GATE Aptitude Formula Sheet

Exam Pattern

Total Marks	**15** (Common for all branches)
Total Questions	**10**
1-Mark Questions	5 Questions = 5 Marks
2-Mark Questions	5 Questions = 10 Marks
Negative Marking (MCQ Only)	1-Mark Question : $-\frac{1}{3}$
	2-Mark Question : $-\frac{2}{3}$
No Negative Marking	MSQ and NAT Questions

Aptitude Sections

Quantitative | **Verbal**

Analytical | **Spatial**

Resources

Official Syllabus	**GATE 2027 General Aptitude Syllabus**
GATE Aptitude PYQs	**GATE Overflow PYQ PDF** Includes GATE Aptitude (All Branches) + Mathematics (GATE CSE) PYQs.
CAT PYQs	**Aptitude Overflow**

Practice • **Accuracy** • **Speed** • **Revision**

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1. Quantitative Aptitude

1.1 Number System

- **Divisibility Rules**

Divisor	Divisibility Rule	Example
2	Last digit is 0, 2, 4, 6, or 8.	246
3	Sum of digits is divisible by 3.	372 $(3+7+2=12)$
4	Last 2 digits are divisible by 4.	516 $(16 \div 4)$
5	Last digit is 0 or 5.	435
6	Number is divisible by both 2 and 3.	426
7	Double the last digit and subtract it from the remaining number. Repeat if needed.	$203 \rightarrow 20 - 2 \times 3 = 14$
8	Last 3 digits are divisible by 8.	7128 $(128 \div 8)$
9	Sum of digits is divisible by 9.	729 $(7+2+9=18)$
10	Last digit is 0.	870
11	Difference of alternate digit sums is divisible by 11.	$50644 \rightarrow (5+6+4)-(0+4)=11$

- **Number of Factors (Divisors)**

If

$$N = p_1^{a_1} \times p_2^{a_2} \times p_3^{a_3} \cdots$$

then

$$\boxed{\text{Number of Factors} = (a_1+1)(a_2+1)(a_3+1)\cdots}$$

Example:

$$360 = 2^3 \times 3^2 \times 5^1$$

$$\text{Number of Factors} = (3+1)(2+1)(1+1) = 4 \times 3 \times 2 = \boxed{24}$$

• Greatest Common Divisor (HCF)

Using **Prime Factorization**: Take the minimum powers.

NOTE: Factors must be in their lowest terms before applying the formulas.

Example:

$$24 = 2^3 \times 3 \qquad 36 = 2^2 \times 3^2$$

$$\text{HCF} = 2^2 \times 3 = 12$$

• Least Common Multiple (LCM)

Take the maximum powers.

NOTE: Factors must be in their lowest terms before applying the formulas.

Example:

$$24 = 2^3 \times 3 \qquad 36 = 2^2 \times 3^2$$

$$\text{LCM} = 2^3 \times 3^2 = 72$$

• Relationship Between HCF and LCM

For two numbers,

$$\text{HCF} \times \text{LCM} = a \times b$$

Example:

$$6 \times 36 = 12 \times 18 = 216$$

• Co-prime Numbers

Two numbers are called **co-prime** if their **HCF (GCD)** is 1.

Examples:

$$(8, 15) \qquad (25, 36) \qquad (14, 25) \qquad (9, 10)$$

• HCF of Fractions

$$\text{HCF} = \frac{\text{HCF of Numerators}}{\text{LCM of Denominators}}$$

• LCM of Fractions

$$\text{LCM} = \frac{\text{LCM of Numerators}}{\text{HCF of Denominators}}$$

• Prime Number Test

Check divisibility only by prime numbers $\leq \sqrt{n}$.
If none divides n, then n is Prime.

Example:

$$n = 97, \quad \sqrt{97} \approx 10, \quad \text{Check } 2, 3, 5, 7$$

$$97 \not\equiv 0 \pmod{2, 3, 5, 7} \quad \Rightarrow \quad \boxed{97 \text{ is Prime}}$$

• Important Algebraic Formulae

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

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

$$(a+b)^2 - (a-b)^2 = 4ab \qquad (a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$$

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

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

1.2 Percentages

- **Fraction to Percentage**

$\frac{1}{1} = 100\%$	$\frac{1}{2} = 50\%$	$\frac{1}{3} = 33.33\%$	$\frac{1}{4} = 25\%$
$\frac{1}{5} = 20\%$	$\frac{1}{6} = 16.67\%$	$\frac{1}{7} = 14.29\%$	$\frac{1}{8} = 12.5\%$
$\frac{1}{9} = 11.11\%$	$\frac{1}{10} = 10\%$	$\frac{1}{11} = 9.09\%$	$\frac{1}{12} = 8.33\%$

- **Basic Formulae**

$$\% = \frac{\text{Part}}{\text{Whole}} \times 100 \qquad x\% \text{ of } A = \frac{xA}{100}$$

$$\text{Increase by } x\%: \quad A_{\text{new}} = A\left(1 + \frac{x}{100}\right)$$

$$\text{Decrease by } x\%: \quad A_{\text{new}} = A\left(1 - \frac{x}{100}\right)$$

- **Percentage Change**

$$\% \text{ Change} = \frac{\text{New} - \text{Old}}{\text{Old}} \times 100$$

$$\text{Original} = \frac{\text{New}}{1 + \frac{x}{100}} \qquad \text{Original} = \frac{\text{New}}{1 - \frac{x}{100}}$$

- **Important Formulae**

$$A \text{ is } \frac{a}{b}\% \text{ more than } B \implies B \text{ is } \frac{a}{a+b}\% \text{ less than } A$$

$$A \text{ is } \frac{a}{b}\% \text{ less than } B \implies B \text{ is } \frac{a}{b-a}\% \text{ more than } A$$

• Net Percentage Change

Step 1: Successive Percentage Changes

Suppose an original value is changed successively by $x\%$ and $y\%$.
The final value is obtained by multiplying the two change factors:

$$\boxed{\text{Final Value} = \text{Initial Value}\left(1 \pm \frac{x}{100}\right)\left(1 \pm \frac{y}{100}\right)}$$

- Use $+$ for an increase.
- Use $-$ for a decrease.

Step 2: Derive the Net Percentage Change

Expanding the expression:

$$= 1 \pm \frac{x}{100} \pm \frac{y}{100} + \frac{(\pm x)(\pm y)}{10000}$$

Therefore,

$$\boxed{\text{Net Change } (\%) = \pm x \pm y + \frac{(\pm x)(\pm y)}{100}}$$

Step 3: Sign Convention

1st Change	2nd Change	Sign Selection
Increase $(x\%)$	Increase $(y\%)$	$+x, +y$
Increase $(x\%)$	Decrease $(y\%)$	$+x, -y$
Decrease $(x\%)$	Increase $(y\%)$	$-x, +y$
Decrease $(x\%)$	Decrease $(y\%)$	$-x, -y$
Increase $(x\%)$	Decrease $(x\%)$	$x, -x$

KEY TAKEAWAY: Do not need to memorize four separate formulas. Just remember the multiplication of successive change factors and expand the expression using the appropriate signs.

1.3 Ratio & Proportion

- **Ratio**

$$\boxed{a : b = \frac{a}{b}} \qquad \boxed{a : b = ka : kb,\ k \neq 0}$$

- **Proportion**

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

- **Rules of Proportion**

If

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

then

$$\boxed{\textbf{Componendo:}\quad \frac{a+b}{b} = \frac{c+d}{d}}$$

$$\boxed{\textbf{Dividendo:}\quad \frac{a-b}{b} = \frac{c-d}{d}}$$

$$\boxed{\textbf{Componendo–Dividendo:}\quad \frac{a+b}{a-b} = \frac{c+d}{c-d}}$$

NOTE: The denominators must be non-zero.

- **Aggregate Property:**

If

$$\frac{a}{b} = \frac{c}{d} = \frac{e}{f} = k$$

then,

$$a = kb, \qquad c = kd, \qquad e = kf$$

Adding,

$$a + c + e = k(b + d + f)$$

Therefore,

$$\boxed{\frac{a+c+e}{b+d+f} = \frac{a}{b} = \frac{c}{d} = \frac{e}{f}}$$

NOTE: The numerators and denominators of equal ratios can be added together while preserving their common ratio.]

• Division of a Total

If a total T is divided in the ratio $m : n$,

$$\text{1st Share} = \frac{m}{m+n}T \qquad \text{2nd Share} = \frac{n}{m+n}T$$

• Compound Ratio

$$(a : b) \times (c : d) = ac : bd$$

• Duplicate, Sub-duplicate, Triplicate & Sub-triplicate Ratio

Duplicate: $a : b \Rightarrow a^2 : b^2$

Sub-duplicate: $a : b \Rightarrow \sqrt{a} : \sqrt{b}$

Triplicate: $a : b \Rightarrow a^3 : b^3$

Sub-triplicate: $a : b \Rightarrow \sqrt[3]{a} : \sqrt[3]{b}$

• Third & Fourth Proportional

Third Proportional: $\frac{a}{b} = \frac{b}{c} \Rightarrow c = \frac{b^2}{a}$

Fourth Proportional: $\frac{a}{b} = \frac{c}{d} \Rightarrow d = \frac{bc}{a}$

• Direct & Inverse Proportion

Direct Proportion: $x \propto y \Rightarrow \frac{x_1}{x_2} = \frac{y_1}{y_2}$

Inverse Proportion: $x \propto \frac{1}{y} \Rightarrow x_1 y_1 = x_2 y_2$

1.4 Profit & Loss

Basic Terminology:

Cost Price (CP):	The price at which an article is purchased.
Selling Price (SP):	The price at which an article is sold.
Marked Price (MP):	The price printed or displayed on an article before any discount.
Profit (Gain):	The amount earned when the Selling Price is greater than the Cost Price.
Loss:	The amount lost when the Selling Price is less than the Cost Price.
Discount:	The reduction offered on the Marked Price.

- **Basic Definitions**

$$\textbf{Profit} = SP - CP \quad \textbf{Loss} = CP - SP$$

$$\textbf{Discount} = MP - SP$$

- **Profit & Loss Percentage**

$$\textbf{Profit\%} = \frac{SP - CP}{CP} \times 100 \quad \textbf{Loss\%} = \frac{CP - SP}{CP} \times 100$$

- **Selling Price Formula**

$$\textbf{Profit Case} \quad SP = CP\left(1 + \frac{P}{100}\right)$$

$$\textbf{Loss Case} \quad SP = CP\left(1 - \frac{L}{100}\right)$$

- **Cost Price Formula**

$$\textbf{Given Profit} \quad CP = \frac{100}{100 + P} \times SP$$

$$\textbf{Given Loss} \quad CP = \frac{100}{100 - L} \times SP$$

• Discount

Discount %

$$\frac{MP - SP}{MP} \times 100$$

Selling Price

$$SP = MP\left(1 - \frac{D}{100}\right)$$

• Successive Discount

Successive Discounts

Successive discounts are simply consecutive percentage decreases. Each discount is applied to the price obtained after the previous discount.

Suppose two successive discounts of $D_1\%$ and $D_2\%$ are offered on an article with Marked Price MP.

After the first discount:

$$P_1 = MP\left(1 - \frac{D_1}{100}\right)$$

After the second discount:

$$SP = MP\left(1 - \frac{D_1}{100}\right)\left(1 - \frac{D_2}{100}\right)$$

Let D_{eq} be the equivalent single discount. Then,

$$SP = MP\left(1 - \frac{D_{\text{eq}}}{100}\right)$$

Equating and expanding,

$$1 - \frac{D_{\text{eq}}}{100} = 1 - \frac{D_1}{100} - \frac{D_2}{100} + \frac{D_1 D_2}{10000}$$

Therefore,

$$D_{\text{eq}} = D_1 + D_2 - \frac{D_1 D_2}{100}$$

- **Equal Selling Price**

$$\text{Gain } x\%,\ \text{Loss } x\% \ \Rightarrow\ \text{Net Loss} = \frac{x^2}{100}\%$$

$$\text{Gain } x\%,\ \text{Loss } y\% \ \Rightarrow\ \%\text{Net P/L} = \frac{100(x-y)-2xy}{200+x-y}$$

- **When CP of m Articles = SP of n Articles**

$$\%\ \text{Profit/Loss} = \left(\frac{m-n}{n}\right) \times 100$$

$$m > n \Rightarrow \text{Profit} \qquad m < n \Rightarrow \text{Loss}$$

1.5 Simple & Compound Interest

- **Notation**

Symbol	Meaning	Symbol	Meaning
P	Principal	R	Rate of Interest (% p.a.)
T	Time (years)	A	Amount
SI	Simple Interest	CI	Compound Interest
m	Compounding periods/year	r	Growth/Depreciation rate (%)
n	Number of periods		

- **Simple Interest**

$$SI = \frac{PRT}{100} \qquad A = P + SI = P\left(1 + \frac{RT}{100}\right)$$

- **Compound Interest**

$$A = P\left(1 + \frac{R}{100}\right)^T$$

$$CI = P\left[\left(1 + \frac{R}{100}\right)^T - 1\right]$$

- **Compounding m Times per Year**

$$A = P\left(1 + \frac{R}{100m}\right)^{mT}$$

m	Frequency
1	Annually
2	Half-yearly
4	Quarterly
12	Monthly

- **Different Rates for Different Years**

$$A = P\prod_{i=1}^{n}\left(1+\frac{R_i}{100}\right)$$

$$A = P\left(1+\frac{R_1}{100}\right)\left(1+\frac{R_2}{100}\right)\left(1+\frac{R_3}{100}\right)\cdots$$

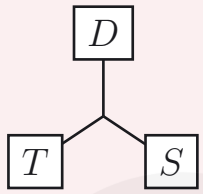
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1.6 Time, Speed & Distance

• Notation

D	Distance	S	Speed
T	Time	v_1, v_2	Speeds of two objects
L_T	Length of train	L_O	Length of object/platform
S_T	Speed of train	S_O	Speed of object
v_b	Boat speed in still water	v_s	Stream speed
v_d	Downstream speed	v_u	Upstream speed

• Basic Relation



Distance–Speed–Time Shortcut

$$D = S \times T$$

• Unit Conversion

$$1 \text{ km/hr} = \frac{5}{18} \text{ m/s} \qquad 1 \text{ m/s} = \frac{18}{5} \text{ km/hr}$$

• Average Speed

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

$$\text{Equal Distances:} \quad v_{\text{avg}} = \frac{2v_1v_2}{v_1 + v_2}$$

$$\text{Equal Times:} \quad v_{\text{avg}} = \frac{v_1 + v_2}{2}$$

• Relative Speed

$$\text{Same Direction:} \quad v_{\text{rel}} = |v_1 - v_2|$$

$$\text{Opposite Direction:} \quad v_{\text{rel}} = v_1 + v_2$$

• Trains

Train crossing a pole: $T = \dfrac{L_T}{S_T}$

Train crossing a platform: $T = \dfrac{L_T + L_O}{S_T}$

Two trains crossing: $T = \dfrac{L_1 + L_2}{v_{\text{rel}}}$

Opposite direction: $T = \dfrac{L_1 + L_2}{v_1 + v_2}$

Same direction: $T = \dfrac{L_1 + L_2}{|v_1 - v_2|}$

• Boats & Streams

$v_d = v_b + v_s$ $\quad$ $v_u = v_b - v_s$

$v_b = \dfrac{v_d + v_u}{2}$ $\quad$ $v_s = \dfrac{v_d - v_u}{2}$

• Circular Track

Same Direction (Catch-up): $T = \dfrac{L}{|v_1 - v_2|}$

Opposite Direction (Meeting): $T = \dfrac{L}{v_1 + v_2}$

1.7 Time & Work

- **Basic Relation**

Let W be total work, R the work rate, and T the time taken.

$$\boxed{W = RT} \qquad \boxed{R = \frac{W}{T}} \qquad \boxed{T = \frac{W}{R}}$$

If A completes the work in x days:

$$\boxed{\text{A's one-day work} = \frac{1}{x}}$$

- **Combined Work**

If A and B finish the work individually in x and y days, respectively:

$$\boxed{R_{A+B} = \frac{1}{x} + \frac{1}{y}} \qquad \boxed{T_{A+B} = \frac{xy}{x+y}}$$

For three workers, taking z as C's completion time in days:

$$\boxed{R_{A+B+C} = \frac{1}{x} + \frac{1}{y} + \frac{1}{z}}$$

- **Efficiency**

For the same task, efficiency is inversely proportional to time:

$$\boxed{E \propto \frac{1}{T}} \qquad \boxed{E_A : E_B = T_B : T_A}$$

If A is k times as efficient as B:

$$\boxed{E_A : E_B = k : 1} \qquad \boxed{T_A : T_B = 1 : k}$$

• Man–Day–Hour (MDH)

⋆ Asli Masale Sach Sach, MDH MDH! ⋆

For the same work and equal worker productivity, let M = number of workers, D = days, and H = working hours per day.

$$\boxed{M_1 D_1 H_1 = M_2 D_2 H_2}$$

If working hours per day are equal:

$$\boxed{M_1 D_1 = M_2 D_2}$$

Required days for the second group:

$$\boxed{D_2 = \frac{M_1 D_1 H_1}{M_2 H_2}}$$

• Alternate-Day Work

If A and B work on alternate days, starting with A, let R_A and R_B be their respective daily work rates.

$$\boxed{\text{Work in 2 days} = R_A + R_B}$$

• Pipes & Cisterns

If an inlet fills a tank in x hours:

$$\boxed{R_{\text{inlet}} = \frac{1}{x}}$$

If an outlet empties the tank in y hours:

$$\boxed{R_{\text{outlet}} = -\frac{1}{y}}$$

With one inlet and one outlet open together:

$$\boxed{R_{\text{net}} = \frac{1}{x} - \frac{1}{y}}$$

1.8 Permutations & Combinations

- **Basic Concepts**

Permutation: Arrangement of objects where order matters.

Combination: Selection of objects where order does not matter.

$$\boxed{{}^nP_r = r! \times {}^nC_r}$$

- **Factorial**

Factorial of a non-negative integer n:

$$\boxed{n! = n(n-1)(n-2)\cdots 2 \cdot 1}$$

$$\boxed{0! = 1, \qquad 1! = 1}$$

$$\boxed{n! = n(n-1)!}$$

• Permutation (Arrangement)

Number of ways to select and arrange r objects from n distinct objects:

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

Special Cases

All n objects:	$n!$
Repetition allowed:	n^r
Circular arrangement:	$(n-1)!$

If n objects contain $p, q, r, \ldots$ identical objects:

$$\boxed{\text{Arrangements} = \frac{n!}{p!q!r!\cdots}}$$

Example: Arrangements of the word LEVEL:

$$\boxed{\frac{5!}{2!\,2!} = 30}$$

• Combination (Selection)

Number of ways to select r objects from n distinct objects:

$$\boxed{{}^nC_r = \frac{n!}{r!(n-r)!}}$$

Example: Selecting 3 students from 5 students:

$$\boxed{{}^5C_3 = 10}$$

Important Properties

$$\begin{aligned} {}^nC_r &= {}^nC_{n-r} \\ {}^nC_0 &= {}^nC_n = 1 \\ {}^nC_r + {}^nC_{r-1} &= {}^{n+1}C_r \\ {}^nP_r &= r!\,{}^nC_r \end{aligned}$$

Sum of Combinations

$$\boxed{\sum_{r=0}^{n} {}^nC_r = 2^n}$$

• Binomial Theorem

For a non-negative integer n:

$$\boxed{(a+b)^n = \sum_{r=0}^{n} {}^nC_r a^{n-r} b^r}$$

• Distribution of Identical Objects (Stars & Bars)

For distributing r identical objects into n distinct boxes:
Non-negative distribution:

$$\boxed{\binom{n+r-1}{n-1}}$$

Non-negative: Empty boxes are allowed.

Integer Solutions

$x_1 + x_2 + \cdots + x_n = r, \quad x_i \geq 0$:

$$\boxed{\binom{r+n-1}{n-1}}$$

Example: Number of non-negative integer solutions of

$$x_1 + x_2 + x_3 = 5$$

$$\boxed{\binom{7}{2} = 21}$$

• Counting Principles

Sum Rule: Mutually exclusive alternatives:

$$\boxed{m + n}$$

Product Rule: Successive choices:

$$\boxed{m \times n}$$

Complement Rule:

$$\boxed{\text{Desired} = \text{Total} - \text{Undesired}}$$

Inclusion–Exclusion Principle:
For two sets:

$$\boxed{|A \cup B| = |A| + |B| - |A \cap B|}$$

For three sets:

$$\boxed{\begin{aligned} |A \cup B \cup C| = {} & |A| + |B| + |C| \\ & - |A \cap B| - |B \cap C| - |A \cap C| \\ & + |A \cap B \cap C| \end{aligned}}$$

1.9 Probability & Statistics

- **Basic Concepts of Probability**

For equally likely outcomes,

$$P(A) = \frac{n(A)}{n(S)}$$

$$0 \leq P(A) \leq 1$$

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

$$P(S) = 1, \qquad P(\varnothing) = 0$$

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

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

- **Conditional Probability**

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$$

$$P(A \cap B) = P(A \mid B)P(B)$$

Independent Events:

$$P(A \cap B) = P(A)P(B)$$

$$P(A \mid B) = P(A)$$

• Total Probability & Bayes' Theorem

If $A_1, A_2, \ldots, A_n$ are mutually exclusive and exhaustive events,

$$P(B) = \sum_{i=1}^{n} P(B \cap A_i) = \sum_{i=1}^{n} P(A_i)P(B \mid A_i)$$

Bayes' Theorem:

$$P(A \mid B) = \frac{P(A)P(B \mid A)}{\sum_{i=1}^{n} P(B \cap A_i)} = \frac{P(A)P(B \mid A)}{\sum_{j=1}^{n} P(A_j)P(B \mid A_j)}$$

• Random Variables

Probability Mass Function (PMF):

$$P(X = x) = p(x), \qquad \sum_{x} p(x) = 1$$

Probability Density Function (PDF):

$$\int_{-\infty}^{\infty} f(x)\,dx = 1$$

$$P(a \le X \le b) = \int_{a}^{b} f(x)\,dx$$

Cumulative Distribution Function (CDF):

$$F(x) = P(X \le x)$$

$$P(a < X \le b) = F(b) - F(a)$$

• Expectation and Variance

Expected Value (Mean):

For a discrete random variable,

$$E(X) = \sum_{x} xP(X = x)$$

For a continuous random variable,

$$E(X) = \int_{-\infty}^{\infty} x f(x)\, dx$$

Linearity of Expectation:

$$E(aX + b) = aE(X) + b$$

$$E(X + Y) = E(X) + E(Y)$$

Variance:

$$\text{Var}(X) = E(X^2) - [E(X)]^2$$

$$\text{Var}(aX + b) = a^2\, \text{Var}(X)$$

For independent random variables,

$$\text{Var}(X + Y) = \text{Var}(X) + \text{Var}(Y)$$

$\sigma = \sqrt{\text{Var}(X)}$ where σ denotes the standard deviation of X.

• Important Probability Distributions

1.10 Geometry & Mensuration

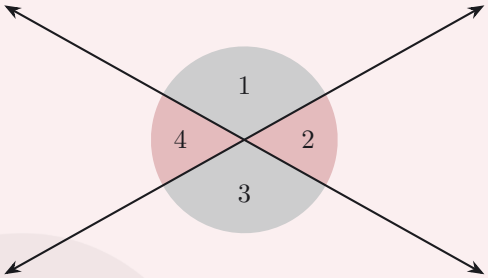
- **Angles**

Complementary angles = 90°

Supplementary angles = 180°

Angles around a point = 360°

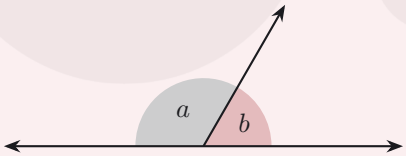
Vertically opposite angles are equal



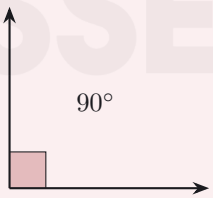
$\angle 1 = \angle 3$

$\angle 2 = \angle 4$

Linear pair: $a + b = 180°$



Linear pair



Right angle

• Parallel Lines & Transversal

When two parallel lines are cut by a transversal:

Corresponding Angles

$\boxed{\angle 1 = \angle 5}$ $\boxed{\angle 2 = \angle 6}$

$\boxed{\angle 3 = \angle 7}$ $\boxed{\angle 4 = \angle 8}$

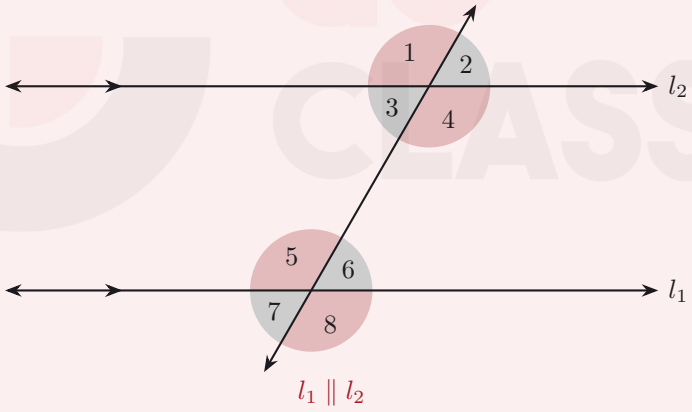
Alternate Interior Angles

$\boxed{\angle 3 = \angle 6}$ $\boxed{\angle 4 = \angle 5}$

Interior Angles on the Same Side

$\boxed{\angle 3 + \angle 5 = 180^\circ}$

$\boxed{\angle 4 + \angle 6 = 180^\circ}$



Same shade ⇒ equal angles; grey + red = 180°.

• Polygons

For a polygon with n sides:

$$\boxed{\text{Sum of interior angles} = (n-2)180^\circ}$$

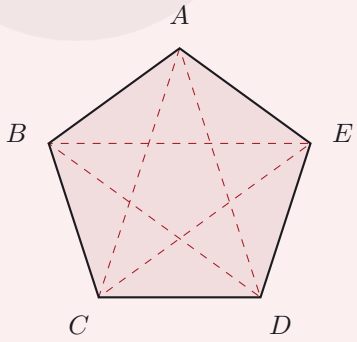
$$\boxed{\text{Each interior angle of a regular polygon} = \frac{(n-2)180^\circ}{n}}$$

$$\boxed{\text{Sum of exterior angles} = 360^\circ}$$

$$\boxed{\text{Each exterior angle} = \frac{360^\circ}{n}}$$

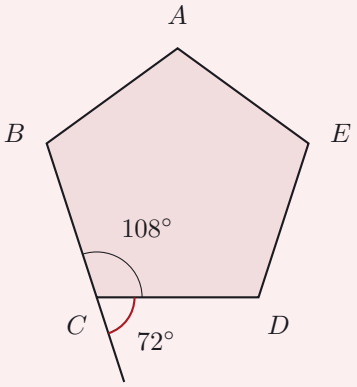
$$\boxed{\text{Number of diagonals} = \frac{n(n-3)}{2}}$$

$$\boxed{\text{Interior angle} + \text{Exterior angle} = 180^\circ}$$



Pentagon: $n = 5$

Interior sum $= 540^\circ$, Diagonals $= 5$



Interior + Exterior

$108^\circ + 72^\circ = 180^\circ$

NOTE: The formulas for each interior angle and each exterior angle are applicable only to **regular polygons**, where all sides and interior angles are equal.

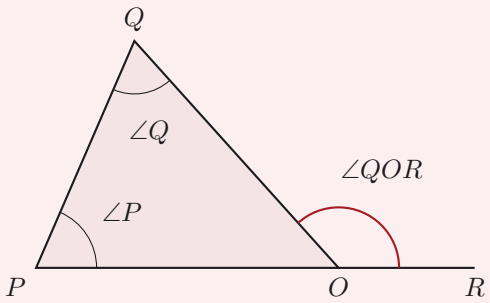
• Triangle: Basic Properties

For triangle ABC, with angles A, B, C:

$$\boxed{A + B + C = 180^\circ}$$

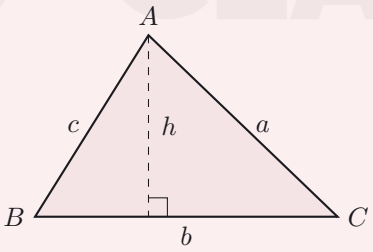
$$\boxed{\text{Exterior angle} = \text{sum of two opposite interior angles}}$$

$$\boxed{\angle QOR = \angle P + \angle Q}$$



$$\boxed{\text{Area} = \frac{1}{2}bh} \qquad \boxed{\text{Perimeter} = a + b + c}$$

The largest side is opposite the largest angle.



• Special Triangles

Equilateral triangle (side a):

$$h = \frac{\sqrt{3}}{2}a \qquad \text{Area} = \frac{\sqrt{3}}{4}a^2 \qquad \text{Each angle} = 60^\circ$$

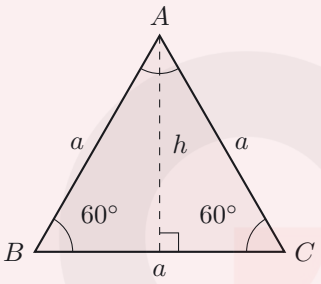
Isosceles triangle:

$$AB = AC \implies \angle B = \angle C$$

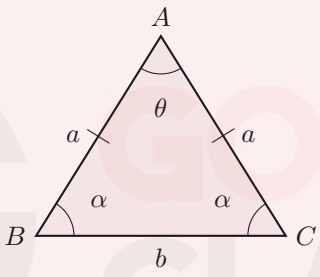
Right-angled triangle:

$$c^2 = a^2 + b^2$$

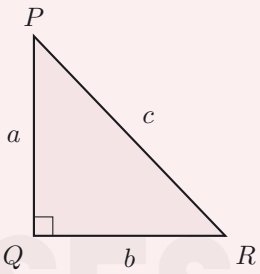
Here, c is the hypotenuse and a, b are the perpendicular sides.



Equilateral



Isosceles



Right triangle

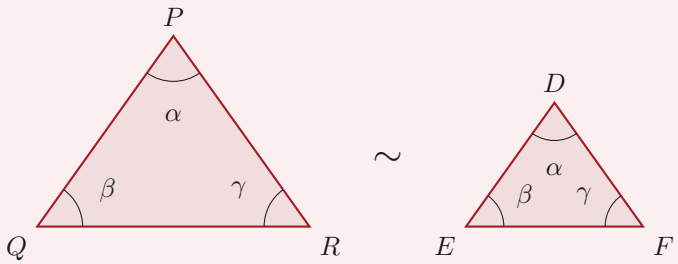
• Triangle Theorems

Similar Triangles

If $\triangle PQR \sim \triangle DEF$, then their corresponding angles are equal and corresponding sides are proportional.

$$\boxed{\angle P = \angle D, \quad \angle Q = \angle E, \quad \angle R = \angle F}$$

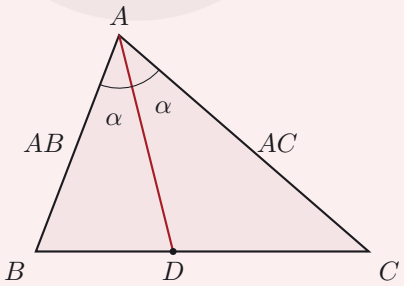
$$\boxed{\frac{PQ}{DE} = \frac{QR}{EF} = \frac{PR}{DF}}$$



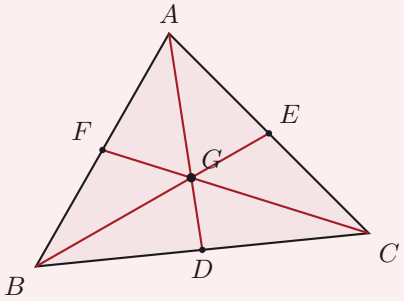
Angle bisector theorem: if AD bisects $\angle A$,

$$\boxed{\frac{BD}{DC} = \frac{AB}{AC}}$$

Median: divides a triangle into two equal-area triangles.
Centroid: divides each median in the ratio $2:1$, measured from the vertex.



$$\frac{BD}{DC} = \frac{AB}{AC}$$



$$AG : GD = 2 : 1$$

• Circle: Basic Properties

For a circle of radius r and diameter d:

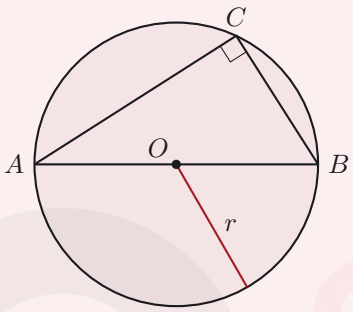
$$\boxed{d = 2r} \qquad \boxed{\text{Circumference} = 2\pi r = \pi d}$$

$$\boxed{\text{Area} = \pi r^2}$$

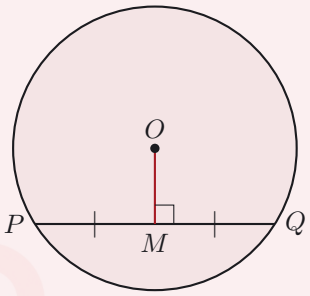
Angle subtended by a diameter at the circumference:

$$\boxed{\angle ACB = 90^\circ}$$

The perpendicular from the centre to a chord bisects the chord.
Equal chords subtend equal angles at the centre.



Angle in a semicircle ($d = 2r$)



$PM = MQ$

GO CLASSES

• Circle: Chords & Tangents

A radius is perpendicular to the tangent at the point of contact.

$$\boxed{OT \perp PT}$$

Tangents drawn from the same external point are equal:

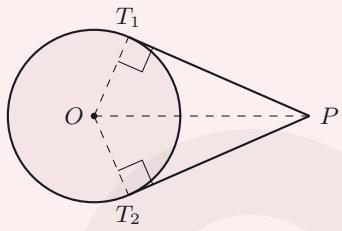
$$\boxed{PT_1 = PT_2}$$

Tangent-secant theorem:

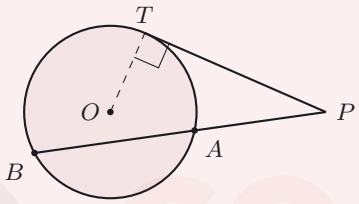
$$\boxed{PT^2 = PA \cdot PB}$$

For two secants from external point P:

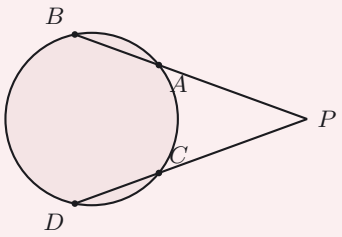
$$\boxed{PA \cdot PB = PC \cdot PD}$$



$PT_1 = PT_2$



$PT^2 = PA \cdot PB$



$PA \cdot PB = PC \cdot PD$

• Circle: Arcs & Angles

Angle at the centre is twice the angle at the circumference subtended by the same arc:

$$\boxed{\angle AOB = 2\angle ACB}$$

Angle in a semicircle:

$$\boxed{90^\circ}$$

Opposite angles of a cyclic quadrilateral:

$$\boxed{\angle A + \angle C = 180^\circ}$$

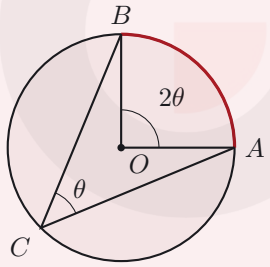
$$\boxed{\angle B + \angle D = 180^\circ}$$

Arc length for central angle θ in degrees:

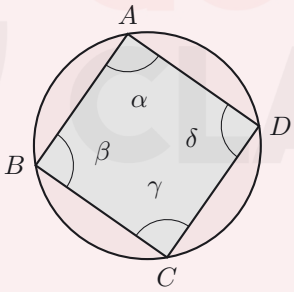
$$\boxed{L = \frac{\theta}{360^\circ} 2\pi r}$$

Sector area:

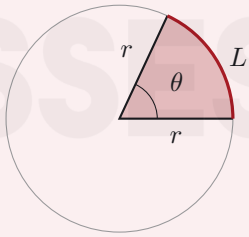
$$\boxed{A = \frac{\theta}{360^\circ} \pi r^2}$$



$\angle AOB = 2\angle ACB$



$\alpha + \gamma = 180^\circ,\ \beta + \delta = 180^\circ$



Arc L and sector

• Quadrilaterals

Sum of interior angles:

$$\boxed{360^\circ}$$

Parallelogram (base b, height h):

$$\boxed{A = bh} \qquad \boxed{P = 2(a+b)}$$

Rectangle (length l, breadth b):

$$\boxed{A = lb} \qquad \boxed{P = 2(l+b)} \qquad \boxed{d = \sqrt{l^2 + b^2}}$$

Square (side a):

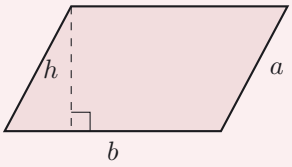
$$\boxed{A = a^2} \qquad \boxed{P = 4a} \qquad \boxed{d = a\sqrt{2}}$$

Rhombus (diagonals d_1, d_2):

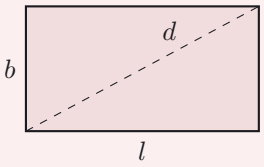
$$\boxed{A = \frac{1}{2}d_1 d_2}$$

Trapezium (parallel sides a, b, height h):

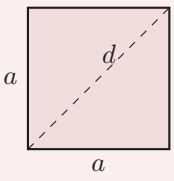
$$\boxed{A = \frac{1}{2}(a+b)h}$$



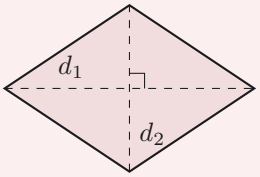
Parallelogram



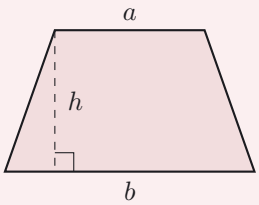
Rectangle



Square



Rhombus



Trapezium

• Triangle: Area Formulas

Base b and perpendicular height h:

$$\boxed{A = \frac{1}{2}bh}$$

Triangle Area Formula (Three Sides) a, b, c:

$$\boxed{A = \sqrt{s(s-a)(s-b)(s-c)}}$$

where

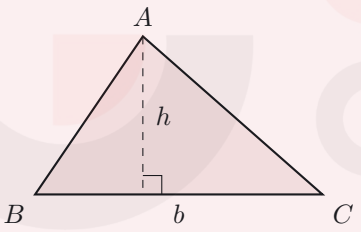
$$\boxed{s = \frac{a+b+c}{2}}$$

Two sides a, b and included angle C:

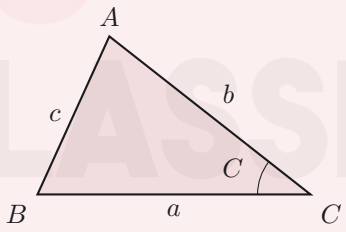
$$\boxed{A = \frac{1}{2}ab\sin C}$$

For an equilateral triangle:

$$\boxed{A = \frac{\sqrt{3}}{4}a^2} \qquad \boxed{h = \frac{\sqrt{3}}{2}a}$$



$A = \frac{1}{2}bh$



$A = \frac{1}{2}ab\sin C$

• Pythagoras Theorem

For a right triangle with perpendicular sides a, b and hypotenuse c:

$$\boxed{a^2 + b^2 = c^2}$$

Common Pythagorean triples:

$$\boxed{3, 4, 5} \quad \boxed{5, 12, 13} \quad \boxed{8, 15, 17}$$

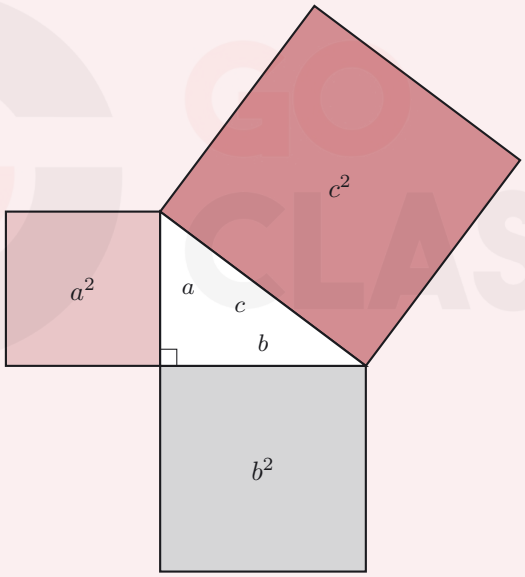
$$\boxed{7, 24, 25} \quad \boxed{20, 21, 29}$$

If c is the longest side:

$$\boxed{c^2 = a^2 + b^2 \Rightarrow \text{right-angled}}$$

$$\boxed{c^2 < a^2 + b^2 \Rightarrow \text{acute-angled}}$$

$$\boxed{c^2 > a^2 + b^2 \Rightarrow \text{obtuse-angled}}$$



• Solid Geometry: Cube & Cuboid

Cube (side a):

$$\boxed{V = a^3} \qquad \boxed{\text{Total Surface Area (TSA)} = 6a^2} \qquad \boxed{\text{Lateral Surface Area (LSA)} = 4a^2}$$

$$\boxed{\text{Space diagonal} = a\sqrt{3}}$$

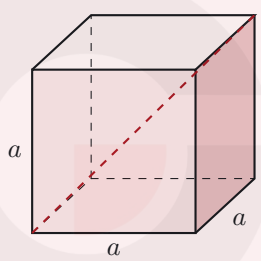
Cuboid (length l, breadth b, height h):

$$\boxed{V = lbh}$$

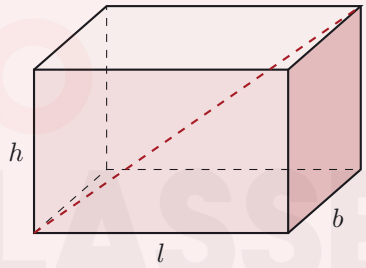
$$\boxed{\text{TSA} = 2(lb + bh + hl)}$$

$$\boxed{\text{LSA} = 2h(l + b)}$$

$$\boxed{\text{Space diagonal} = \sqrt{l^2 + b^2 + h^2}}$$



Cube



Cuboid

Dashed red line = space diagonal.

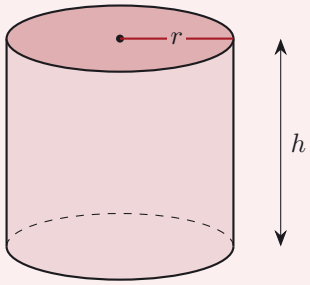
• Solid Geometry: Cylinder

For radius r and height h:

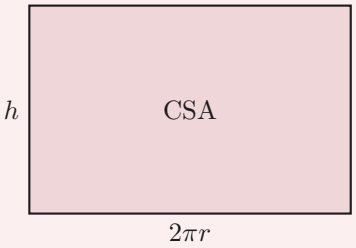
$$\boxed{V = \pi r^2 h}$$

$$\boxed{\text{Curved surface area} = 2\pi rh}$$

$$\boxed{\text{TSA} = 2\pi r(h + r)}$$



Cylinder



Curved surface unrolled

• Solid Geometry: Cone

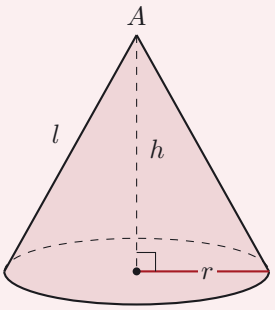
For radius r, vertical height h, and slant height l:

$$\boxed{l = \sqrt{r^2 + h^2}}$$

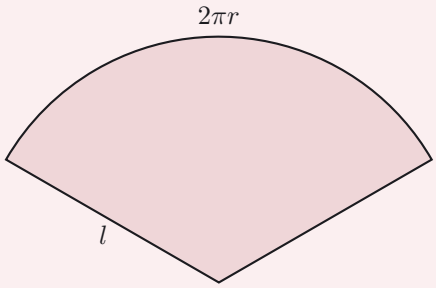
$$\boxed{V = \frac{1}{3}\pi r^2 h}$$

$$\boxed{\text{Curved surface area} = \pi rl}$$

$$\boxed{\text{TSA} = \pi r(l + r)}$$



Cone



Curved surface unrolled

• Solid Geometry: Sphere & Hemisphere

Sphere (radius r):

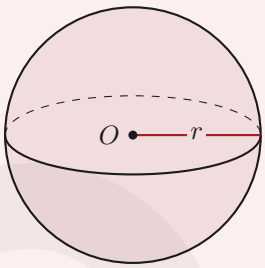
$$V = \frac{4}{3}\pi r^3 \qquad \text{Surface area} = 4\pi r^2$$

Hemisphere (radius r):

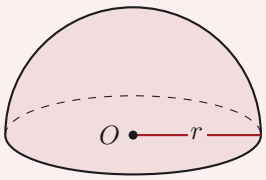
$$V = \frac{2}{3}\pi r^3$$

$$\text{Curved surface area} = 2\pi r^2$$

$$\text{TSA} = 3\pi r^2$$



Sphere



Hemisphere

• Geometry: Quick Reminders

$$\text{Area units} = (\text{length unit})^2$$

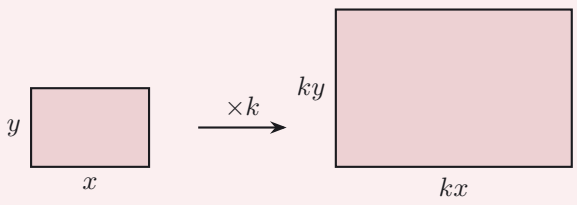
$$\text{Volume units} = (\text{length unit})^3$$

$$\pi \approx \frac{22}{7} \approx 3.1416$$

For similar figures with linear scale factor k:

$$\text{Perimeter ratio} = k$$

$$\text{Area ratio} = k^2 \qquad \text{Volume ratio} = k^3$$



Original

Scaled by k

• Solid Geometry: Quick Remember

	Volume	Total Surface Area	Lateral / Curved Surface Area
Cube	a^3	$6a^2$	$4a^2$
Cuboid	lbh	$2(lb+bh+hl)$	$2h(l+b)$
Cylinder	$\pi r^2 h$	$2\pi r(r+h)$	$2\pi rh$
Cone	$\frac{1}{3}\pi r^2 h$	$\pi r(r+l)$	$\pi rl \quad \{l=\sqrt{r^2+h^2}\}$
Sphere	$\frac{4}{3}\pi r^3$	$4\pi r^2$	$4\pi r^2$
Hemisphere	$\frac{2}{3}\pi r^3$	$3\pi r^2$	$2\pi r^2$

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2. Verbal

3. Analytical

4. Spatial

NOTE	For the above 3 topics (Verbal, Analytical and Spatial), practice as much as you can. Learn the topics and important formulas while solving questions.

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