

Maths Last-Minute Revision Notes

SscAce

SSC CGL Tier 1 • Formulas, shortcuts & standard values • 20–30 minute revision

★ **Must remember** — highlighted rows

1 PERCENTAGE

Basics	$x\%$ of $y = xy/100$ a is what % of $b = (a/b) \times 100$ $x\%$ of $y = y\%$ of x
% change	$(\text{Change} \div \text{Original}) \times 100$ $\text{New} = \text{Old} \times (100 \pm x)/100$
A vs B	A is $x\%$ more than $B \Rightarrow B$ is $[100x/(100 + x)]\%$ less than A A is $x\%$ less than $B \Rightarrow B$ is $[100x/(100 - x)]\%$ more than A
Successive change	Net % = $a + b + ab/100$ (increase +, decrease -) e.g. +20% then -20%: $20 - 20 - 4 = -4\%$
Price & use	Price $\uparrow x\% \Rightarrow$ use $\downarrow [100x/(100 + x)]\%$ (expenditure same) Price $\downarrow x\% \Rightarrow$ use $\uparrow [100x/(100 - x)]\%$
Area change	Side $+x\% \Rightarrow$ area $+(2x + x^2/100)\%$ Side $-x\% \Rightarrow$ area $-(2x - x^2/100)\%$ Length $\pm x\%$, breadth $\pm y\% \Rightarrow$ area: $x + y + xy/100$ (use signs)
Growth / decay	$P(1 + r/100)^n$ (growth) $P(1 - r/100)^n$ (decay)
Fraction $\leftrightarrow$ %	$1/2 = 50\% \cdot 1/3 = 33\frac{1}{3}\% \cdot 1/4 = 25\% \cdot 1/5 = 20\%$ $1/6 = 16\frac{2}{3}\% \cdot 1/7 = 14.28\% \cdot 1/8 = 12.5\% \cdot 1/9 = 11.11\%$ $1/10 = 10\% \cdot 1/12 = 8\frac{1}{3}\% \cdot 3/4 = 75\% \cdot 2/3 = 66\frac{2}{3}\%$

2 RATIO & PROPORTION

Basics	$a : b = a/b$ $a : b = c : d \Rightarrow ad = bc$
Divide N	In ratio $a : b \Rightarrow N \cdot a/(a + b)$ and $N \cdot b/(a + b)$
Link ratios	$a : b = m : n, b : c = p : q \Rightarrow a : b : c = mp : np : nq$
Compound	$a : b$ and $c : d \Rightarrow ac : bd$ Duplicate $a^2 : b^2$ · Triplicate $a^3 : b^3$ · Sub-duplicate $\sqrt{a} : \sqrt{b}$
Proportionals	Mean proportional = $\sqrt{ab}$ · Third = b^2/a · Fourth of $a, b, c = bc/a$
Comp.-Div.	$a/b = c/d \Rightarrow (a + b)/(a - b) = (c + d)/(c - d)$
Direct	$y/x = \text{constant}$ (one $\uparrow \Rightarrow$ other $\uparrow$)
Inverse	$xy = \text{constant}$ (one $\uparrow \Rightarrow$ other $\downarrow$) e.g. men $\times$ days = constant
Alligation	Cheaper : Dearer = $(d - m) : (m - c)$ (c = cheaper price, d = dearer price, m = mean price)

Partnership	Profit share $\propto$ Investment $\times$ Time Same time $\Rightarrow$ ratio of investments Same investment $\Rightarrow$ ratio of time Working partner's salary is paid first; balance divided in ratio
Ages	Difference of two ages never changes; take ages as ax, bx

3 AVERAGE

Basic	Average = $\text{Sum} \div N$ $\text{Sum} = \text{Average} \times N$
Number series	First n natural: $\text{Sum} = n(n + 1)/2$, $\text{Avg} = (n + 1)/2$ First n odd: $\text{Sum} = n^2$, $\text{Avg} = n$ First n even: $\text{Sum} = n(n + 1)$, $\text{Avg} = n + 1$ Consecutive / AP terms: $\text{Avg} = (\text{First} + \text{Last})/2 = \text{middle term}$
Combined	$(n_1a_1 + n_2a_2) / (n_1 + n_2)$
Add one item	$\text{Avg} \uparrow$ by $d \Rightarrow$ new item = $\text{Old avg} + (n + 1)d$ $\text{Avg} \downarrow$ by $d \Rightarrow$ new item = $\text{Old avg} - (n + 1)d$ (also batsman's next innings)
Remove one item	$\text{Avg} \uparrow$ by $d \Rightarrow$ removed = $\text{Old avg} - (n - 1)d$ $\text{Avg} \downarrow$ by $d \Rightarrow$ removed = $\text{Old avg} + (n - 1)d$ (n = original count)
Replacement	One member replaced, average of n members changes by $d \Rightarrow \text{New} - \text{Old} = n \times d$ (+ if avg $\uparrow$, - if $\downarrow$)
Weighted	$\Sigma(\text{weight} \times \text{value}) / \Sigma \text{weight}$
Average speed	Equal distances: $2xy/(x + y)$ Equal times: $(x + y)/2$
Age tip	After t years, group average = old average + t (same members)

4 PROFIT, LOSS & DISCOUNT

Basics	Profit = $SP - CP$ Loss = $CP - SP$
Percentage	Profit % = $(\text{Profit}/CP) \times 100$ Loss % = $(\text{Loss}/CP) \times 100$ (always on CP)
SP and CP	$SP = CP \times (100 \pm x)/100$ $CP = SP \times 100/(100 \pm x)$ (+ profit, - loss)
Ratio	Profit $x\% \Rightarrow CP : SP = 100 : (100 + x)$ Loss $x\% \Rightarrow 100 : (100 - x)$
Discount	Discount = $MP - SP$ Disc % = $(\text{Discount}/MP) \times 100$ (on MP) $SP = MP \times (100 - d)/100$
Successive discounts	Net = $d_1 + d_2 - d_1d_2/100$ (20% & 10% $\Rightarrow$ 28%)

MP above CP	MP = x% above CP, discount y% $\Rightarrow$ Profit % = $x - y - xy/100$
Same SP	One article gains x%, other loses x% (same SP) $\Rightarrow$ overall Loss = $x^2/100$ %
False weight	Gain % = $[\text{Error} \div (\text{True weight} - \text{Error})] \times 100$ (900 g for 1 kg: $100/900 = 11.11\%$)
x for y	SP of x articles = CP of y articles $\Rightarrow$ Profit % = $(y - x)/x \times 100$
Overall	Overall % = Total profit $\div$ Total CP $\times 100$ (not the average of the %s)
Fraction tip	$12.5\% = 1/8 \cdot 16\frac{2}{3}\% = 1/6 \cdot 20\% = 1/5 \cdot 25\% = 1/4 \cdot 33\frac{1}{3}\% = 1/3$ e.g. 12.5% profit $\Rightarrow$ SP = CP $\times 9/8$

5 SIMPLE & COMPOUND INTEREST

SI	SI = $PRT/100$ $A = P + SI = P(1 + RT/100)$
CI	$A = P(1 + R/100)^n$ $CI = A - P$
Compounding	Half-yearly: rate $R/2$, time $2n$ Quarterly: rate $R/4$, time $4n$ Rule: rate $\div k$, time $\times k$ (k = periods per year)
CI - SI (2 yrs)	$P(R/100)^2 = (1\text{-year SI}) \times R/100$
CI - SI (3 yrs)	$P(R/100)^2(3 + R/100)$
CI % of P	2 yrs: $2R + R^2/100$ 3 yrs: $3R + 3R^2/100 + R^3/10^4$
Different rates	$A = P(1 + R_1/100)(1 + R_2/100)(1 + R_3/100)$
n times	SI: sum becomes n times in T yrs $\Rightarrow R \times T = 100(n - 1)$ CI: $(1 + R/100)^T = n$
From two amounts	SI per year = $(A_2 - A_1)/(t_2 - t_1)$; then $P = A_1 - (\text{SI per year} \times t_1)$

6 TIME, SPEED & DISTANCE

Core	Speed = Distance/Time $D = S \times T$ $T = D/S$
Units	km/h $\rightarrow$ m/s: $\times 5/18$ m/s $\rightarrow$ km/h: $\times 18/5$ 36 km/h = 10 m/s $\cdot$ 54 km/h = 15 m/s $\cdot$ 72 km/h = 20 m/s
Ratios	Same distance: Speed $\propto 1/\text{Time}$ Same time: Distance $\propto$ Speed
Average speed	Total D $\div$ Total T Equal distances: $2xy/(x + y)$
Relative speed	Same direction: $S_1 - S_2$ Opposite: $S_1 + S_2$ Time to meet / overtake = Gap $\div$ Relative speed
Train: pole / man	Time = Length of train $\div$ Speed
Train: platform / bridge	Time = $(L_{\text{train}} + L_{\text{platform}}) \div$ Speed

Two trains	Opposite: $(L_1 + L_2)/(S_1 + S_2)$ Same direction: $(L_1 + L_2)/(S_1 - S_2)$
Boats & streams	Downstream $D = u + v$ Upstream $U = u - v$ (u = still water, v = stream) $u = (D + U)/2$ $v = (D - U)/2$
Round trip	Average speed = $(u^2 - v^2)/u$ (equal distances up and down)
Time ratio	Upstream time = $n \times$ downstream time (same distance) $\Rightarrow u : v = (n + 1) : (n - 1)$
Circular track	First meeting after $L/(S_1 + S_2)$ (opposite) or $L/(S_1 - S_2)$ (same direction)

7 TIME & WORK

Basics	Work = Efficiency $\times$ Time Efficiency $\propto 1/\text{Time}$
1 day's work	A takes a days $\Rightarrow 1/a$ per day A and B together: $ab/(a + b)$ days A, B, C together: $abc/(ab + bc + ca)$ days
LCM method	Total work = LCM of days Efficiency = Total $\div$ Days Time = Total $\div$ Combined efficiency e.g. 12 d & 15 d: Total 60, efficiency 5 + 4 = 9/day $\Rightarrow 60/9 = 6\frac{2}{3}$ days
Men-days	$M_1 D_1 H_1/W_1 = M_2 D_2 H_2/W_2$ (add efficiency E on both sides if given)
Wages	Wages $\propto$ work done = Efficiency $\times$ Days worked
Efficiency	A is k times as efficient as B $\Rightarrow$ Time ratio $A : B = 1 : k$
Pipes	Inlet = + efficiency; outlet / leak = - efficiency; Net = Σ efficiencies Time = Capacity $\div$ Net rate
Leak	Pipe fills in a hrs, with leak in b hrs ($b > a$) $\Rightarrow$ leak empties full tank in $ab/(b - a)$ hrs

8 ALGEBRA

Squares	$(a + b)^2 = a^2 + 2ab + b^2$ $(a - b)^2 = a^2 - 2ab + b^2$ $a^2 - b^2 = (a + b)(a - b)$
Cubes	$(a + b)^3 = a^3 + b^3 + 3ab(a + b)$ $(a - b)^3 = a^3 - b^3 - 3ab(a - b)$
Cubes $\pm$	$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$ $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$
Linked	$(a + b)^2 + (a - b)^2 = 2(a^2 + b^2)$ $(a + b)^2 - (a - b)^2 = 4ab$ $a^4 - b^4 = (a^2 + b^2)(a + b)(a - b)$
Three variables	$(a + b + c)^2 = a^2 + b^2 + c^2 + 2(ab + bc + ca)$ $a^3 + b^3 + c^3 - 3abc = (a + b + c)(a^2 + b^2 + c^2 - ab - bc - ca)$ $a^2 + b^2 + c^2 - ab - bc - ca = \frac{1}{2}[(a - b)^2 + (b - c)^2 + (c - a)^2]$ If $a + b + c = 0 \Rightarrow a^3 + b^3 + c^3 = 3abc$

Product	$(x + a)(x + b) = x^2 + (a + b)x + ab$
$x + 1/x = k$	$x^2 + 1/x^2 = k^2 - 2 \mid x^3 + 1/x^3 = k^3 - 3k$ $x^4 + 1/x^4 = (k^2 - 2)^2 - 2$
$x - 1/x = k$	$x^2 + 1/x^2 = k^2 + 2 \mid x^3 - 1/x^3 = k^3 + 3k$ $(x + 1/x)^2 - (x - 1/x)^2 = 4$
Quadratic	$ax^2 + bx + c = 0 \Rightarrow x = (-b \pm \sqrt{D}) / 2a$, where $D = b^2 - 4ac$ Sum of roots = $-b/a \mid$ Product = c/a $D > 0$: two real roots · $D = 0$: equal roots · $D < 0$: no real roots
Indices	$a^m \times a^n = a^{m+n} \mid a^m/a^n = a^{m-n}$ $(a^m)^n = a^{mn} \mid a^0 = 1 \mid a^{-n} = 1/a^n$
Surds	$\sqrt{a} \times \sqrt{b} = \sqrt{ab} \mid (\sqrt{a} + \sqrt{b})(\sqrt{a} - \sqrt{b}) = a - b$ $1/(\sqrt{a} + \sqrt{b}) = (\sqrt{a} - \sqrt{b})/(a - b)$
Series sums	$1 + 2 + \dots + n = n(n + 1)/2 \cdot 1^2 + \dots + n^2 =$ $n(n + 1)(2n + 1)/6 \cdot 1^3 + \dots + n^3 = [n(n + 1)/2]^2$
Coordinates	Distance = $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ · Slope $m = (y_2 - y_1)/(x_2 - x_1)$ · $y = mx + c$ Horizontal line ($y = k$): slope 0 · Vertical line ($x = k$): slope undefined

9 GEOMETRY

Angles	Complementary = 90° · Supplementary = 180° · Vertically opposite angles are equal · Angles on a straight line = 180° · Around a point = 360°
Parallel lines	Corresponding angles equal · Alternate angles equal · Co-interior (same-side) angles sum to 180°
Polygon	Interior angle sum = $(n - 2) \times 180^\circ$ · Each interior angle (regular) = $(n - 2) \times 180^\circ/n$ · Each exterior angle = $360^\circ/n$ · Diagonals = $n(n - 3)/2$
Triangle	Angle sum = 180° · Exterior angle = sum of two opposite interior angles · $a + b > c$ · Larger side lies opposite larger angle
Centres	Centroid divides median 2 : 1 · Incentre: $\angle BIC = 90^\circ + A/2$ · Orthocentre: $\angle BHC = 180^\circ - A$ · Circumcentre: $\angle BOC = 2A$ (acute triangle)
Theorems	Angle bisector: $BD/DC = AB/AC$ · Midpoint theorem: joining midpoints $\parallel$ third side and = $1/2$ of it · BPT: $DE \parallel BC \Rightarrow AD/DB = AE/EC$
Congruence	SSS · SAS · ASA / AAS · RHS
Radii	Circumradius $R = abc/(4\Delta)$ · Inradius $r = \Delta/s$ (s = semi-perimeter) Right triangle: $R = \text{hypotenuse}/2$ · $r = (a + b - c)/2$

Area of Δ	$\frac{1}{2} \times \text{base} \times \text{height} \cdot \frac{1}{2}ab \sin C$ · Heron: $\sqrt{[s(s - a)(s - b)(s - c)]}$ Equilateral: area = $(\sqrt{3}/4)a^2$ · height = $(\sqrt{3}/2)a$
Pythagoras	$a^2 + b^2 = c^2$ (right triangle) Triplets: 3-4-5 · 5-12-13 · 8-15-17 · 7-24-25 · 20-21-29 · 9-40-41 (and multiples) 45° - 45° - 90° : sides 1 : 1 : $\sqrt{2}$ · 30° - 60° - 90° : sides 1 : $\sqrt{3}$: 2
Similar Δ	AA / SAS / SSS · Sides in ratio $k \Rightarrow$ perimeter, altitude, median in ratio k ; area in ratio k^2
Quadrilaterals	Angle sum = 360° · Parallelogram: opposite sides & angles equal, diagonals bisect each other, area = base $\times$ height Rectangle: diagonals equal · Rhombus: diagonals bisect at 90° , area = $\frac{1}{2}d_1d_2$, side = $\frac{1}{2}\sqrt{(d_1^2 + d_2^2)}$ · Square: diagonal = $a\sqrt{2}$ Trapezium: area = $\frac{1}{2}(a + b)h$ · Cyclic: opposite angles sum to 180° ; Ptolemy: $AC \cdot BD = AB \cdot CD + AD \cdot BC$
Circle	Central angle = $2 \times$ angle at circumference · Angles in the same segment are equal · Angle in a semicircle = 90° · Tangent $\perp$ radius · Tangents from an external point are equal · Perpendicular from centre bisects chord · Alternate segment theorem
Chords	Intersecting chords: $PA \cdot PB = PC \cdot PD$ · Tangent-secant: $PT^2 = PA \cdot PB$
Common tangents	Direct = $\sqrt{[d^2 - (r_1 - r_2)^2]}$ · Transverse = $\sqrt{[d^2 - (r_1 + r_2)^2]}$ Number of common tangents: 4 (separate) · 3 (touch externally) · 2 (intersect) · 1 (touch internally) · 0 (one inside the other)
Arc & sector	Arc = $(\theta/360^\circ) \times 2\pi r$ · Sector area = $(\theta/360^\circ) \times \pi r^2$

10 MENSURATION

Square	$A = a^2$ · $P = 4a$ · diagonal = $a\sqrt{2}$
Rectangle	$A = lb$ · $P = 2(l + b)$ · diagonal = $\sqrt{l^2 + b^2}$
Triangle	$A = \frac{1}{2}bh$ · Equilateral: $(\sqrt{3}/4)a^2$
Circle	$A = \pi r^2$ · $C = 2\pi r$ · Semicircle: $A = \frac{1}{2}\pi r^2$, $P = \pi r + 2r$ · Ring: $\pi(R^2 - r^2)$
Hexagon (reg.)	$A = (3\sqrt{3}/2)a^2$
Cuboid	$V = lbh$ · TSA = $2(lb + bh + hl)$ · LSA = $2h(l + b)$ · diagonal = $\sqrt{l^2 + b^2 + h^2}$
Cube	$V = a^3$ · TSA = $6a^2$ · LSA = $4a^2$ · diagonal = $a\sqrt{3}$
Cylinder	$V = \pi r^2 h$ · CSA = $2\pi rh$ · TSA = $2\pi r(r + h)$

Cone	$V = \frac{1}{3}\pi r^2 h \cdot l = \sqrt{(r^2 + h^2)} \cdot CSA = \pi r l \cdot TSA = \pi r(r + l)$
Sphere	$V = (4/3)\pi r^3 \cdot \text{Surface area} = 4\pi r^2$
Hemisphere	$V = (2/3)\pi r^3 \cdot CSA = 2\pi r^2 \cdot TSA = 3\pi r^2$
Frustum	$V = (\pi h/3)(R^2 + Rr + r^2) \cdot l = \sqrt{[h^2 + (R - r)^2]}$ $CSA = \pi l(R + r) \cdot TSA = \pi l(R + r) + \pi(R^2 + r^2)$
Prism / Pyramid	Prism: $V = \text{base area} \times h$, $LSA = \text{base perimeter} \times h$ · Pyramid: $V = \frac{1}{3} \times \text{base area} \times h$
Hollow cylinder	$V = \pi h(R^2 - r^2)$
Notes	Melting & recasting: volume stays same · Use $\pi = 22/7$ when radius is a multiple of 7 · Cone made from sector: slant height = sector radius, base circumference = arc length

SSC tricks	$\sin\theta + \cos\theta = k \Rightarrow \sin\theta \cos\theta = (k^2 - 1)/2$ $\sin^4\theta + \cos^4\theta = 1 - 2\sin^2\theta \cos^2\theta$ $\sin^6\theta + \cos^6\theta = 1 - 3\sin^2\theta \cos^2\theta$ $\sec\theta + \tan\theta = k \Rightarrow \sec\theta - \tan\theta = 1/k$ $\operatorname{cosec}\theta + \cot\theta = k \Rightarrow \operatorname{cosec}\theta - \cot\theta = 1/k$ $\sin\theta + \cos\theta = \sqrt{2} \ (0^\circ < \theta < 90^\circ) \Rightarrow \theta = 45^\circ$
Range	$-1 \leq \sin\theta, \cos\theta \leq 1 \mid \sec\theta , \operatorname{cosec}\theta \geq 1$ $a \sin\theta + b \cos\theta$ has maximum $\sqrt{a^2 + b^2}$
Heights & distances	$\tan\theta = \text{Height/Base} \mid \text{Angle of elevation} = \text{angle of depression (alternate angles)}$ $\tan 30^\circ = 1/\sqrt{3} \mid \tan 45^\circ = 1 \mid \tan 60^\circ = \sqrt{3}$
Two observations	Points d apart on same line, elevations $\alpha > \beta$ (β from the farther point): $h = d/(\cot\beta - \cot\alpha)$ For 30° and 60° : $h = (\sqrt{3}/2)d \mid \text{Shadow length} = h \cot\theta$

11 TRIGONOMETRY

θ	0°	30°	45°	60°	90°
$\sin \theta$	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	$\sqrt{3}$	∞
$\cot \theta$	∞	$\sqrt{3}$	1	$1/\sqrt{3}$	0
$\sec \theta$	1	$2/\sqrt{3}$	$\sqrt{2}$	2	∞
$\operatorname{cosec} \theta$	∞	2	$\sqrt{2}$	$2/\sqrt{3}$	1

Reciprocal	$\sin \theta \times \operatorname{cosec} \theta = 1 \mid \cos \theta \times \sec \theta = 1 \mid \tan \theta \times \cot \theta = 1$ $\tan \theta = \sin \theta / \cos \theta \mid \cot \theta = \cos \theta / \sin \theta$
Identities	$\sin^2\theta + \cos^2\theta = 1$ $1 + \tan^2\theta = \sec^2\theta$ $1 + \cot^2\theta = \operatorname{cosec}^2\theta$
Complementary	$\sin(90^\circ - \theta) = \cos \theta \mid \cos(90^\circ - \theta) = \sin \theta$ $\tan(90^\circ - \theta) = \cot \theta \mid \cot(90^\circ - \theta) = \tan \theta$ $\sec(90^\circ - \theta) = \operatorname{cosec} \theta \mid \operatorname{cosec}(90^\circ - \theta) = \sec \theta$
$180^\circ - \theta$	$\sin(180^\circ - \theta) = \sin \theta \mid \cos(180^\circ - \theta) = -\cos \theta$ $\tan(180^\circ - \theta) = -\tan \theta$
Sum / difference	$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$ $\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$ $\tan(A \pm B) = (\tan A \pm \tan B) / (1 \mp \tan A \tan B)$
Double angle	$\sin 2\theta = 2 \sin \theta \cos \theta$ $\cos 2\theta = \cos^2\theta - \sin^2\theta = 1 - 2\sin^2\theta = 2\cos^2\theta - 1$ $\tan 2\theta = 2\tan\theta / (1 - \tan^2\theta)$

12 DATA INTERPRETATION

Percentage	Part/Total $\times 100$ · % change = (New - Old)/Old $\times 100$ · Percentage points $\neq$ percent change
Ratio	Compare ratios by cross-multiplying · x% of A = y% of B $\Rightarrow A : B = y : x$
Average	Average = Total $\div$ Count · Missing value = Average $\times n$ - Sum of known values
Pie chart	1% = 3.6° · Value = (Angle/360°) $\times$ Total · Angle = (Value/Total) $\times 360^\circ$
Growth	Growth % = (Later - Earlier)/Earlier $\times 100$ (base = earlier value)
Read first	Units (thousand / lakh / crore), year, legend, scale, and exactly what is asked (% , ratio, difference)
Speed tips	Calculate only what is asked · 15% = 10% + 5% · 25% = $\frac{1}{4}$ · Round to 1-2 significant digits when options are far apart
Option elimination	Check range (more / less than $\frac{1}{2}$, 1, 2) · Unit digit · Sign of change · Estimate magnitude first, then pick the closest option
Traps	"% of" vs "% more than" · Wrong year / column · Mixing total and average · Ignoring units

13 CALCULATION SPEED SHEET

Squares 1–30

$1^2 = 1$	$2^2 = 4$	$3^2 = 9$	$4^2 = 16$	$5^2 = 25$
$6^2 = 36$	$7^2 = 49$	$8^2 = 64$	$9^2 = 81$	$10^2 = 100$
$11^2 = 121$	$12^2 = 144$	$13^2 = 169$	$14^2 = 196$	$15^2 = 225$
$16^2 = 256$	$17^2 = 289$	$18^2 = 324$	$19^2 = 361$	$20^2 = 400$
$21^2 = 441$	$22^2 = 484$	$23^2 = 529$	$24^2 = 576$	$25^2 = 625$
$26^2 = 676$	$27^2 = 729$	$28^2 = 784$	$29^2 = 841$	$30^2 = 900$

Cubes 1–20

$1^3 = 1$	$2^3 = 8$	$3^3 = 27$	$4^3 = 64$
$5^3 = 125$	$6^3 = 216$	$7^3 = 343$	$8^3 = 512$
$9^3 = 729$	$10^3 = 1000$	$11^3 = 1331$	$12^3 = 1728$
$13^3 = 2197$	$14^3 = 2744$	$15^3 = 3375$	$16^3 = 4096$
$17^3 = 4913$	$18^3 = 5832$	$19^3 = 6859$	$20^3 = 8000$

Fraction ↔ percentage (extended)

$1/11 = 9.09\%$	$1/12 = 8.33\%$	$1/13 = 7.69\%$	$1/14 = 7.14\%$
$1/15 = 6.67\%$	$1/16 = 6.25\%$	$1/17 = 5.88\%$	$1/18 = 5.56\%$
$1/19 = 5.26\%$	$1/20 = 5\%$	$2/3 = 66.67\%$	$3/4 = 75\%$
$2/5 = 40\%$	$3/5 = 60\%$	$4/5 = 80\%$	$3/8 = 37.5\%$
$5/8 = 62.5\%$	$7/8 = 87.5\%$	$5/6 = 83.33\%$	$2/7 = 28.57\%$
$3/7 = 42.86\%$	$4/7 = 57.14\%$	$5/7 = 71.43\%$	$6/7 = 85.71\%$

× 5, 25, 125

$$\begin{aligned} n \times 5 &= n \times 10 \div 2 \\ n \times 25 &= n \times 100 \div 4 \\ n \times 125 &= n \times 1000 \div 8 \end{aligned}$$

× 9, 99, 11

$$\begin{aligned} n \times 9 &= 10n - n \quad | \quad n \times 99 = 100n - n \\ \times 11: &\text{ add adjacent digits } (23 \times 11 = 2 \quad | \quad 2+3 \quad | \quad 3 = 253) \end{aligned}$$

Ends in 5

$$(n5)^2 = n(n+1) \text{ followed by } 25 \quad \text{e.g.} \quad 65^2: 6 \times 7 = 42 \Rightarrow 4225$$

Near 50 / 100

$$\begin{aligned} (50 \pm x)^2 &= 2500 \pm 100x + x^2 \\ (100 \pm x)^2 &= 10000 \pm 200x + x^2 \end{aligned}$$

$a^2 - b^2$ trick

$$\begin{aligned} 47 \times 53 &= 50^2 - 3^2 = 2491 \quad | \quad \text{Base 100:} \\ 96 \times 98 &\rightarrow (96 - 2) \quad | \quad (4 \times 2) = 9408 \end{aligned}$$

Divisibility

3, 9: digit sum | 4: last two digits | 8: last three digits
6: by 2 and 3 | 12: by 3 and 4
11: (sum of odd-place digits) – (sum of even-place digits) = 0 or a multiple of 11

Unit-digit cycles

2: 2, 4, 8, 6 | 3: 3, 9, 7, 1
7: 7, 9, 3, 1 | 8: 8, 4, 2, 6
4: 4, 6 | 9: 9, 1 | 0, 1, 5, 6: unchanged
Divide power by 4 and use the remainder (remainder 0 $\Rightarrow$ 4th value)

Approximation

$$\begin{aligned} \sqrt{2} &\approx 1.414 \quad | \quad \sqrt{3} \approx 1.732 \quad | \quad \sqrt{5} \approx 2.236 \\ \sqrt{6} &\approx 2.449 \quad | \quad \sqrt{7} \approx 2.646 \quad | \quad \pi \approx 3.14 \text{ or } 22/7 \\ (1+x)^n &\approx 1 + nx \text{ for small } x \\ &\text{Round to friendly numbers} \cdot \text{Check the unit digit} \cdot \text{Compare option gaps before exact calculation} \cdot \text{Follow BODMAS} \end{aligned}$$

5-MINUTE FORMULA SHEET

Only the most important formulas

Percentage	$\text{Net \%} = a + b + ab/100$ $\% \text{ change} = (\text{Change}/\text{Original}) \times 100$ $A \text{ is } x\% \text{ more than } B \Rightarrow B \text{ is } 100x/(100 + x)\% \text{ less than } A$ $\text{Price } \uparrow x\% \Rightarrow \text{use } \downarrow 100x/(100 + x)\%$
Ratio	$\text{Divide } N \text{ in } a : b \Rightarrow Na/(a + b), Nb/(a + b)$ Alligation: Cheaper : Dearer = $(d - m) : (m - c)$ $\text{Partnership: profit} \propto \text{investment} \times \text{time}$ $a/b = c/d \Rightarrow (a + b)/(a - b) = (c + d)/(c - d)$
Average	$\text{Avg} = \text{Sum}/N$ Add item: $\text{Old avg} + (n + 1)d$ Replacement: $\text{New} - \text{Old} = n \times d$ $\text{Remove item: Old avg} - (n - 1)d \text{ if avg } \uparrow, + (n - 1)d \text{ if avg } \downarrow$ Equal-distance avg speed: $2xy/(x + y)$
Profit / Loss	$\text{Profit \%} = \text{Profit}/\text{CP} \times 100$ $\text{SP} = \text{CP}(100 \pm x)/100$ $\text{Net discount} = d_1 + d_2 - d_1d_2/100$ $\text{MP } x\% \text{ above CP, discount } y\%: \text{profit \%} = x - y - xy/100$ Same SP, gain & loss $x\%: \text{loss} = x^2/100 \%$
SI / CI	$\text{SI} = \text{PRT}/100$ $A = P(1 + R/100)^n$ Half-yearly: $R/2$ and $2n$ $\text{CI} - \text{SI} (2 \text{ yrs}) = P(R/100)^2$ $\text{CI} - \text{SI} (3 \text{ yrs}) = P(R/100)^2(3 + R/100)$
Speed	$\text{km/h} \times 5/18 = \text{m/s}$ Relative speed: $S_1 \pm S_2$ Avg speed (equal distances) = $2xy/(x + y)$ $\text{Train} + \text{platform: } (L_1 + L_2) \div \text{speed}$ Boat: $u = (D + U)/2, v = (D - U)/2$
Work	$\text{Work} = \text{Efficiency} \times \text{Time}$ A + B together: $ab/(a + b)$ LCM method $M_1D_1H_1/W_1 = M_2D_2H_2/W_2$ Fill a hrs, with leak b hrs: leak empties in $ab/(b - a)$
Algebra	$(a \pm b)^2 = a^2 \pm 2ab + b^2$ $a^2 - b^2 = (a + b)(a - b)$ $(a \pm b)^3 = a^3 \pm b^3 \pm 3ab(a \pm b)$ $a^3 \pm b^3 = (a \pm b)(a^2 \mp ab + b^2)$ $a + b + c = 0 \Rightarrow a^3 + b^3 + c^3 = 3abc$ $x + 1/x = k \Rightarrow x^2 + 1/x^2 = k^2 - 2$ $x^3 + 1/x^3 = k^3 - 3k$ $ax^2 + bx + c = 0: D = b^2 - 4ac, \text{sum} = -b/a, \text{product} = c/a$
Geometry	$\text{Polygon: } (n - 2) \times 180^\circ$ Exterior angle = $360^\circ/n$ Centroid divides median $2 : 1$ $\angle \text{BIC} = 90^\circ + A/2$ $\text{Equilateral area} = (\sqrt{3}/4)a^2$ $R = abc/4\Delta$ $r = \Delta/s$ Triplets: 3-4-5, 5-12-13, 8-15-17, 7-24-25 $\text{Similar } \Delta: \text{area ratio} = k^2$ Centre angle = $2 \times \text{circumference angle}$ $\text{PA} \cdot \text{PB} = \text{PC} \cdot \text{PD}$ $\text{PT}^2 = \text{PA} \cdot \text{PB}$ $\text{Direct tangent} = \sqrt{d^2 - (r_1 - r_2)^2}$ $\text{Transverse tangent} = \sqrt{d^2 - (r_1 + r_2)^2}$
Mensuration	$\text{Cuboid: } V = lbh, \text{TSA} = 2(lb + bh + hl)$ $\text{Cube: } V = a^3, \text{TSA} = 6a^2$ $\text{Cylinder: } V = \pi r^2 h, \text{CSA} = 2\pi rh, \text{TSA} = 2\pi r(r + h)$ $\text{Cone: } V = \frac{1}{3}\pi r^2 h, \text{CSA} = \pi rl, l^2 = r^2 + h^2$ $\text{Sphere: } V = (4/3)\pi r^3, \text{SA} = 4\pi r^2$ $\text{Hemisphere: } V = (2/3)\pi r^3, \text{TSA} = 3\pi r^2$ $\text{Frustum: } V = (\pi h/3)(R^2 + Rr + r^2)$
Trigonometry	$\sin^2\theta + \cos^2\theta = 1$ $1 + \tan^2\theta = \sec^2\theta$ $1 + \cot^2\theta = \text{cosec}^2\theta$ $\sin(90^\circ - \theta) = \cos\theta$ $\sin 30^\circ = 1/2, \sin 45^\circ = 1/\sqrt{2}, \sin 60^\circ = \sqrt{3}/2$ $\tan 30^\circ = 1/\sqrt{3}, \tan 45^\circ = 1, \tan 60^\circ = \sqrt{3}$ $\sin\theta + \cos\theta = k \Rightarrow \sin\theta \cos\theta = (k^2 - 1)/2$ $\sec\theta + \tan\theta = k \Rightarrow \sec\theta - \tan\theta = 1/k$ $\text{Two angles } \alpha > \beta: h = d/(\cot\beta - \cot\alpha)$
Data Interp.	$\text{Pie: } 1\% = 3.6^\circ$ $\% \text{ change} = (\text{New} - \text{Old})/\text{Old} \times 100$ $\text{Missing value} = \text{Avg} \times n - \text{Sum of others}$ $\text{Estimate first, then eliminate options}$
Numbers	$1 + 2 + \dots + n = n(n + 1)/2$ $1^2 + \dots + n^2 = n(n + 1)(2n + 1)/6$ $1^3 + \dots + n^3 = [n(n + 1)/2]^2$ $11^2 - 20^2: 121, 144, 169, 196, 225, 256, 289, 324, 361, 400$ $1/7 = 14.28\%$ $1/9 = 11.11\%$ $1/11 = 9.09\%$ $(n5)^2 = n(n + 1)$ followed by 25

Quick-revision aid by SscAce. Verify formulas against standard textbooks and official sources. Not an official SSC document.