v m/s, then time taken by the trains to cross each other $= \frac{(a+b)}{(u+v)}$ sec

* if moving in same direction $= \frac{(a+b)}{(u-v)}$ sec

~~Imp~~

* If two trains 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

$$\boxed{A\text{'s speed} : B\text{'s speed} = \sqrt{b} : \sqrt{a}}$$

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Alligation or mixture :-

* Rule of Alligation :- if two ingredients are mixed, then

Imp

$$\left(\frac{\text{Quantity of cheaper (सस्ता)}}{\text{Quantity of dearer (महंगा)}}\right) = \frac{(\text{C.P of deared}) - (\text{mean price})}{(\text{mean price}) - (\text{C.P of cheaper})}$$

C.P of cheaper (सस्ता) c d , C.P of a unit quantity of Dearer महंगा

(m)

mean price (C.P of mixture)

$(d-m)$ $(m-c)$

(cheaper quantity) (सस्ता) : (Dearer quantity) (महंगा) $= (d-m) : (m-c)$

* Suppose a container contains x units of liquid from which y units are taken out and replaced by water. After n operations, the quantity of pure liquid

$$= \boxed{x\left(1-\frac{y}{x}\right)^{n}}$$

Interest :-

* Simple Interest :-

$$\boxed{S.I = \frac{P \times R \times T}{100}}$$

$P \rightarrow$ principal
$R \rightarrow$ Rate, R% per annum
$T \rightarrow$ Time, years.

$$A = P + S.I$$

$$A = P + \left(\frac{P \times R \times T}{100}\right)$$

Remark :- The day on which money is deposited is not counted while the day on which money is withdrawn is counted.

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* Compound Interest :

1) When interest is compound Annually : $\boxed{\text{Amount} = P\left(1+\frac{R}{100}\right)^n}$

2) When interest is compounded Half-yearly :- $A = P\left(1+\frac{R/2}{100}\right)^{2n}$

When interest is compounded Quarterly :- $A = P\left(1+\frac{R/4}{100}\right)^{4n}$

* When Rates are different for different years, then

$$\boxed{\text{Ammount} = P\left(1+\frac{R_1}{100}\right)\left(1+\frac{R_2}{100}\right)\left(1+\frac{R_3}{100}\right)}$$

* Present worth of Rs x due n year :

$$\left[\text{present worth} = \frac{x}{\left(1+\frac{R}{100}\right)^n}\right]$$

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$$\boxed{\frac{d}{dx}(a^x) = a^x \log_e a}$$ where a is constant.

$a^m = x$

Logarithms :-

$m = \log_a x$ if a is positive real number.

* $\log_a (xy) = \log_a x + \log_a y$
* $\log_a \left(\frac{x}{y}\right) = \log_a x - \log_a y$
* $\log_a x^p = p \log_a x$
* $\boxed{\log_a x = \frac{\log_b x}{\log_b a} = \frac{\log x}{\log a}}$
* $\log_x x = 1$
* $\boxed{\log_a 1 = 0}$
* $\boxed{\log_a x = \frac{1}{\log_x a}}$

* **Note :-** When base is not mentioned, it is taken as 10

CALENDAR :-

* Odd days :- The No. of days more than the complete weeks are called odd days.
* Leap year :- (i) every leap year is divisible by 4, if it is not a century
  (ii) Every 4th century is a leap year and no other century is a leap year.

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CALENDAR :-

* **Odd days** :- The No. of days more than the complete weeks are called odd days.

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  (ii) Every 4^{th} century is a leap year and no other century is a leap year.

* A leap year has $\boxed{366 \text{ days}}$

Example (i) Each of years 1948, 2004, 1676 etc is a leap year
(ii) Each of the year 400, 800, 1200, 1600, 2000 etc is a leap year

* **ordinary year** :- The year which is not a leap year is called an ordinary year. An ordinary year has 365 days.

* **Counting of odd days** :-

(i) 1 ordinary year $= 365$ day $= (\overset{364 \text{ day}}{52 \text{ weeks}} + 1 \text{ day})$

$\therefore$ 1 ordinary year has 1 odd days

(ii) 1 leap year $= 366$ day $= (52 \text{ weeks} + 2 \text{ day})$

$\therefore$ 1 leap year has 2 odd days.

(iii) **100 years** $=$ 76 ordinary year + 24 leap years

$= (76 \times 1 + 24 \times 2)$ odd days $= 124$ odd days

$= (17 \text{ weeks} + 5 \text{ days}) = $ 5 odd days

$\frac{100}{4} = 25$ but, 100 is first century, so not a leap year

* Number of odd days in 100 years = 5
* Number of odd days in 200 years = $(5 \times 2) \overset{10=7+3}{=} 3$ odd days
* Number of odd days in 300 year = $(5 \times 3) \overset{15=14+1}{=} 1$ odd day.
* Number of odd days in 400 year = $(5 \times 4 + \underbrace{1}_{\{2\}})$ = 0 odd day

for 400 leap year, 2 ordinary days.

* Similarly, each one of 800 years, 1200 years, 1600 years, 2000 years etc has 0 odd day.

* Day of week Related to ODD days :-

No. of days	0	1	2	3	4	5	6
Day	Sun	Mon	Tues	Wed	Thurs	fri	sat.

Month →	Jan	feb	March	April	May	June	July	Aug.	Sep.
days →	31	29 If leap year | 28 days	31	30	31	30	31	31	30
			Oct	Nov	Dec.				
			31	30	31				

Clocks :-

* Short hand (smaller one) :- hour hand
* Long hand (larger one) :- Minute hand

(i) In 60 minute, the Minute hand gains 55 minutes on the hour hand

(ii) In every hour, both the hands coincide once.

(iii) The hands are in the same straight line when they are coincident or opposite to each other. 1 day = 12+12 = 24 times

(iv) When the two hands are at right Angles, they are 15 minute spaces apart.

(v) When the hands are in opposite directions; they are 30 minute spaces apart.

(vi) Angle traced by hour hand in 12 hrs = 360°

(vii) Angle traced by minute hand in 60 min = 360°

Too fast :- If watch indicate 8:15, correct time 8, it is 15 minutes too fast.

Too slow :- If watch indicate 7:45, correct time 8, it is 15 minutes too slow.

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factorial, $n! = n(n-1)(n-2)\cdots 3.2.1$, n = positive integer

$\boxed{0! = 1}$, $\boxed{1! = 1}$ $\boxed{2! = 2}$ $\boxed{3! = 6}$ $\boxed{4! = 24}$ $\boxed{5! = 120}$

PERMUTATIONS : The different arrangements of a given no. of things by taking some or all at a time, are called permutations.

* Number of permutations : of n things, taken r at a time

$${}^nP_r = n(n-1)(n-2)\cdots(n-r+1) = \frac{n!}{(n-r)!} , \quad \boxed{{}^nP_r = \frac{n!}{(n-r)!}}$$

* No. of all permutations of n things, taken all at a time = $n!$
* If n objects of which p_1 are alike one kind, p_2 are alike another kind, then No. of permutations = $\boxed{\dfrac{n!}{(p_1!)(p_2!)}}$ $\rightarrow {}^nP_r = \dfrac{n!}{(n-r)!}$

COMBINATIONS : selection which can be formed by taking some or all of a number of objects, is called a combination.

* Note → that ab and ba are two different permutations but they ~~are~~ represent the same combination

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* Note → that ab and ba are two different permutations but they ~~are~~ represent the same combination

$$\boxed{{}^nC_r = \frac{n!}{(n-r)!\,r!}} = \frac{n(n-1)(n-2)\cdots \text{to } r \text{ factors}}{r!}$$

* Note that : $\boxed{{}^nC_n = 1}$ and $\boxed{{}^nC_0 = 1}$, $\boxed{{}^nC_r = {}^nC_{(n-r)}}$

*

Probability :-

* Sample space : the set S of all possible outcomes
* probability of occurrence of an Event.

Let S be the sample space and let E be an event. $\boxed{E \subseteq S}$

$$\boxed{P(E) = \frac{n(E)}{n(S)}}$$

* $P(S) = 1$; $0 \le P(E) \le 1$; $P(\phi) = 0$
* $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
* If $\bar{A}$ denotes (not-A) then

$$P(\bar{A}) = 1 - P(A)$$

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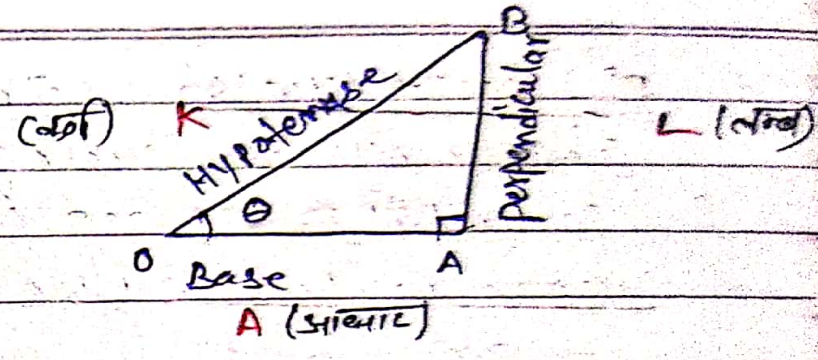
Heights & Distances :

In a right angle ΔOAB



* $\begin{array}{ccc} \sin\theta & \cos\theta & \tan\theta \\ L & A & L \\ K & K & A \\ \text{cosec}\,\theta & \sec\theta & \tan\theta \end{array}$

* $\sin\theta = \frac{L}{K} = \frac{\text{लम्ब}}{\text{कर्ण}} = \frac{AB}{OB}$

$\text{cosec}\,\theta = \frac{1}{\sin\theta}$, $\sec\theta = \frac{1}{\cos\theta}$

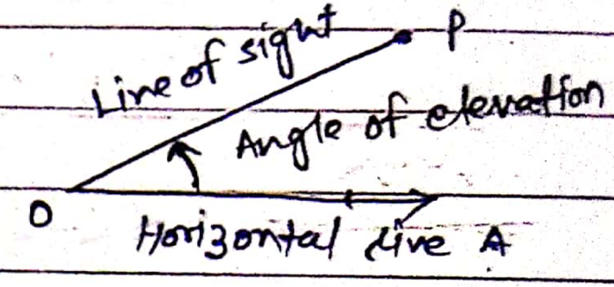
$\cot\theta = \frac{1}{\tan\theta}$

* Trigonometrical Identities :

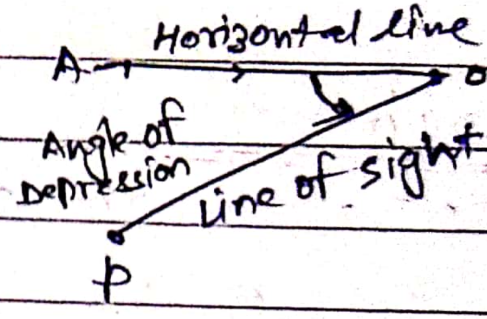
* $\boxed{\sin^2\theta + \cos^2\theta = 1}$, * $\boxed{1 + \tan^2\theta = \sec^2\theta}$ * $\boxed{1 + \cot^2\theta = \text{cosec}^2\theta}$

θ	$0°$	$30°\ (\pi/6)$	$45°\ (\pi/4)$	$60°\ (\pi/3)$	$90\ (\pi/2)$
$\sin\theta$	0	$1/2$	$1/\sqrt{2}$	$\sqrt{3}/2$	1
$\cos\theta$	1	$\sqrt{3}/2$	$1/\sqrt{2}$	$1/2$	0
$\tan\theta$	0	$1/\sqrt{3}$	1	$\sqrt{3}$	∞

* **Angle of Elevation :-**
  If object P, placed above the level of eye.

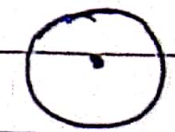


* **Angle of Depression :-**
  If object P, placed below the level of eye.



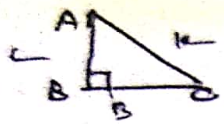
PIE - charts : (Data Interpretation)

Sum of all the central angles is := 360°



$$\left\{ \text{Central Angle of the component} = \left(\frac{\text{Value of the component}}{\text{Total value}} \times 360^\circ \right) \right\}$$

Right Angle triangle



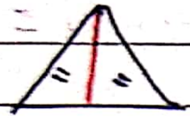
* Pythagoras theorem $AC^2 = AB^2 + BC^2$

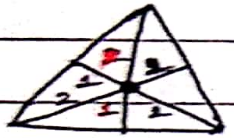
AREA :-

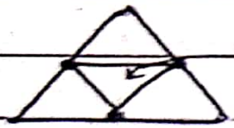
* sum of Angles of a triangle = $180°$

Result on Triangles :

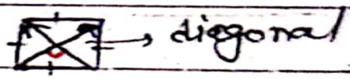
1) → sum of any two sides of a triangle is greater than the third side.

2)  The line joining the mid-point of a side of a triangle to the opposite vertex called the median.

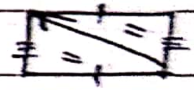
3)  The point where the three medians of a triangle meet, is called centroid. The centroid divides each of the median in the ratio 2 : 1

4)  1/4th Area of triangle

Result on Quadrilaterals :-



square



Rectangle

+ Diagonals of a Rhombus are unequal and bisect each other at right angles.

* Of all the Parallelogram of given sides, the parallelogram which is a rectangle has the greatest area.

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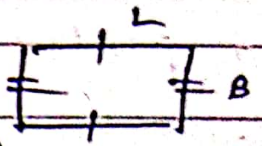
* Important formulae :-

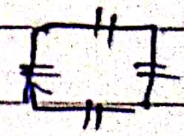


Rectangle

1) Area of a Rectangle = (Length × Breadth)

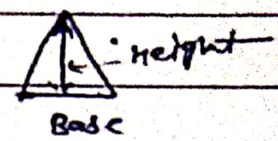
Perimeter of a Rectangle = 2 (L+B)

2) Area of a square (वर्ग) = $(\text{side})^2 = \frac{1}{2}(\text{diagonal})^2$

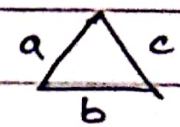


3) Area of 4 walls of a room = 2 (Length + Breadth) × Height

4) Area of a triangle = $\frac{1}{2}$ × Base × height



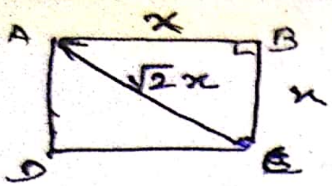
Area of a triangle = $\sqrt{s(s-a)(s-b)(s-c)}$



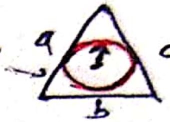
s = semi-perimeter

$s = \frac{1}{2}(a+b+c)$

* Area of a equilateral triangle = $\boxed{\frac{\sqrt{3}}{4} \times (\text{side})^2}$

Square 

$AC^2 = AB^2 + BC^2$
$AC^2 = x^2 + x^2$
$AC^2 = 2x^2$
$AC = \sqrt{2}x$

Incircle 

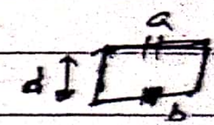
$s = \frac{1}{2}(a+b+c)$

* Radius of incircle of an equilateral triangle of side a $= \frac{a}{2\sqrt{3}}$

* Radius of incircle of a triangle of area Δ and semi-perimeter s $= \frac{\Delta}{s}$

5) Area of a parallelogram = (Base × Height)

Area of a rhombus $= \frac{1}{2}$ (product of diagonals)



Area of a trapezium $= \frac{1}{2}$ (sum of parallel side) × (distance b/w them)

*6) $\boxed{\text{Area of a circle} = \pi R^2}$ R = Radius

* $\boxed{\text{circumference of a circle} = 2\pi R}$ or πD

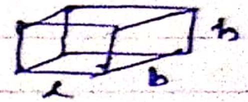
* Length of an Arc $= \frac{2\pi R\theta}{360}$, θ is the central angle

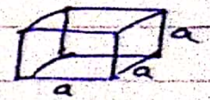
Volume and Surface Area ⇒

1) **Cuboid :-** Volume $= (l \times b \times h)$

Surface Area $:= 2(lb + bh + lh)$

Diagonal $= \sqrt{l^2 + b^2 + h^2}$

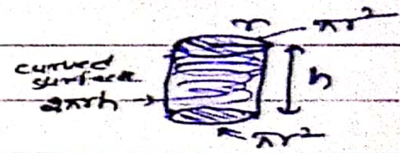




2) **Cube :-** Volume $= a^3$

★★ Surface area $= 6a^2$

Diagonal $= \sqrt{3}a$



3) **Cylinder :-** Volume $= \pi r^2 h$

★★ Curved surface Area $= 2\pi r h$

total surface area $= (2\pi r h + 2\pi r^2) = 2\pi r(h + r)$

4) **Sphere :-** Volume $= \frac{4}{3}\pi r^3$

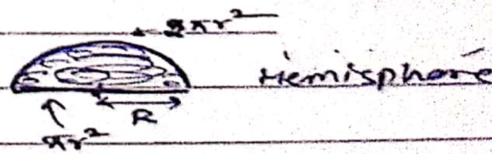
★★ surface area $= 4\pi r^2$

5) **Hemisphere !** volume $= \frac{2}{3}\pi r^3$

Curved surface area $= 2\pi r^2$

total surface area $= (2\pi r^2 + \pi r^2)$

$= 3\pi r^2$



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4) sphere :- Volume = $\frac{4}{3}\pi r^3$

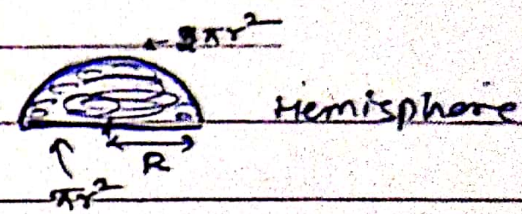
surface area = $4\pi r^2$

5) Hemisphere ! volume = $\frac{2}{3}\pi r^3$

curved surface area = $2\pi r^2$

total surface area = $(2\pi r^2 + \pi r^2)$

$= 3\pi r^2$

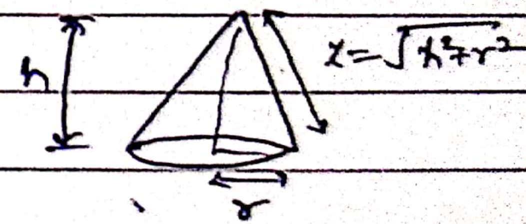


6) cone :- slant height = $l = \sqrt{h^2+r^2}$

volume = $\frac{1}{3}\pi r^2 h$

curved surface Area = $\pi r l$

total surface Area = $(\pi r l + \pi r^2)$



* $\boxed{1 \text{ litre} = 1000 \text{ cm}^3}$, $\boxed{1 m^3 = 1000 \text{ litre}}$ $\boxed{1 \text{ lit} = 10^{-3} m^3}$

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