MBA ONE STOP · CAT

CAT Quant Formula Sheet: Arithmetic, Algebra, Geometry and Modern Maths

Every formula you need for CAT Quantitative Ability, grouped by topic, with 8 worked examples and the speed rules that save marks.

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How to use this sheet

Quantitative Ability is the third of three CAT sections. Each section is timed at exactly 40 minutes, and you cannot move between sections. A correct answer earns 3 marks, a wrong MCQ costs 1 mark, and a skipped question scores zero. Non-MCQ (type-in) questions have no negative marking.

The official CAT 2026 pages do not state how many QA questions there are, so plan around minutes, not a fixed count. The rest of this sheet is teaching content: formulas, shortcuts and worked examples.

Tip. Memorise a formula only if it saves you more than 30 seconds. Anything you can derive in under a minute does not need to live in your head.

Arithmetic: percentages, profit, mixtures, interest

Idea	Formula
Successive change of a% then b%	Net % = a + b + ab/100 (a fall is negative)
Selling price from cost	SP = CP × (1 + p/100)
Selling price from marked price	SP = MP × (1 - d/100)
Same SP, one item at x% profit and one at x% loss	Overall loss = $x^2/100$ %
Alligation (cheaper and dearer into a mean)	Cheaper : Dearer = (Dearer - Mean) : (Mean - Cheaper)
Repeated replacement (x litres of mixture drawn and replaced by water each time, vessel holds V)	Original liquid left after n rounds = V × (1 - x/V)^n
Combined average of two groups	(n1 × a1 + n2 × a2) / (n1 + n2)
Simple interest	SI = P × R × T / 100
Compound amount	A = P × (1 + r/100)^n
CI minus SI for 2 years	$P \times (r/100)^2$

Example. A shopkeeper marks an item 40% above cost price and then gives a 15% discount. What is the profit percentage?

1. Take cost price = 100. Marked price = 140.
2. Selling price = 140 × 0.85 = 119.
3. Profit = 119 - 100 = 19.
4. Check with successive change: 40 - 15 + (40 × -15)/100 = 25 - 6 = 19.

Answer: 19% profit

Example. Rice at ₹42/kg is mixed with rice at ₹66/kg so that the mixture is worth ₹50/kg. In what ratio are the two varieties mixed?

1. Cheaper = 42, dearer = 66, mean = 50.
2. Cheaper : dearer = (66 - 50) : (50 - 42) = 16 : 8 = 2 : 1.
3. Check: (2 × 42 + 1 × 66) / 3 = 150 / 3 = 50.

Answer: 2 : 1 (cheaper : dearer)

Time, speed, distance and work

Idea	Formula
Average speed, equal distances at a and b	2ab / (a + b)
Unit change	km/h × 5/18 = m/s
Relative speed	Same direction: a - b. Opposite: a + b
Two trains crossing	Time = (L1 + L2) / relative speed
Boats	Downstream = b + c, upstream = b - c, so b = (D + U)/2 and c = (D - U)/2
Work rate	Rate = 1 / days; rates add
Two workers together	ab / (a + b) days
Pipes	Inlet rates add, outlet rates subtract

Example. Priya drives from Pune to Mumbai, 150 km, at 50 km/h and returns at 75 km/h. What is her average speed for the round trip?

1. Distances are equal, so use 2ab/(a + b) = 2 × 50 × 75 / 125 = 60.
2. Check with totals: time = 150/50 + 150/75 = 3 + 2 = 5 hours; distance = 300 km; 300 / 5 = 60.

Answer: 60 km/h (not 62.5, which is the plain average)

Example. A can finish a job in 12 days and B in 18 days. They work together for 4 days, then A leaves. How many more days does B need?

1. Rates: A = 1/12, B = 1/18. Together = 3/36 + 2/36 = 5/36 per day.
2. In 4 days: 4 × 5/36 = 5/9 done, so 4/9 remains.
3. B alone: (4/9) ÷ (1/18) = 8 days.
4. Check with 36 units of work: A does 3 a day, B does 2. Together 5 a day, so 20 units in 4 days. 16 units left at 2 a day = 8 days.

Answer: 8 days

Number system

Idea	Formula
Number of factors of N = p^a × q^b × r^c	(a + 1)(b + 1)(c + 1)
Sum of factors	Product of (p^(a+1) - 1)/(p - 1) over each prime
Trailing zeros in n!	floor(n/5) + floor(n/25) + floor(n/125) + ...
HCF and LCM of two numbers	HCF × LCM = product of the two numbers
Euler's totient	φ(N) = N × (1 - 1/p) over each prime p of N
Euler's theorem	a^φ(m) leaves remainder 1 mod m when HCF(a, m) = 1

Idea	Formula
Divisible by 11	Alternating digit sum is divisible by 11
Divisible by 9	Digit sum is divisible by 9

For last digits, use the cycle: 2, 3, 7 and 8 repeat every 4 powers; 4 and 9 repeat every 2; 0, 1, 5 and 6 never change.

Example. How many factors of 360 are even?

1. $360 = 2^3 \times 3^2 \times 5$.
2. Total factors = $4 \times 3 \times 2 = 24$.
3. Odd factors use no 2: $3 \times 2 = 6$.
4. Even factors = 24 - 6 = 18.

Answer: 18

Algebra, progressions and logarithms

QUADRATIC $AX^2 + BX + C = 0$

Sum of roots = $-b/a$, product = c/a, discriminant $D = b^2 - 4ac$, real roots when $D \geq 0$

USEFUL IDENTITIES

$x^2 + 1/x^2 = (x + 1/x)^2 - 2$; $x^3 + 1/x^3 = (x + 1/x)^3 - 3(x + 1/x)$; $a^3 + b^3 = (a + b)^3 - 3ab(a + b)$

AM-GM (POSITIVE A, B)

$(a + b)/2 \geq \sqrt{(ab)}$, equality only when $a = b$. For a fixed sum, the product is largest when the numbers are equal.

MODULUS

$|x - a| < k$ means $a - k < x < a + k$; $|x - a| > k$ means $x > a + k$ or $x < a - k$

ARITHMETIC PROGRESSION

$T_n = a + (n - 1)d$; $S_n = n/2 \times [2a + (n - 1)d]$

GEOMETRIC PROGRESSION

$T_n = a \times r^{(n-1)}$; $S_n = a(r^n - 1)/(r - 1)$; $S_\infty = a/(1 - r)$ when $|r| < 1$

LOGARITHMS

$\log(ab) = \log a + \log b$; $\log(a^k) = k \log a$; $\log_a b = \log b / \log a$; $a^{(\log_a x)} = x$

Example. If $x + 1/x = 5$, find $x^2 + 1/x^2$ and $x^3 + 1/x^3$.

1. $x^2 + 1/x^2 = 5^2 - 2 = 23$.
2. $x^3 + 1/x^3 = 5^3 - 3 \times 5 = 125 - 15 = 110$.

Answer: 23 and 110

Geometry and mensuration

Idea	Formula
Heron's area	$\sqrt{(s(s - a)(s - b)(s - c))}$, $s = (a + b + c)/2$
Inradius and circumradius	$r = \text{Area}/s$; $R = abc/(4 \times \text{Area})$
Right triangle	Circumradius = hypotenuse / 2
Similar figures	Area ratio = (side ratio)^2; volume ratio = (side ratio)^3
Polygon angle sum	$(n - 2) \times 180°$; diagonals = $n(n - 3)/2$

Idea	Formula
Circle	Arc = θ/360 × 2πr; sector = θ/360 × πr²; angle at centre = 2 × angle at circumference
Cylinder	V = πr²h; curved area = 2πrh
Cone	V = ⅓πr²h; slant l = √(r² + h²); curved area = πrl
Sphere	V = 4/3 πr³; surface = 4πr²
Cuboid diagonal	√(l² + b² + h²)
Triangle from coordinates	½ |x1(y2 - y3) + x2(y3 - y1) + x3(y1 - y2)|

Learn these Pythagorean triples with their multiples: 3-4-5, 5-12-13, 8-15-17, 7-24-25.

Example. A triangle has sides 13, 14 and 15 cm. Find its area, inradius and circumradius.

1. s = 21. Area = √(21 × 8 × 7 × 6) = √7056 = 84.
2. Inradius = 84 / 21 = 4.
3. Circumradius = (13 × 14 × 15) / (4 × 84) = 2730 / 336 = 8.125 = 65/8.

Answer: Area 84 cm², inradius 4 cm, circumradius 8.125 cm

Modern maths: counting, probability, sets

Idea	Formula
Arrangements and selections	nPr = n!/(n - r)!; nCr = n!/(r!(n - r)!)
Arrangements with repeats	n!/(p! q! r!)
Circular arrangements	(n - 1)!
Identical items into r distinct boxes	(n + r - 1)C(r - 1); each box at least one: (n - 1)C(r - 1)
Probability of A or B	P(A) + P(B) - P(A and B)
At least one	1 - P(none)
Two sets	n(A ∪ B) = n(A) + n(B) - n(A ∩ B)

Example. Six friends sit in a row. In how many ways can they sit if A and B must not sit together?

1. Total arrangements = 6! = 720.
2. A and B together: treat them as one block. 5! × 2 = 240.
3. Not together = 720 - 240 = 480.

Answer: 480

Speed rules for the 40 minutes

□ Read the last line of the question first. Know what is being asked before you start computing.
□ Plug in options when the algebra looks long. Start with the middle value.
□ Round when the options are far apart. Exact arithmetic is wasted effort.
□ Give a new question about two minutes to show a path. If none appears, mark it and move on.
□ Never leave a non-MCQ blank if you have any answer. There is no negative marking for them.
□ On a wrong-prone MCQ, guess only after removing at least one option. Each wrong MCQ costs 1 mark against 3 for a right one.

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