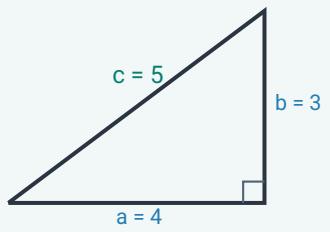
25 MATHS FORMULAS

HIGH SCHOOL STUDY GUIDE

01 / Triangles, equations & coordinates

FORMULAS 01-05

01



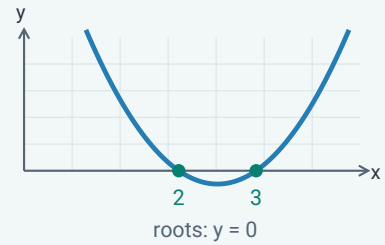
Pythagorean theorem

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

Find a missing side of a right triangle.
The hypotenuse c is opposite the right angle.

$3^2 + 4^2 = 25 \Rightarrow c = 5$

02



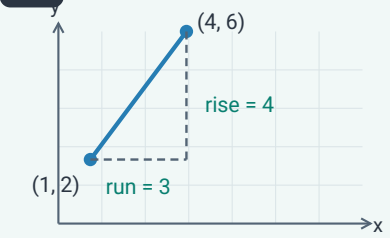
Quadratic formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Solve $ax^2 + bx + c = 0$, with $a \neq 0$.
The ± gives two candidates; real roots require $b^2 - 4ac \geq 0$.

$x^2 - 5x + 6 = 0 \Rightarrow x = 2 \text{ or } 3$

03



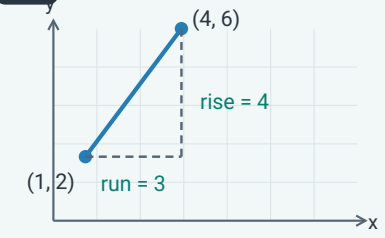
Distance formula

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Find the straight-line distance between two points.
Square the coordinate changes, add, then take the square root.

$d = \sqrt{(4-1)^2 + (6-2)^2} = 5$

04



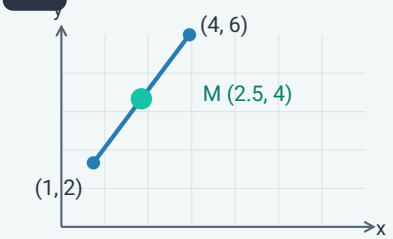
Slope formula

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\text{rise}}{\text{run}}$$

Measure a line's steepness using matching coordinate order.
A vertical line has undefined slope: its run is zero.

$m = \frac{6-2}{4-1} = \frac{4}{3}$

05



Midpoint formula

$$M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

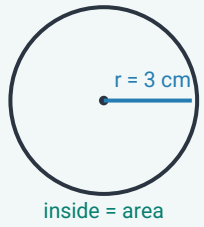
Find the point halfway along a line segment.
Average the x-coordinates and the y-coordinates separately.

$M = \left(\frac{1+4}{2}, \frac{2+6}{2}\right) = (2.5, 4)$

CHECK: Match coordinate order. Mark the right angle. Keep the whole quadratic numerator over 2a.

25 MATHS FORMULAS

06



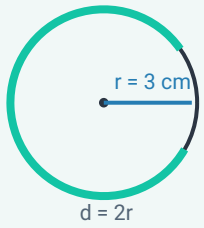
Area of a circle

$$A = \pi r^2$$

Measure the space inside a circle, in square units.
r is the radius: centre to edge, not the full diameter.

$r = 3\text{ cm} \Rightarrow A = 9\pi\text{ cm}^2$

07



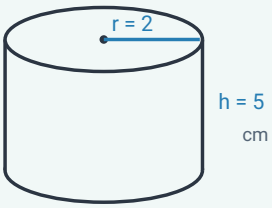
Circumference of a circle

$$C = 2\pi r = \pi d$$

Find the distance around a circle, in length units.
Use radius r or diameter d, where d = 2r.

$r = 3\text{ cm} \Rightarrow C = 6\pi\text{ cm}$

08



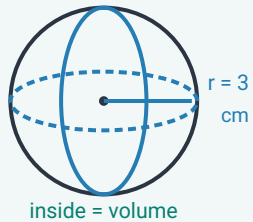
Volume of a cylinder

$$V = \pi r^2 h$$

Find the space inside a cylinder, in cubic units.
Multiply circular base area by perpendicular height h.

$r = 2\text{ cm},\ h = 5\text{ cm} \Rightarrow V = 20\pi\text{ cm}^3$

09



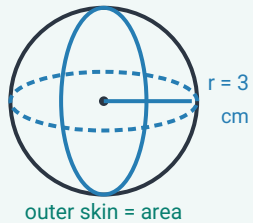
Volume of a sphere

$$V = \frac{4}{3}\pi r^3$$

Find the space inside a sphere, in cubic units.
Cube the radius before multiplying by four-thirds pi.

$r = 3\text{ cm} \Rightarrow V = 36\pi\text{ cm}^3$

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Surface area of a sphere

$$A = 4\pi r^2$$

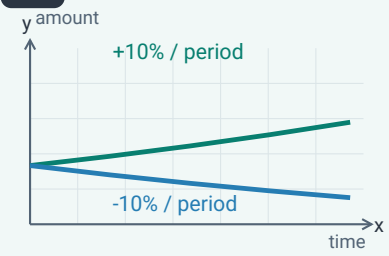
Find the area of a sphere's outer surface, in square units.
Use this for the covering material, rather than its capacity.

$r = 3\text{ cm} \Rightarrow A = 36\pi\text{ cm}^2$

UNITS: lengths in cm or m; areas in cm² or m²; volumes in cm³ or m³. Keep π until the last step.

25 MATHS FORMULAS

11



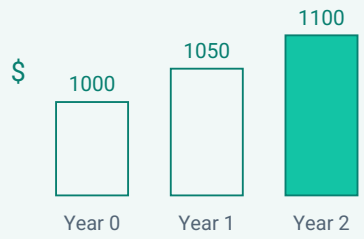
Exponential growth / decay

$$A = P(1 \pm \frac{r}{n})^{nt}$$

Repeat a fixed percentage change: + for growth, − for decay.
P = start; r = rate per time unit; n = periods per unit; t = time.

$P = 100,\ r = 0.10,\ n = 1,\ t = 3:\quad A = 133.10 \text{ or } 72.90$

12



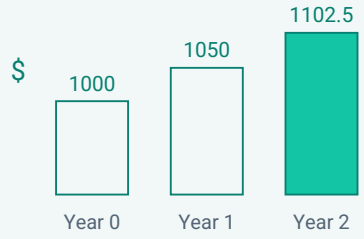
Simple interest

$$I = Prt \qquad A = P + I$$

Find interest I earned only on the original principal P.
Use a decimal annual rate r and time t in years.

$P = 1000,\ r = 0.05,\ t = 2 \Rightarrow I = 100,\ A = 1100$

13



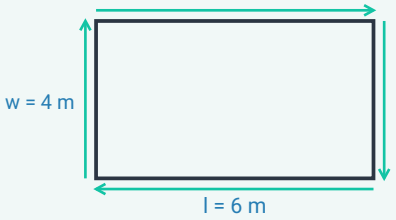
Compound interest

$$A = P(1 + \frac{r}{n})^{nt}$$

Find the total when interest also earns interest; interest = A − P.
r = annual decimal rate; n = compounds/year; t = years.

$1000(1 + 0.05/1)^{1 \times 2} = 1102.50$

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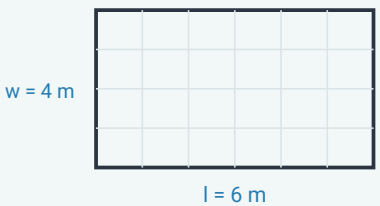
Perimeter of a rectangle

$$P = 2l + 2w = 2(l + w)$$

Find the total distance around a rectangle.
Add two lengths l and two widths w; use length units.

$P = 2(6) + 2(4) = 20 \text{ m}$

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Area of a rectangle

$$A = lw$$

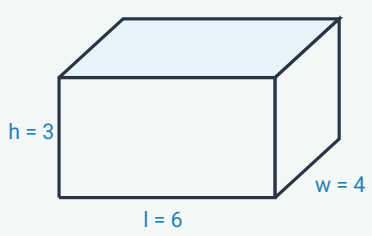
Find the surface covered by a rectangle.
Multiply length by width; use square units.

$A = 6 \times 4 = 24 \text{ m}^2$

RATES: 5% = 0.05. Growth assumes a fixed rate; ordinary decay needs $0 \le r/n \le 1$. Interest examples use dollars.

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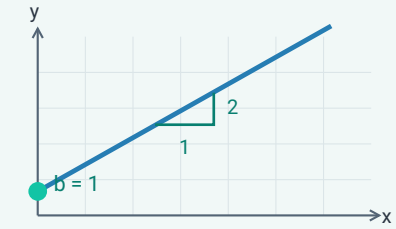
Volume of a rectangular prism

$$V = lwh$$

Find a box's capacity or the space it occupies.
Multiply length, width and perpendicular height; use cubic units.

$V = 6 \times 4 \times 3 = 72\ \text{cm}^3$

17



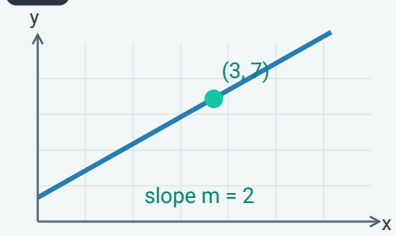
Slope-intercept form

$$y = mx + b$$

Write or graph a nonvertical line: m is slope; b is y-intercept.
Start at (0, b), then move according to the rise/run.

$y = 2x + 1: \quad x = 3 \Rightarrow y = 7$

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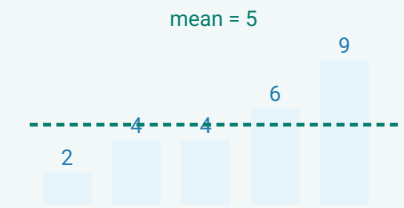
Point-slope form

$$y - y_1 = m(x - x_1)$$

Write a nonvertical line's equation from a slope and one point.
Substitute the known point (x_1, y_1) and slope m.

$y - 7 = 2(x - 3) \Rightarrow y = 2x + 1$

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Mean

$$\bar{x} = \frac{\sum x_i}{n}$$

Find the arithmetic average: add all values, divide by their count.
Σ means "sum"; the mean can be pulled by extreme values.

$\bar{x} = \frac{2+4+4+6+9}{5} = 5$

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Median

odd n: $x_{((n+1)/2)}$ even n: $\frac{x_{(n/2)} + x_{(n/2+1)}}{2}$

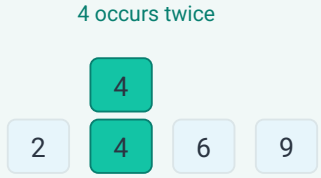
Sort first; subscripts mark positions in the ordered list.
For even n, average the middle two. Less affected by extremes.

$2, 4, 4, 6, 9 \Rightarrow 4; \qquad 2, 4, 6, 9 \Rightarrow 5$

READ THE SYMBOLS: l = length; w = width; h = height. A symbol's meaning depends on its formula.

25 MATHS FORMULAS

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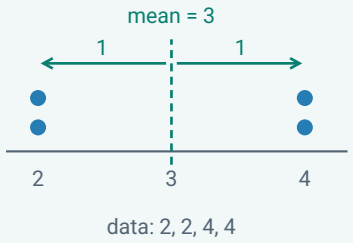
Mode

$$\text{mode} = \text{most frequent value}$$

Find the most common value or category.
Tied highest frequencies give multiple modes; equal frequencies: no mode.

$2, 4, 4, 6, 9 \Rightarrow \text{mode} = 4$

22



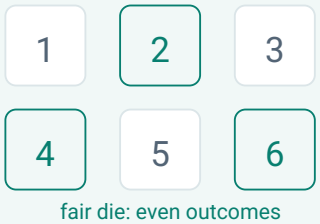
Standard deviation

$$\sigma = \sqrt{\frac{\sum(x_i - \mu)^2}{N}} \qquad s = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}}$$

Measure spread: subtract the mean, square, average, then root.
Use N for a whole population; n − 1 for a sample estimate (n > 1).

$2, 2, 4, 4: \quad \mu = 3, \quad \sigma = \sqrt{4/4} = 1$

23



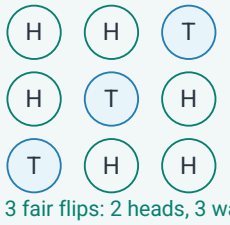
Probability

$$P(E) = \frac{\text{favorable outcomes}}{\text{total outcomes}}$$

For equally likely outcomes, count favorable results over all results.
Probabilities range from 0 (impossible) to 1 (certain).

$P(\text{even on a fair die}) = \frac{3}{6} = \frac{1}{2} = 50\%$

24



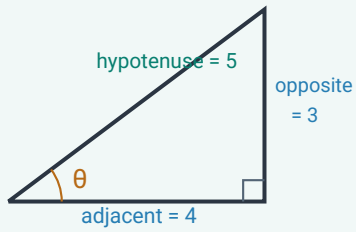
Binomial distribution

$$P(X = k) = \binom{n}{k} p^k (1-p)^{n-k}$$

Find exactly k successes in n independent two-outcome trials.
Each trial has the same success chance p; choose(n,k) counts arrangements.

$P(2 \text{ heads in } 3) = 3(0.5)^2(0.5) = 0.375$

25



Trigonometric functions

$$\sin\theta = \frac{O}{H} \quad \cos\theta = \frac{A}{H} \quad \tan\theta = \frac{O}{A}$$

In a right triangle, relate an angle to side ratios: SOH-CAH-TOA.
O = opposite, A = adjacent, H = hypotenuse, relative to θ.

$\sin\theta = 3/5, \quad \cos\theta = 4/5, \quad \tan\theta = 3/4$

BINOMIAL: choose(n,k) = n! / [k!(n − k)!]; 0! = 1. TRIG: use degree mode for angles given in degrees.