STUDY FORMULA BOOKLET

Edexcel IAL Maths Unit P1 (WMA11): pure mathematics 1

The booklet on your desk prints only the cosine rule from what P1 needed. Learn first the quadratic formula, discriminant, sine rule, triangle area, arc length, sector area, straight-line formulae and the power rules for differentiating and integrating.

GIVEN printed in the formula booklet LEARN IT not in the booklet: learn it

Built by CuratedPrep from 22 past question papers for Unit P1 in our question bank, October 2019 to January 2026. Given means it is in the Mathematical Formulae and Statistical Tables booklet (Issue 2, 2021) handed out in every unit exam. Learn it means a past question needed it and the exam did not print it.

Indices and surds

None of these is in the booklet, so all of them are Learn it.

Laws of indices

Use them to write both sides of an equation with the same base, or to simplify before you differentiate. Used in: Jan 2026 (A) Q2(i), matching powers of 2; Oct 2025 Q4(i), matching powers of 3; Jun 2025 Q1, simplifying powers of x.

$$a^m \times a^n = a^{m+n}, \quad a^m \div a^n = a^{m-n}, \quad (a^m)^n = a^{mn}$$

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Negative and fractional indices

Rewrite roots and 1/x^n as powers of x before you differentiate or integrate. Used in: Jan 2026 (A) Q3(a), splitting a fraction into powers of x; Jun 2025 Q3, dividing each numerator term by the denominator before integrating; Jun 2025 Q1.

$$a^{-n} = \frac{1}{a^n}, \quad a^{1/n} = \sqrt[n]{a}, \quad a^{m/n} = \left(\sqrt[n]{a}\right)^m$$

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Surd product rule

Use it to simplify surds, for example sqrt(27) = 3 sqrt(3). Used in: Jan 2026 (A) Q2(ii); Oct 2025 (A) Q1(a), a side of a right-angled isosceles triangle; Jan 2026 Q2(b), roots in the form p + q sqrt(3).

$$\sqrt{ab} = \sqrt{a}\,\sqrt{b}$$

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Rationalising a denominator

Multiply top and bottom by the conjugate, because (a + sqrt(b))(a - sqrt(b)) = a^2 - b leaves a rational denominator. Used in: Oct 2025 (A) Q1(b); Oct 2024 Q2(ii); Oct 2023 Q3(a).

$$\frac{1}{a+\sqrt{b}} = \frac{a-\sqrt{b}}{a^2-b}$$

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Quadratics

Quadratic formula

Roots of ax^2 + bx + c = 0. It is one of three accepted non-calculator methods with factorising and completing the square: show a, b and c substituted into it, not just the roots. Used in: Jan 2026 Q2(b), roots in the form p + q sqrt(3); Jun 2022 Q6(b); Jun 2023 Q1, critical values of an inequality.

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

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Completing the square

The turning point of the curve is at x = -b/(2a); it is a minimum when a > 0. Used in: Oct 2025 Q5(a), $2x^2$ - 16x + 50; Jan 2025 Q9(a), maximum point from the completed square; Oct 2023 Q11(a).

$$ax^2+bx+c = a\left(x+\frac{b}{2a}\right)^2 + \left(c-\frac{b^2}{4a}\right)$$

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Discriminant

For $ax^2 + bx + c = 0$: $b^2 - 4ac > 0$ gives two real roots, $b^2 - 4ac = 0$ one repeated root, $b^2 - 4ac < 0$ no real roots. When k sits inside a, b or c, the discriminant becomes a quadratic in k to solve as an inequality. Used in: Jan 2026 (A) Q8, no real roots; Oct 2025 (A) Q6; Jun 2025 Q10(b).

$$b^2 - 4ac$$

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Line meeting or touching a curve

Set the line equal to the curve and collect to a three-term quadratic in x first, then apply the discriminant. Used in: Jun 2024 (R) Q4(b), tangent; Oct 2024 Q6(b), meets at least once; Jan 2024 Q7(b), does not cross or touch.

$$b^2 - 4ac = 0 \text{ (touches)}, \quad b^2 - 4ac \geq 0 \text{ (meets at least once)}, \quad b^2 - 4ac < 0 \text{ (does not meet)}$$

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Straight lines and linear models

Gradient of a line through two points

Subtract in the same order on the top and the bottom. Used in: Jan 2026 Q4(a); Oct 2025 (A) Q4(a); Jun 2025 (A) Q8(a).

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

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Equation of a straight line

Use one point and the gradient, then rearrange to y = mx + c, or to ax + by + c = 0 with integer a, b and c when the question asks. Used in: Jan 2026 (A) Q4(b); Oct 2025 (A) Q4(a); Jan 2026 Q4(a).

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

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Perpendicular lines

The gradient of a perpendicular line, and of a normal, is the negative reciprocal, -1/m. Used in: Jan 2026 (A) Q4(b); Oct 2025 (A) Q4(b), angle QPR = 90 degrees; Jan 2023 Q2(a), proving that angle PQR = 90 degrees.

$$m_1 m_2 = -1$$

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Parallel lines

Parallel lines have equal gradients, including a tangent that is parallel to a given line. Used in: Oct 2025 Q10(b), tangent parallel to a normal; Jan 2020 Q6(a).

$$m_1 = m_2$$

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Midpoint of a line segment

Add the coordinates, then halve. Used in: Oct 2024 Q1(b), for a perpendicular bisector; Jun 2024 (R) Q9(c).

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

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Distance between two points

Pythagoras' theorem on the differences in x and in y. Leave the answer as a simplified surd when asked. Used in: Jun 2025 Q5(c), shortest distance to the origin; Jun 2024 (R) Q7(a), distance AB as a surd; Jan 2024 Q5(c).

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

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nth term of an arithmetic sequence

Printed in the booklet. The scheme accepts it as an alternative to simultaneous equations for a linear model, using the two given values as terms. Used in: Oct 2019 Q2(a).

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

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Lengths and areas of plane shapes

Pythagoras' theorem

c is the hypotenuse of the right-angled triangle. Used in: Oct 2025 (A) Q1(a), a side of a right-angled isosceles triangle; Oct 2025 (A) Q4(b), as an alternative to gradients; Jun 2023 Q5(b).

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

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Area of a triangle from base and height

Use it when a coordinate or a right angle gives the height, instead of the sine formula. Used in: Jan 2026 Q4(c); Jun 2024 Q9(c); Oct 2021 Q5(b).

$$A = \tfrac{1}{2} \times \text{base} \times \text{height}$$

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Area of a trapezium

a and b are the parallel sides and h is the distance between them. Used in: Jan 2026 (A) Q4(c), trapezium plus triangle; Jun 2023 Q7(a).

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

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Area of a rectangle or parallelogram

The height is the perpendicular distance, not the slanted side. Used in: Jun 2024 (R) Q7(c); Jan 2020 Q6(b), parallelogram PQRS; Jun 2023 Q2(b).

$$A = \text{base} \times \text{height}$$

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Perimeter of a rectangle

Used to write down an equation linking the length and the width. Used in: Jun 2023 Q2(a).

$$P = 2(x + y)$$

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Triangles, arcs and sectors

Every one of the 22 papers in the bank has a radians question with an arc or sector, usually joined to a triangle, so this section is the most useful to know cold.

Right-angled triangle trigonometry

Use it when a right angle is present or can be drawn, for example to find a height or a side of a joined triangle. Used in: Jun 2024 Q5(c); Jun 2023 Q5; Jan 2020 Q4(a), cos of angle AOD from two lengths.

$$\sin\theta = \frac{\text{opp}}{\text{hyp}}, \quad \cos\theta = \frac{\text{adj}}{\text{hyp}}, \quad \tan\theta = \frac{\text{opp}}{\text{adj}}$$

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Sine rule

Use it with a side and the angle opposite it. If the angle could be obtuse, check whether 180 degrees minus your answer is the one you need. Used in: Jan 2026 (A) Q6(a); Jan 2026 Q5(a); Jun 2022 Q2.

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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Cosine rule

Printed in the booklet. Use $a^2 = b^2 + c^2 - 2bc\cos A$ for a side, or rearrange to $\cos A = (b^2 + c^2 - a^2)/(2bc)$ for an angle. Used in: Jan 2026 (A) Q6(b); Oct 2025 Q3(a), largest angle from sides in the ratio 2 : 4 : 5; Oct 2025 (A) Q7(b).

$$a^2 = b^2 + c^2 - 2bc\cos A$$

GIVEN

Area of a triangle from two sides and the angle between

C is the angle between sides a and b. Used in: Jan 2026 Q5(b); Oct 2025 (A) Q7(c); Jan 2024 Q2(a), finding sin θ from a given area.

$$\text{area} = \tfrac{1}{2}ab\sin C$$

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Arc length

θ must be in radians. Used in: Oct 2025 (A) Q7(a); Jan 2026 Q5(c); Oct 2025 Q7(c), the major sector.

$$s = r\theta$$

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Area of a sector

θ must be in radians. Rearrange it to find r or θ when the area is given. Used in: Oct 2025 Q7(a), finding r from an area of 30 m^2; Jan 2026 Q5(b); Oct 2025 (A) Q7(c).

$$A = \tfrac{1}{2}r^2\theta$$

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Perimeter of a sector

Two radii plus the arc. For a joined shape, add only the outer edges. Used in: Oct 2024 Q5(a); Oct 2022 Q8(a)(ii); Oct 2019 Q1(b).

$$P = 2r + r\theta$$

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Radians and degrees

pi radians is 180 degrees, and a full turn is 2 pi radians. The schemes allow a whole question to be done in degrees if the final angle is converted back. Used in: Jan 2026 Q5; Jun 2025 (A) Q9, where 0.8 radians is 45.8 degrees; Jan 2025 Q8.

$$\theta^\circ = \theta \text{ rad} \times \frac{180}{\pi}$$

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Trigonometric graphs

Period of sin kx and cos kx

y = sin kx is y = sin x stretched horizontally by a factor 1/k. Used in: Oct 2023 Q10(a)(ii), period of a cosine graph in degrees; Oct 2019 Q9(a), period of sin(x/12).

$$\text{period} = \frac{2\pi}{k} \quad \left(\text{or } \frac{360^\circ}{k}\right)$$

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Symmetry of the sine graph

Use them to write other solutions or other values in terms of one known value. Used in: Jun 2022 Q9(a), values in terms of p = sin alpha; Jun 2022 Q2(b), the obtuse angle; Oct 2019 Q9(c)(i).

$$\sin(180^\circ - \theta) = \sin\theta, \quad \sin(180^\circ + \theta) = -\sin\theta, \quad \sin(-\theta) = -\sin\theta$$

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Cosine as a shifted sine

A cosine graph is the sine graph shifted by a quarter of a period. Used in: Oct 2019 Q9(c)(ii), the smallest positive solution of cos(x/12) = k.

$$\cos\theta = \sin\left(\tfrac{\pi}{2} - \theta\right)$$

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Differentiation

Derivative of a power

Multiply by any coefficient, differentiate term by term, and a constant gives 0. Used in: Jan 2026 Q1(a); Oct 2025 Q1(a); Jan 2026 (A) Q3(a).

$$\frac{d}{dx}\left(x^n\right) = nx^{n-1}$$

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Tangent and normal at a point

Find f(a) and f'(a) first, then use the line equation with the point and the new gradient. Used in: Jan 2026 (A) Q7(b), normal; Oct 2025 Q1(b), tangent; Oct 2025 (A) Q9(a), normal.

$$y - f(a) = f'(a)(x - a) \text{ (tangent)}, \qquad m_{\text{normal}} = -\frac{1}{f'(a)}$$

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Gradient of a chord and the limit

Q has x coordinate a + h. The gradient of the chord tends to the gradient of the tangent as h tends to 0. Used in: Jan 2020 Q3(b); Oct 2019 Q7(b).

$$m_{PQ} = \frac{f(a+h) - f(a)}{h} \to f'(a) \text{ as } h \to 0$$

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Integration

Integral of a power

Add 1 to the power and divide by the new power; add + c when you integrate. Used in: Jan 2026 Q1(b); Jan 2026 (A) Q7(a); Oct 2025 (A) Q5.

$$\int x^n \, dx = \frac{x^{n+1}}{n+1} + c, \quad n \neq -1$$

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Also learn these

Solving quadratic inequalities

Find the critical values, then take the outside regions for greater than zero or the region between them for less than zero, written in the variable asked for. Used in: Jan 2026 (A) Q1(b); Oct 2025 (A) Q2(b); Oct 2025 (A) Q6.

Hidden quadratics

Spot an equation that is quadratic in x^2, x^3, sqrt(x) or 2^x, substitute, solve, then go back to x. Used in: Oct 2025 (A) Q3; Jun 2025 Q10(a); Jan 2024 Q4.

Simultaneous equations by substitution

Equate the two equations, or substitute the line into the curve, to reach one equation in x, then find y from the line. Used in: Jan 2026 Q2; Oct 2025 Q5(b); Oct 2025 (A) Q8(a).

Models from two data points

Put each pair of values into the model to form two equations, then solve for the constants a and b. Used in: Jun 2025 (A) Q2(a); Jan 2025 Q3(a); Oct 2019 Q2(a).

Equation of a curve from its roots

A cubic that crosses the x-axis at a and touches it at b is y = k(x - a)(x - b)^2, and one more point gives k. Used in: Jan 2026 Q6(b); Jan 2026 (A) Q10(a); Jun 2025 Q7(a).

Graph transformations

y = f(x) + a moves the graph up by a, y = f(x + a) moves it left by a, y = af(x) stretches it by a in the y direction, y = f(ax) stretches it by 1/a in the x direction and y = -f(x) reflects it in the x-axis; to describe one, give its type, direction and size. Used in: Jan 2026 (A) Q5; Jun 2025 (A) Q1(a); Jun 2025 Q9(a).

Reciprocal graphs

y = k/(x + a) has a vertical asymptote at x = -a and the x-axis as its horizontal asymptote; find the intercepts by putting x = 0 and y = 0. Used in: Oct 2025 Q6(a); Jun 2025 (A) Q7(a); Oct 2024 Q6(a).

Reading trigonometric graphs

The amplitude is half the distance between the maximum and minimum, the period is one full cycle, and a cosine graph reflected in the x-axis is -cos x; use these to write f(x) from a sketch. Used in: Jan 2026 Q9(a); Oct 2025 Q9(a); Jun 2025 (A) Q3(a).

Tangent graph facts

y = tan x has period pi (180 degrees) and vertical asymptotes at odd multiples of pi/2 (90 degrees). Used in: Jan 2023 Q9(a); Jun 2021 Q9(a); Jan 2026 Q9(c).

Counting solutions in an interval

Sketch both graphs over one period, count the intersections, then use the period to scale up to the interval given. Used in: Jun 2025 Q4(c); Jun 2025 (A) Q3(b); Jan 2026 (A) Q9.

Exact trigonometric values

Know sin, cos and tan of 30, 45 and 60 degrees (pi/6, pi/4 and pi/3) and the related obtuse angles, for questions that ask for an exact answer. Used in: Jun 2021 Q3(a); Oct 2022 Q8(b).

Angles in a triangle and a full turn

The angles of a triangle add to pi (180 degrees), angles on a straight line add to pi, and a full turn is 2 pi, which gives the angle of a major sector. Used in: Jan 2026 Q5(a); Jun 2025 Q6(a); Oct 2025 Q7(b).

Area of a segment

Subtract the area of the triangle formed by the two radii from the area of the sector. Used in: Jan 2022 Q5(b); Jan 2020 Q4(b).

Second derivative

Differentiate f'(x) again to get f''(x), and substitute the x value you are given. Used in: Jun 2025 Q8(b); Jun 2024 Q7(a); Jan 2021 Q7(b).

Stationary points

At a turning point dy/dx = 0; to find where the gradient itself is least, set its derivative to 0. Used in: Jan 2020 Q9; Oct 2024 Q3(b); Jan 2026 Q7(b).

Finding f(x) from f'(x)

Integrate term by term, add + c, then substitute a point on the curve to find c. Used in: Jan 2026 (A) Q7(a); Oct 2025 (A) Q9(b); Oct 2025 Q8(c).

Defining a region with inequalities

Write one inequality for each boundary: y below a curve or above a line, and x greater than 0 for the y-axis. Used in: Oct 2025 Q5(c); Jun 2025 (A) Q8(c); Oct 2019 Q3(c).

Using the booklet in the exam

- Write the sine rule, 1/2 ab sin C, s = r θ and A = 1/2 r^2 θ from memory before you start a sector question. Only the cosine rule is printed.
- Many recent questions say solutions relying on calculator technology are not acceptable. Show factorising, completing the square, or a, b and c substituted into the quadratic formula before you write the roots.
- For a line and a curve, set them equal, collect to a three-term quadratic, then use b^2 - 4ac: equal to 0 for a tangent, at least 0 for meets, below 0 for no intersection.
- Before you differentiate or integrate, expand brackets or split a fraction into powers of x, using negative and fractional indices. Add + c when you integrate.

- Give a straight-line equation in the form the question asks for, either y = mx + c or ax + by + c = 0 with integer a, b and c, and keep radians mode on for arc and sector work.

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