STUDY FORMULA BOOKLET

Cambridge 9709 Maths Paper 1: pure mathematics 1

MF19 gives the arc and sector formulae, the quadratic formula, the AP and GP formulae, the binomial expansion and the rules for x^n. Learn first the discriminant, circle and straight-line formulae, triangle area, connected rates and volume of revolution, which it does not print.

GIVEN printed in the formula list (MF19) LEARN IT not in MF19: learn it

Built by CuratedPrep from 41 past question papers for Paper 1 in our question bank, March 2020 to November 2025. Given means it is in the List of formulae and statistical tables (MF19) given in every paper. Learn it means a past question needed it and the exam did not print it.

Quadratics and intersections

MF19 prints the quadratic formula. Completing the square and the discriminant are not printed, so they are Learn it.

Quadratic equation

Printed in MF19. Factorising, completing the square and the formula are all accepted ways to solve a three-term quadratic, so show whichever you use. Used in: Nov 2025 paper 12 Q1(c), exact roots of a quadratic; Nov 2025 paper 15 Q5, a quadratic in 3^x; Nov 2025 paper 11 Q1, critical values of k.

$$ax^2 + bx + c = 0 \Rightarrow x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

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Completing the square

Gives the vertex at x = -b/(2a), and the least value c - $b^2/(4a)$ when a > 0, which is the range of the function. Used in: Nov 2025 paper 12 Q1(ab), writing a quadratic in the form $p(x + q)^2 + r$; Nov 2025 paper 15 Q3(ab), then the k that makes a line touch the curve; Nov 2025 paper 13 Q10(a), then the range of f.

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

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Discriminant

For $ax^2 + bx + c = 0$. When k sits inside a, b or c, the discriminant is an expression in k to solve as an inequality. Used in: Nov 2025 paper 11 Q1, two distinct real roots; Jun 2025 paper 15 Q10(b), a line that misses a circle; Nov 2024 paper 12 Q10(c), showing a function is decreasing.

$$b^2 - 4ac > 0 \text{ (two real roots)}, \quad b^2 - 4ac = 0 \text{ (repeated root)}, \quad b^2 - 4ac < 0 \text{ (no real roots)}$$

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Line meeting a curve

Set the line equal to the curve, collect to a three-term quadratic in x, then apply the discriminant. Used in: Jun 2025 paper 11 Q6(b), curve and line that do not intersect; Mar 2025 paper 12 Q1, values of k for which they do not meet; Nov 2024 paper 11 Q4, meets for all k.

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

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Functions and graph transformations

Transformations of y = f(x)

Describe each step as a type (translation, stretch, reflection), a direction and a size, and state the order when there is more than one step. A translation and a stretch in the same direction do not commute. Used in: Nov 2025 paper 13 Q6(a), a sequence taking y = x^3 to a given cubic; Nov 2025 paper 12 Q3(b), stretch by 3 in y then reflect in the y-axis; Jun 2025 paper 11 Q10(a), stretch and translation.

$$f(x) + a \text{ (up } a), \quad f(x + a) \text{ (left } a), \quad af(x) \text{ (y stretch, factor } a), \quad f(ax) \text{ (x stretch, factor } \tfrac{1}{a}), \quad -f(x), \quad f(-x)$$

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Coordinate geometry and circles

None of these is printed in MF19, so all of them are Learn it.

Gradient of a line through two points

Subtract in the same order on the top and the bottom. A chord's gradient is the same formula. Used in: Nov 2025 paper 13 Q3(b), the gradient of the chord AD; Nov 2025 paper 12 Q7(b), the gradient of the diameter PQ; Jun 2025 paper 15 Q7(a), finding p from a given gradient of AB.

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

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Equation of a straight line

Use a point and the gradient, then rearrange to y = mx + c or ax + by + c = 0, whichever the question asks for. Used in: Nov 2025 paper 15 Q11(a), a tangent in the form y = mx + c; Jun 2025 paper 15 Q10(a), a tangent to a circle in the form ax + by + c = 0; Jun 2025 paper 13 Q9(b), the tangent at R.

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

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Perpendicular lines

The gradient of a perpendicular line, a normal, or a tangent to a circle (perpendicular to the radius) is -1/m. Used in: Nov 2025 paper 12 Q7(b), the tangent at the end of a diameter; Jun 2025 paper 13 Q9(a), angle PRQ a right angle; Jun 2025 paper 11 Q2(a), the gradient of a normal.

$$m_1 m_2 = -1$$

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Midpoint of a line segment

The centre of a circle with a given diameter is the midpoint of the diameter, and a perpendicular bisector passes through the midpoint. Used in: Nov 2025 paper 13 Q8(a), the circle with a diameter from (6, 1) to a second point; Nov 2025 paper 12 Q7(a), the circle on diameter PQ; Jun 2025 paper 15 Q7(c), the perpendicular bisector of AB.

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

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Distance between two points

A radius is the distance from the centre to a point on the circle, and half a diameter is a radius. Used in: Nov 2025 paper 12 Q7(a), the radius from the diameter PQ; Nov 2025 paper 13 Q8(a), the radius of a circle; Nov 2021 paper 11 Q7(b), the exact length of a chord AB.

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

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Circle: centre and radius form

The centre is (a, b) and the radius is r. Substituting a point on the circle gives an equation for the missing coordinate. Used in: Nov 2025 paper 15 Q1(a), stating the equation of a circle; Nov 2025 paper 15 Q1(b), the two values of k at x = 8; Nov 2025 paper 12 Q7(a).

$$(x-a)^2+(y-b)^2=r^2$$

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Circle: expanded form

Or complete the square in x and in y to read off the centre and radius. Used in: Jun 2025 paper 15 Q10(a), the centre then a tangent; Jun 2025 paper 12 Q8(a), the centre C and where a line cuts the circle; Nov 2024 paper 12 Q8(b), finding p and q from a tangent and normal.

$$x^2+y^2+2gx+2fy+c=0 \;\Rightarrow\; \text{centre } (-g,-f),\;\; r=\sqrt{g^2+f^2-c}$$

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Circular measure and triangles

MF19 prints arc length and sector area, but not the radian-degree link, the triangle rules or the area of a triangle.

Arc length of a circle

θ must be in radians. For a perimeter, add the straight sides to the arc. Used in: Nov 2025 paper 15 Q4(a), the perimeter of a logo made from a sector and a rhombus; Jun 2025 paper 15 Q5(a), the perimeter of the shaded region BCD; Mar 2025 paper 12 Q4(a).

$$s=r\theta$$

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Area of a sector of a circle

θ must be in radians. For a segment, subtract the triangle from the sector. Used in: Nov 2025 paper 15 Q4(b), the area of the logo; Jun 2025 paper 15 Q5(b), a sector minus a triangle; Mar 2025 paper 12 Q4(b), the area of a shaded region.

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

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Radians and degrees

Put angles in radians before you use s = r θ or A = 1/2 r^2 θ. The Jun 2023 paper 11 Q4 scheme accepts degrees throughout if the conversion is used in the formulae. Used in: Jun 2025 paper 15 Q5(a), an angle of 60 degrees put into the arc length; Nov 2025 paper 12 Q10(b), an angle of 120 degrees as 2 pi/3; Nov 2021 paper 11 Q6(a), arcs of 60 degrees in terms of pi.

$$\pi \text{ radians} = 180^\circ$$

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Right-angled triangle trigonometry

Drop a perpendicular from the centre to a chord: it splits the angle and the chord in half, so a chord of a circle has length 2r sin(θ/2). Used in: Nov 2025 paper 13 Q5(a), the exact angle POQ from a chord of length 4 root 3; Jun 2025 paper 13 Q8(a), the angle EAF in a square; Mar 2025 paper 12 Q4(a), the chord AB in an isosceles triangle.

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

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Pythagoras' theorem

c is the hypotenuse. It is the quickest way to a missing side when two sides of a right-angled triangle are known. Used in: Jun 2024 paper 13 Q8, a triangle formed by two tangents and the centre; Jun 2023 paper 11 Q4, the chord BC in a sector; Jun 2022 paper 11 Q5(b), the length AD in a sector.

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

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Cosine rule

Or cos A = (b^2 + c^2 - a^2/(2bc) for an angle. It is not printed in MF19. In these papers the schemes accept it as an alternative to right-angled trigonometry. Used in: Jun 2025 paper 13 Q8(a), the angle EAF in a square; Jun 2023 paper 11 Q4, the chord BC; Nov 2022 paper 13 Q8(a), an angle at the centre of two overlapping circles.

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

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Area of a triangle from two sides and the angle between

C is the angle between sides a and b. A sector's triangle with two radii has area 1/2 r^2 sin θ. Used in: Nov 2025 paper 15 Q4(b), the area of a rhombus; Nov 2025 paper 13 Q5(b), the triangle in a segment; Mar 2025 paper 12 Q4(b), a triangle OAB with OA = OB = 10.

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

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Trigonometry

Tangent

Replace tan θ by sin θ/cos θ, multiply through, then use the Pythagorean identity to reach a quadratic in sin or cos. Used in: Nov 2025 paper 15 Q6(a), showing an equation becomes a quadratic in cos θ; Jun 2024 paper 13 Q4(a), the same type of show-that; Jun 2021 paper 11 Q7(ab), proving an identity.

$$\tan\theta \equiv \frac{\sin\theta}{\cos\theta}$$

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Pythagorean identity

Use it to replace cos^2 θ by 1 - sin^2 θ, or the other way round, so the equation has one trigonometric function. Used in: Nov 2025 paper 12 Q6(c), a quadratic in sin x; Nov 2025 paper 13 Q2(b), solving cos^2 θ in terms of sin θ; Nov 2025 paper 15 Q6(a).

$$\cos^2\theta + \sin^2\theta \equiv 1$$

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Solutions of a trigonometric equation in an interval

alpha is the calculator value. In radians use pi and 2 pi. Add or subtract full turns until every solution lies inside the interval, and give no extra values. Used in: Jun 2025 paper 11 Q1, four solutions between -180 and 180 degrees; Nov 2025 paper 13 Q2(b), solutions between 0 and 2 pi; Nov 2025 paper 12 Q6(c).

$$\sin\theta = k:\ \alpha,\ 180^\circ - \alpha;\quad \cos\theta = k:\ \alpha,\ 360^\circ - \alpha;\quad \tan\theta = k:\ \alpha,\ \alpha + 180^\circ$$

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Exact values of sine, cosine and tangent

In radians the angles are pi/6, pi/4 and pi/3. Learn them for questions that ask for an exact value. Used in: Nov 2025 paper 13 Q5(a), the exact value of an angle in a circle; Nov 2025 paper 12 Q10(a), showing that s = root 3 r; Jun 2025 paper 11 Q9(a), the exact area of a segment.

$$\sin 30^\circ = \cos 60^\circ = \tfrac{1}{2},\ \sin 60^\circ = \cos 30^\circ = \tfrac{\sqrt{3}}{2},\ \sin 45^\circ = \cos 45^\circ = \tfrac{\sqrt{2}}{2},\ \tan 30^\circ = \tfrac{1}{\sqrt{3}},\ \tan 45^\circ = 1,\ \tan 60^\circ = \sqrt{3}$$

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Series

MF19 prints the formulae for arithmetic and geometric progressions and the binomial expansion, so these rows are Given.

Arithmetic series: nth term

a is the first term and d the common difference. Used in: Nov 2025 paper 13 Q4(a), the 30th term; Nov 2025 paper 11 Q9(b), the 15th terms of two progressions; Nov 2021 paper 11 Q4(b), the term that is zero.

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

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Arithmetic series: sum of n terms

Use either form: the first needs the last term l, the second needs d. Used in: Nov 2025 paper 12 Q8(b), the sum of the first 20 terms; Nov 2025 paper 11 Q9(a), partial sums that themselves form a progression; Nov 2021 paper 11 Q4(a), the sum of the first eight terms.

$$S_n = \frac{1}{2}n(a+l) = \frac{1}{2}n\{2a + (n-1)d\}$$

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Geometric series: nth term

r is the common ratio, found from u2/u1. Used in: Nov 2025 paper 11 Q2(a), the second and fifth terms given; Jun 2025 paper 11 Q3(a), the tenth term; Mar 2020 paper 12 Q8(b), a salary growing by 3% a year.

$$u_n = ar^{n-1}$$

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Geometric series: sum of n terms

Use it when r is not 1. Used in: Jun 2024 paper 13 Q10(b), the sum of the first 20 terms; Jun 2024 paper 12 Q5(b), the sum of the first 10 terms; Nov 2024 paper 11 Q10(b).

$$S_n = \frac{a(1-r^n)}{1-r} \quad (r \neq 1)$$

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Geometric series: sum to infinity

Only valid when |r| < 1, so check the ratio first. Used in: Nov 2025 paper 15 Q2(b), using the ratio from part (a); Nov 2025 paper 12 Q8(b); Jun 2025 paper 11 Q3(b), the exact sum with a negative ratio.

$$S_\infty = \frac{a}{1-r} \quad (|r| < 1)$$

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Three terms in a progression

Equate the consecutive differences for an arithmetic progression and the consecutive ratios for a geometric one. Used in: Nov 2025 paper 13 Q4(a), terms 20, k and k - 5; Nov 2025 paper 12 Q8(a), a GP and an AP built from the same a, b and c; Nov 2025 paper 11 Q9(a).

$$a, b, c \text{ in AP}: \ 2b = a + c; \qquad a, b, c \text{ in GP}: \ b^2 = ac$$

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Binomial series: positive integer n

Write each term as a coefficient times a power; ascending powers means the power of x rises. Used in: Nov 2025 paper 15 Q9(b), finding p and q from a coefficient; Nov 2025 paper 13 Q1(a), four terms in ascending powers; Jun 2025 paper 11 Q5(a), the first three terms of two expansions.

$$(a+b)^n = a^n + \binom{n}{1}a^{n-1}b + \binom{n}{2}a^{n-2}b^2 + \binom{n}{3}a^{n-3}b^3 + \cdots + b^n$$

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Binomial coefficient

Use nCr for the coefficients, from the calculator or from the formula. Used in: Nov 2025 paper 15 Q9(a), a ratio from two coefficients; Nov 2025 paper 12 Q2, the term independent of x; Jun 2025 paper 15 Q2.

$$\binom{n}{r} = \frac{n!}{r!\,(n-r)!}$$

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Differentiation

Derivative of x to the power n

Multiply by the power, then reduce the power by 1, term by term; a constant differentiates to 0. Used in: Nov 2025 paper 15 Q11(a), the gradient of y = $4x^2$ - x^3 at x = 3; Nov 2025 paper 12 Q9(a), f'(x) for a function with brackets; Jun 2025 paper 13 Q10(b).

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

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Tangent and normal

Find dy/dx at the x value first, then use y - y1 = m(x - x1). Used in: Nov 2025 paper 15 Q11(a), the tangent at P; Jun 2025 paper 12 Q9(d), the normal where dy/dx takes a given value; Jun 2025 paper 11 Q2(a), the gradient of the normal at A.

$$m_{\text{tangent}} = \frac{dy}{dx}, \qquad m_{\text{normal}} = -\frac{1}{dy/dx}$$

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Increasing and decreasing functions

To show a function is always increasing or decreasing, show that f'(x) keeps one sign for every x. Used in: Nov 2025 paper 12 Q9(a), increasing, decreasing or neither; Nov 2024 paper 12 Q10(c), the discriminant of f'(x) = 0; Jun 2024 paper 12 Q9(a), the values of x for which f is decreasing.

$$f'(x) > 0 \Rightarrow \text{increasing}, \qquad f'(x) < 0 \Rightarrow \text{decreasing}$$

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Connected rates of change

Write down dy/dx for the link between the two quantities, substitute the x value, then multiply by the given rate. The same pattern with dV/dr and dr/dt gives a rate of volume or area. Used in: Nov 2025 paper 11 Q7(b), the rate of increase of the area of a segment; Jun 2025 paper 15 Q8(c), the rate for the x-coordinate of a moving point; Jun 2025 paper 12 Q4(a).

$$\frac{dy}{dt} = \frac{dy}{dx} \times \frac{dx}{dt}$$

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Volume of a sphere

Differentiate to get dV/dr = 4 pi r^2, then divide the given dV/dt by it to get dr/dt. Used in: Nov 2020 paper 11 Q3, a spherical balloon whose volume increases at 50 cm^3 per second.

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

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Volume and surface area of a cylinder

An open tank has a base but no top. Use the fixed surface area to write h in terms of r, substitute into V, then differentiate to find the maximum. Used in: Nov 2025 paper 15 Q7(a), the volume of an open cylindrical tank of surface area 600 pi.

$$V = \pi r^2 h, \qquad A_{\text{open tank}} = \pi r^2 + 2\pi r h$$

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Stationary points and their nature

Solve dy/dx = 0 for x, find y, then substitute each x value into the second derivative. Used in: Nov 2025 paper 13 Q11(b), the nature of two stationary points; Jun 2025 paper 13 Q10(b); Jun 2025 paper 11 Q7(b), minima found from the second derivative.

$$\frac{dy}{dx} = 0 \text{ at a stationary point}; \quad \frac{d^2y}{dx^2} > 0 \text{ minimum}, \quad \frac{d^2y}{dx^2} < 0 \text{ maximum}$$

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Integration

Power of x

Add 1 to the power and divide by the new power; write + c for an indefinite integral. Used in: Nov 2025 paper 15 Q11(b), the area under y = $4x^2$ - x^3; Nov 2025 paper 12 Q5(b), the exact area of a shaded region; Nov 2025 paper 12 Q4(b), finding y from dy/dx.

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

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Integral of a linear function raised to a power

Divide by the new power and by a, the coefficient of x. Used in: Jun 2025 paper 11 Q2(b), the equation of a curve from its gradient; Jun 2025 paper 12 Q6, the area under a curve with a bracket in the equation.

$$\int (ax+b)^n \, dx = \frac{(ax+b)^{n+1}}{a(n+1)} + c, \quad n \neq -1$$

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Area under a curve and between curves

Sketch first. A region between a curve and a line is the integral of the curve minus the integral of the line, or the curve integral minus a triangle or trapezium. Used in: Nov 2025 paper 15 Q11(b), the area between a curve, the x-axis and a tangent; Nov 2025 paper 12 Q5(b); Jun 2025 paper 11 Q4, the area between a curve and a line.

$$A = \int_a^b y \, dx, \qquad A = \int_a^b (y_{\text{top}} - y_{\text{bottom}}) \, dx$$

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Volume of revolution

Square y before you integrate. For a region between a curve and a line, subtract the squares, not the square of the difference. For the y-axis, write x^2 in terms of y. Used in: Nov 2025 paper 13 Q9, a region between a curve and a line turned about the x-axis; Nov 2025 paper 15 Q8(a), the volume as a function of a; Nov 2025 paper 11 Q8(b), turned about the y-axis.

$$V = \pi \int_a^b y^2 \, dx \ \text{(about the } x\text{-axis)}, \qquad V = \pi \int_c^d x^2 \, dy \ \text{(about the } y\text{-axis)}$$

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Also learn these

Hidden quadratics

Spot an equation that is quadratic in sin x, cos x, 3^x or another function, substitute, solve, then go back to x. Used in: Nov 2025 paper 15 Q5; Jun 2025 paper 11 Q1; Nov 2025 paper 13 Q2(b).

Solving a curve and a line by substitution

Eliminate y to get one three-term quadratic in x, solve it, then find y from the line. Used in: Jun 2025 paper 11 Q6(a); Jun 2025 paper 15 Q10(b); Nov 2021 paper 11 Q7(b).

Inequalities from a quadratic in k

Find the critical values of k, then take the outside regions for greater than zero or the region between them for less than zero. Used in: Nov 2025 paper 11 Q1; Jun 2025 paper 11 Q6(b); Mar 2025 paper 12 Q1.

Perpendicular bisector

Find the midpoint, find the perpendicular gradient, then write the line through the midpoint. Used in: Jun 2025 paper 15 Q7(c); Jun 2024 paper 12 Q10(b); Nov 2022 paper 12 Q1(a).

Tangent perpendicular to the radius

At the point of contact, the tangent meets the radius at 90 degrees, so its gradient is the negative reciprocal of the radius gradient. Used in: Nov 2025 paper 12 Q7(b); Jun 2025 paper 13 Q9(b); Jun 2025 paper 15 Q10(a).

Composite functions

fg(x) means f applied to g(x), and fg exists only if the range of g lies inside the domain of f. Used in: Nov 2025 paper 15 Q10(c); Nov 2025 paper 12 Q9(d); Jun 2025 paper 11 Q10(f).

Inverse functions

Swap x and y and make y the subject, the domain of the inverse is the range of f, and the graph is the reflection in y = x. Used in: Nov 2025 paper 15 Q10(b); Jun 2025 paper 11 Q10(c); Jun 2025 paper 11 Q10(b).

Domain and range

Read the range from a completed square or from a restricted domain, and say whether the end values are included. Used in: Nov 2025 paper 13 Q10(a); Nov 2025 paper 12 Q9(c), the range of g in terms of a; Nov 2021 paper 11 Q8(c).

Sketching and counting solutions

Sketch a trigonometric graph over its full interval with the intercepts and turning points labelled, then count where it meets a horizontal line. Used in: Nov 2025 paper 12 Q6(a); Nov 2025 paper 12 Q6(b); Nov 2021 paper 11 Q5(b).

Area of a segment

Subtract the area of the triangle formed by the two radii from the area of the sector. Used in: Jun 2025 paper 11 Q9(a); Nov 2025 paper 13 Q5(b); Jun 2025 paper 15 Q5(b).

Binomial coefficients from an expansion

Multiply two expansions and collect the terms that give the power asked for, then solve for the unknown constant. Used in: Jun 2025 paper 11 Q5(b); Nov 2025 paper 11 Q3; Jun 2025 paper 13 Q4(ab), which uses the expansion to approximate a power.

Two progressions in one question

Write each condition as an equation in a and r, or in a and d, then solve them together. Used in: Nov 2025 paper 12 Q8(b); Nov 2021 paper 11 Q4(a); Jun 2025 paper 11 Q3(a).

Gradient of a chord and the tangent

As the second point moves towards the first, the gradient of the chord tends to the gradient of the tangent. Used in: Nov 2025 paper 13 Q3(c).

Constants from a stationary point

A stationary point at a given point means dy/dx = 0 at that x and the point lies on the curve, which gives two equations for the unknown constants. Used in: Jun 2025 paper 15 Q8(a); Jun 2025 paper 12 Q9(a); Mar 2025 paper 12 Q9(b).

Second derivative as a rate of change

The second derivative is the rate of change of the gradient: differentiate dy/dx again and substitute the x value. Used in: Nov 2025 paper 11 Q11(b).

Maximum or minimum with a constraint

Use the fixed quantity to remove one variable, differentiate, set to 0, then substitute back. Used in: Nov 2025 paper 15 Q7(b); Nov 2025 paper 15 Q7(c).

Finding a curve from its gradient

Integrate term by term, add + c, then substitute a point on the curve to find c. Used in: Nov 2025 paper 12 Q4(b); Jun 2025 paper 11 Q2(b); Jun 2025 paper 12 Q9(c).

Improper integral

Integrate, then let the upper limit tend to infinity and say which term goes to 0. Used in: Nov 2021 paper 11 Q10(a).

Using the booklet in the exam

- Write the cosine rule, 1/2 ab sin C, the discriminant, the circle equation and the volume of revolution formula from memory at the start. MF19 prints none of them.
- Use MF19 for the formulae it does print: arc length, sector area, the quadratic formula, AP and GP formulae and the binomial expansion. Know where they sit on the page so you copy them correctly.
- 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.
- Keep the calculator in radians for sector, arc and trigonometric questions that give angles in radians, and give exact answers (with pi or a surd) when the question says exact.
- In a volume of revolution, square y before integrating. When the region lies between a curve and a line, subtract the squares of y, and for the y-axis rewrite x^2 in terms of y.
- For connected rates, write the chain as dy/dt = dy/dx multiplied by dx/dt first, then substitute the x value you are given.

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