Propotion and Ratio.

Imp →
- Unit less.
- Only taken when unit are same.

Ratio is part of total value.

i.e $\frac{A}{B} = \frac{P}{q}$ then $A = PK$

$B = qK$

$A+B = PK + qK = (P+q)K.$

$$K = \frac{A+B}{P+q}$$

Ratio is part of Equality.

i.e $A:B = 5:6$ $\boxed{A=5}$ $\boxed{B=6}$

Ratio of two or more number.

i.e $\frac{A}{B}, \frac{B}{C}$ $A:B:C = \begin{matrix} A & B & B \\ \times & B & C \end{matrix}$

$A:B:C.$

Propotion.

$\frac{a}{b} = \frac{c}{d}$ $\boxed{ad = bc}$

Property

1) Componendo → $\frac{a}{b} = \frac{c}{d}.$

$$\frac{a+b}{b} = \frac{c+d}{d}.$$

2) Dividendo → $$\frac{a-b}{b} = \frac{c-d}{d}.$$

3) Componendo Dividendo $$\frac{\left[\frac{a+b}{b}\right]}{\left[\frac{a-b}{b}\right]} = \frac{\left[\frac{c+d}{d}\right]}{\left[\frac{c-d}{d}\right]}$$

$$= \frac{a+b}{a-b} = \frac{c+d}{c-d}.$$

4) Invertedo :- $\frac{b}{a} = \frac{d}{c}.$

5) Alternendo :- $\frac{a}{c} = \frac{b}{d}.$

By :-
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Percentage.

Find Actual number

$$\text{Actual number} = \%\text{percentage} \times \text{total}$$
$$= \frac{x}{100} \times \text{total}.$$

Percentage.

$$\%.\text{percentage} = \frac{\text{Actual}}{\text{Total}} \times 100$$

Change in percentage.

$$\%.\text{change} = \frac{\text{Final value} - \text{Intial value}}{\text{Intial value}} \times 100$$

Succesive %. change.

$$\text{New value} = \left[1 \pm \frac{x\%}{\text{intial value}}\right] \times \text{Intial value}.$$

+ → when increase in %

− → when decrease in %.

(OR)

$$\text{New value} = \text{Intial value} \times [\text{multiplying factor}]$$

e.g $= 300 + \left[1 + \frac{20}{100}\right] \times \left[1 - \frac{10}{100}\right]$.

20y. ↑ 10% ↓

Note:- When % comes the Divide it by 100.

Simple and Compound Interest.

$$\text{Simple Interes} = T \times R\% \times P.$$

T = No. of Year

R% = Rate of interest i.e $10\% = \frac{10}{100}$

P = Principle Amount.

$$\text{Final Amount} = P + S.I.$$
$$= P + [TR\%.P]$$
$$= P\left[1 + \frac{TP}{100}\right]$$

Compound Interest:

$$A = P\left[1 + \frac{R}{100}\right]^{n}$$ → No. of year.

→ Half Yearly.

$$A = P\left[1 + \frac{R/2}{100}\right]^{2n}$$

→ Quartely

$$A = P\left[1 + \frac{R/4}{100}\right]^{4n}.$$

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Time And Work.

$Men \propto \frac{1}{Day} \propto work$

$M \propto \frac{W}{D}$ $\quad M = \frac{KW}{D}$.

$$K = \frac{DM}{W}.$$

#Power of work.

$$Men = \frac{work}{Day}.$$

$$Day = \frac{work}{work/Day}.$$

Profit and Loss.

- $Profit = S.P - C.P$.
- $Loss = C.P - S.P$.
- $Profit\ (\%) = \frac{S.P - C.P}{C.P} \times 100$.
- $Loss\ (\%) = \frac{C.P - S.P}{C.P} \times 100$
- $S.P = C.P\left[1 + \frac{\%.P}{100}\right]$ --(Profit percent) → multiplying Factor.
- $S.P = C.P\left[1 - \frac{\%.P}{100}\right]$ --(Loss percent).
- $\%\ Discount = \frac{M.P - S.P}{M.P} \times 100$
- $Discount = M.P - S.P$.

Compounded Ratio

$\frac{a}{b} = \frac{c}{d} = \frac{e}{f}$ --(e.g)

$Compounded\ Ratio = \frac{ace}{bdf}$.

$\frac{A}{B} = \frac{P}{q}$

- $Duplicate\ Ratio\ of\ A:B = \frac{P^2}{q^2}$
- $Triplicate\ Ratio\ of\ A:B = \frac{P^3}{q^3}$
- $Sub\text{-}Duplicate\ Ratio\ of\ A:B = \frac{\sqrt{P}}{\sqrt{q}}$
- $Sub\text{-}Triplicate\ Ratio\ of\ A:B = \frac{\sqrt[3]{P}}{\sqrt[3]{q}}$

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Average And Allegation.

- Avg. = $\frac{\text{sum of Data}}{\text{Total No. of Data}}$

- IF the value of each item is +/-/x/÷ by some value of P, then the average of new group will be also +/-/x/÷

- $Avg = \frac{\Sigma}{n} = \frac{\Sigma x_i f_i}{n}$.

  f_i = No. of Repeatation.

If 2 quantity is given.

$$Avg = \frac{(Avg_1 \times n_1) + (Avg_2 \times n_2)}{n_1 + n_2}.$$

If 2 quatity are in form of Ratio.

$$\frac{n_1}{n_2} = \frac{[Avg_2 - AVgT]}{[AVgT - AVg_1]}$$

- [small] Avg_1 — [Big] Avg_2. — $AVgT$

$Avg_2 - AVgT$: $AVgT - Avg_1$

$= n_1 : n_2$.

Alligation

- Action of attaching, Binding, mixing.

Ratio is given. $(r_1 : r_2)$.

$$A.T = \frac{(A_1 \times r_1) + (A_2 \times r_2)}{r_1 + r_2}$$

Speed Distance Time.

- speed = $\frac{\text{Distance}}{\text{Time}}$, $S = \frac{D}{T}$.

- $T = \frac{D}{S}$, $D = S \times T$.

Conversion.

- $\frac{m}{s} \rightarrow \frac{km}{hr} \Rightarrow \frac{m}{s} \times \frac{18}{5} = \frac{km}{hr}$.

- $\frac{km}{hr} \rightarrow \frac{m}{s} = \frac{km}{hr} \times \frac{5}{18} = \frac{m}{sec}$.

Average speed.

Avg speed = $\frac{\text{Total Distance}}{\text{Total time}}$.

$$= \frac{D_1 + D_2}{\frac{D_1}{S_1} + \frac{D_2}{S_2}} = \frac{D_1 + D_2}{t_1 + t_2}.$$

Concept of train, platform.

- Time taken by the train to cross the person

$T = \frac{D}{S} = \frac{l_T}{V_T}$ → length of train, → velocity of train.

- Time taken by the train to cross the platform.

$T = \frac{D}{S} = \frac{l_T + l_P}{V_T}$ l_P = length of platform.

- Time taken to cross train when Both train moving in same direction. (1)

$T = \frac{D}{S} = \frac{l_{T_1} + l_{T_2}}{V_{T_1} - V_{T_2}}$

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- Time taken for the train to cross the men. when they both are moving in same Direction. (2)

$$T = \frac{D}{S} = \frac{l_{T_1} + 0}{V_{T_1} - V_{T_2}}.$$

- Time taken to cross the Train when Both are moving in Opposite direction.

$$T = \frac{D}{S} = \frac{l_{T_1} + l_{T_2}}{V_{T_1} + V_{T_2}}.$$

- Time taken for the train to cross the man / object. when the both are moving in Opposite Direction.

$$T = \frac{D}{S} = \frac{l_{T_1} + 0}{V_{T_1} + V_{T_2}}.$$

Boat stream Concept.

B = Speed of Boat in still water

S = Speed of water.

Upstream (U.P) = B - S.

Downstream (D.S) = B + S.

$$\text{Speed} = \frac{D}{T}.$$

Concept. (Time take to meet).

$$T = \frac{D}{S} = \frac{D}{S_1 + S_2}$$

S_1 and S_2 speed of A and B.

Sequence and Series.

Arithmetic Progression.

- Last term in A.P series

$$T_n = a + (n-1)d$$

- Sum of A.P series.

$$S_n = \frac{n}{2}[2a + (n-1)d].$$

$$S_n = \frac{n}{2}[a + T_n].$$

n = No. of terms.

a = First term

d = Difference b/w 1st and 2nd

T_n = Last term.

S_n = sum of A.P.

Geometric Progression

$$S = \frac{a[1 - r^n]}{1 - r}.$$

- Infinite terms.

$$S_\infty = \begin{cases} \infty, & r > 1 \\ \frac{a}{1-r}, & |r| < 1 \end{cases}.$$

- Last term in G.P series

$$T_n = a r^{n-1}.$$

A.P → $a, a+1d, a+2d \cdots a+(n-1)d$.

G.P → $a, ar, ar^2, ar^3 \cdots ar^{n-1}$

Harmonic Progression (H.P).

- Reciprocal of A.P series.

H.P → $\frac{1}{a}, \frac{1}{a+1d} + \frac{1}{a+2d} \cdots \frac{1}{a+(n-1)d}$.

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Special Series. (sum)

- $1+1+1$ -- n times $= n$
- $1+2+3$ --- n times

$$S = \frac{n(n+1)}{2}.$$

- $1^2+2^2+3^2+4^2$ ---- n^2

$$S = \frac{n(n+1)(2n+1)}{6}.$$

- $1^3+2^3+3^3+4^3$ -- n^3

$$S = \left[\frac{n(n+1)}{2}\right]^2$$

Note!- Above all formula for 1st natural number i.e start from 1

Mean.

e.g a, b, c.

Arthematic mean (A.m) $\rightarrow b = \frac{a+c}{2}$.

Geometric mean (G.m) $\rightarrow b = (ac)^{1/2} = \sqrt{ac}$

Harmonic mean (H.m) $\rightarrow b = \frac{2ac}{a+c}$.

Special Case.

IF $a = b = c$.

then $\boxed{A.m = G.m = H.m}$

IF $a \neq b \neq c$.

then $\boxed{A.m > G.m > H.m}$

Number System.

- Integer $\rightarrow \{---3,-2,-1,0,1,2,3---\}$
- Negative integer $\{---5,-4---1\}$
- Positive integer $\{1,2,3,4---\}$
- Natural number $\{1,2,3,4--\}$
- Whole number $\rightarrow \{0,1,2,3--\}$
- Imaginary number $\rightarrow i = \sqrt{-1}$
- Rational number $\rightarrow p/q$
  - Recurring i.e 0.cccc
  - Finite i.e $\frac{2}{3} = 1.5$.
- Irrational
  - Non-Recurring
  - Non-terminating $\}\sqrt{3}, e, \pi$.
- Proper Fraction $\rightarrow$

$$\frac{p}{q} \text{ -- } \left[-1 < \frac{1}{q} < 1.\right]$$

- Improper Fraction.

$$\frac{p}{q} \text{ -- } \left[\frac{p}{q} > 1, \frac{p}{q} < -1.\right]$$

- Mixed Fraction.

$$3\frac{1}{4},\ 4\frac{1}{6},\ 7\frac{5}{6}$$

- Prime number $\rightarrow \{2,3,5,7--\}$
- Composite number $\{4,6,8,9--\}$

Note!- 1 neither prime nor composite.

0 neither posite not negative.

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Rules of Indices [IMP]

1) $a \times a \times a \cdots m = a^m$

2) $a^m \times a^n = a^{m+n}$.

3) $a^{-m} = \frac{1}{a^m}$

4) $(a^m)^n = a^{m \times n}$

5) $a^0 = 1$

6) $(ab)^m = a^m b^m$

7) $a^{m/n} = \sqrt[n]{a^m}$

8) $a^m = a^n$ then $\boxed{m = n}$

Surds

→ Irrational number.

i.e $\sqrt{2}, \sqrt{3}, \sqrt{5} \cdots$

Cyclicity.

Level 1 (0, 1, 5, 6).

$0^n = 0$ $\quad 1^n = 1$.

$5^n = 5$ $\quad 6^n = 6$.

{0, 1, 5, 6} → unit place same number.

Level 2. (4, 9).

$4^{odd} = 4$ $\quad 9^{odd} = 9$

$4^{even} = 6$ $\quad 9^{even} = 1$.

Level 3 (2, 3, 7, 8)

2 → 2, 4, 8, 6

3 → 3, 9, 7, 1.

7 → 7, 9, 3, 1.

8 → 8, 4, 2, 6.

Procedure.

→ Power divide by the 4 and take remainder as the power for unit place number.

e.g 2^{77} → $4\overline{)77}$ (19, 76, 01) $2^1 = 2$ unit place

→ For Divide last two digit also sufficient.

Concept.

$0! = 1$ $\quad 1! = 1$ $\quad 2! = 2$

$3! = 6$ $\quad 4! = 24$ $\quad 5! = 120$.

After 3! all are Divisible by 4

$2^{11!} = 2^0 = 2^4 = 6$ → unit place No.

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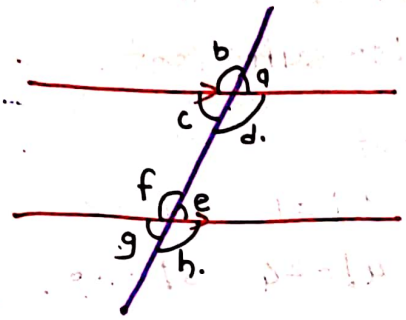
Geometry.

Angles.

$180 < \theta < 360°$ → Reflex Angle.

- Complementry Angle _ sum of angles is 90°

- Supplymentry Angle _ sum of angles is 180°



- Corresponding Angle

∠a and ∠e	∠b and ∠f
∠c and ∠g	∠d and ∠h.

above pair are equal.

- Vertical opposite Angle.

∠b and ∠d	∠a and ∠c
∠f and ∠h	∠g and ∠e.

- Alternate angle.

∠d and ∠f	∠c and ∠e.

- Supplimentry angle. [

∠d and ∠e.

i.e $\angle d + \angle e = 180°$

$\angle c + \angle f = 180°$

Polygon [Close Fig].

Regular Polygon.

↳ All sides are equal

↳ e.g equalateral triangle, Square etc

N side Regular polygon.

side = n.

- Diagonal = $\frac{n}{2}(n-3)$.

- Sum of interior angle = $(n-1)180$

- Sum of exterior angle = 360°

- Each exterior angle = $\frac{360}{n}$.

- Each interior angle = $\frac{(n-1)\ 180}{360}$

Types of polygon.

↳ Convex → Angle is less than 180°

↳ Concave → one of angle more than 180°

Quadrilateral.

↳ 4 side polygon.

↳ sum of both interior and exterior angle is 360°.

Shape	Perimeter	Area.
Rectangle	2(l+b)	l×b.
Square	4s	s^2
Parallelogram	2(a+b)	ah.
Rhombus	4a	$\frac{1}{2}$ d1×d2 ↳ Diagonal.
Trapezium/ Trapezoid	Sum of all side	$\frac{1}{2}h(a+b)$.

Area of Regular Hexagon = $\frac{3\sqrt{3}}{2}$ side^2.

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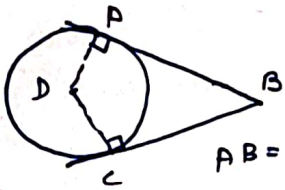
#Circle.

- ⊥ from centre bisect the chord.
- line from centre to mid-chord it is ⊥er.
- ⊥erbisector of chord passes through centre.



AB = BC.

Fig.	Name	Perimeter	area
	Circle.	$2\pi r$	πr^2
	semi-circle.	$\pi r + d$ or $\pi r + 2r$	$\frac{\pi r^2}{2}$.
	Ring	$2\pi r + 2\pi R$	$A = A(o) - A(i)$ $= \pi R^2 - \pi r^2$
	Sector	$2r + \frac{\theta}{360} \times 2\pi r$	$\frac{\theta}{360} \times \pi r^2$
	Arc.	$\frac{\theta}{360} \times 2\pi r$	–

#3D Figure.

Name	Volume	CSA/ LSA	TSA.
Cube	$side^3$	$4\,side^2$	$6\,side^2$.
Cuboid.	$l \times b \times h$	$2h(b+l)$	$2[lb+bh+lh]$
Sphere.	$\frac{4}{3}\pi r^3$	$4\pi r^2$	$4\pi r^2$
Hemi-Sphere	$\frac{2}{3}\pi r^3$	$2\pi r^2$	$3\pi r^2$.
Cylinder	$\pi r^2 h$	$2\pi rh$	$2\pi rh + 2\pi r^2$ $= 2\pi r(h+r)$
Cone.	$\frac{1}{3}\pi r^2 h$	πrl.	$\pi r(l+r)$

Polynomial.

#α and β are root then.

Sum of roots $= \alpha + \beta = \frac{-b}{a}$

Product of roots $= \alpha\beta = \frac{c}{a}$.

#Nature of Roots.

Discriminant

$D = b^2 - 4ac$.

- $= 0$ Real and equal.
- > 0 Real and distinct.
- < 0 Imagnary and conjugate.

#Cubic eqn

$ax^3 + bx^2 + cx + d = 0$.

Sum $= \alpha + \beta + \gamma = \frac{-b}{a}$.

Product $= \alpha\beta\gamma = \frac{-d}{a}$.

$\alpha\beta + \beta\gamma + \alpha\gamma = \frac{c}{a}$.

#Inequality

$a > b \rightarrow b < a$.

$a > b \rightarrow a \not< b$.

$a < b \rightarrow a \not> b$.

$a > b \rightarrow a \not< b \rightarrow a > c$.

$a < b \rightarrow b < c \rightarrow a < c$.

$a > b \rightarrow a + c > b + c$.

$a - c > b - c$.

$a > b$ and $c > 0 \rightarrow ac > bc$.

$a > b$ and $c < 0 \rightarrow ac < bc$.

$a > b$ and $c > d \rightarrow a + c > b + d$.

$a > 0 \rightarrow -a < 0$.

$a > b \rightarrow \frac{1}{a} < \frac{1}{b}$.

$\frac{a}{c} > \frac{b}{c}$ $c > 0$

$\frac{a}{c} < \frac{b}{c}$ $c > 0$

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Permutation And Combination.

Or → + (Add)

And → × (multiply).

Require = Total − Unwanted.

$$ {}^{n}P_{r} = \frac{n!}{(n-r)!} \quad n \geq r $$

n = list of letter.

r = Arrangment of r item.

$$ {}^{n}P_{1} = n. $$

$$ {}^{n}P_{0} = 1. $$

$$ {}^{n}P_{n-1} = n! $$

Selection / Picking.

$$ {}^{n}C_{r} = \frac{n!}{(n-r)!\,r!} \quad n \geq r $$

Relationship.

$$ {}^{n}P_{r} = {}^{n}C_{r}\, r! $$

How many Rectangle in Grid.

$$ \text{All Rectangle} = {}^{n}C_{2} \times {}^{n}C_{2} $$

${}^{n}C_{2}$ → Horizontal line

${}^{n}C_{2}$ → vertical line.

$$ {}^{n}C_{2} = \frac{n(n-1)}{2} $$

Circular table sitting.

$$ (n-1)! $$

Sum of n digit.

1) No Repeatation.

sum of n digit = $(n-1)!$ × (sum of all Digits) × [1111--n times)

2) with Repeatation.

sum of n digit = $[n]^{n-1}$ × [sum of all Digit) × [1111---n times)

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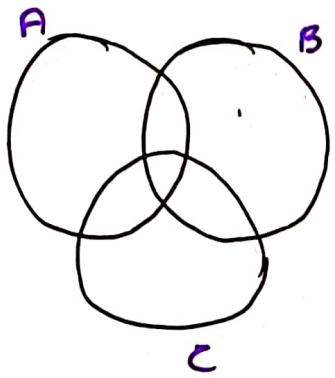
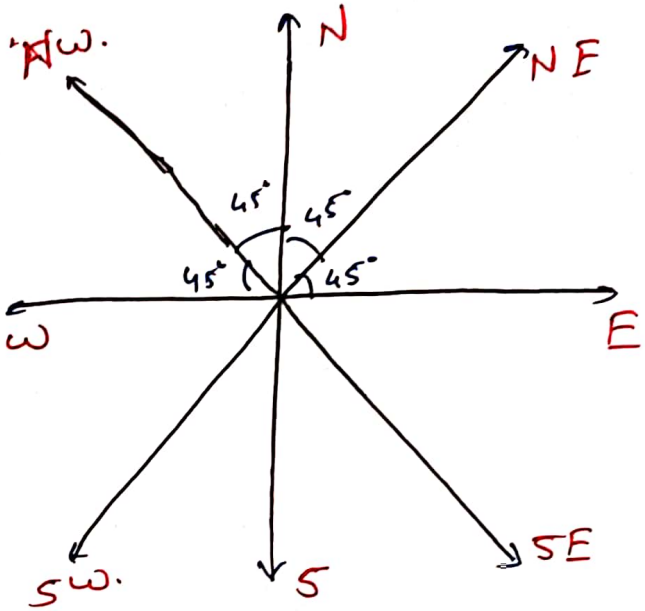
Set theory.



$n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(B \cap C) - n(A \cap C) + n(A \cap B \cap C)$.

Direction.



Clock.

1 hr → 30°

1 min → 6°.

Angle between Hr. and min.

$$\angle^\circ = \left| \frac{11}{2} m - 30H \right|$$

m = minutes.

H = Hours.

#Shadow.

Morning :-

Shadow is to west.

Evening :-

Shadow is to East.

SYLLOGISM.

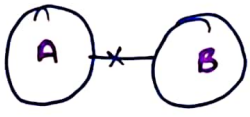
Statement → Conclusion ← Venn Diagram.

#Venn Diagram

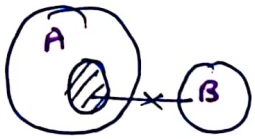
Some A are B

All A are B.

No A are B



Some A are Not B.



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