

The List of Formulae (MF19) is supplied with every paper, and it is shorter than candidates assume. It contains the series expansions, the trigonometric addition formulae and the statistical distributions – and none of the differentiation, integration or coordinate results you use constantly. MF19,

Given in MF19 – do not memorise

The binomial expansion for a positive integer index and for a rational index, with the condition $|x| < 1$ stated.

Arithmetic and geometric series formulae, including the sum to infinity.

The trigonometric addition formulae, the double-angle formulae, and the $R \cos(\theta \pm \alpha)$ forms.

The Maclaurin series for e^x , $\ln(1+x)$, $\sin x$, $\cos x$ and $(1+x)^n$.

Statistics: the binomial, Poisson and normal distributions, and the formulae for the mean and variance of each.

A short table of integrals including $\int \tan x \, dx$ and the inverse-trigonometric results.

You must know – differentiation

Standard derivatives – $x^n \rightarrow nx^{n-1}$, $e^x \rightarrow e^x$, $\ln x \rightarrow 1/x$, $\sin x \rightarrow \cos x$, $\cos x \rightarrow -\sin x$, $\tan x \rightarrow \sec^2 x$

Product rule – $(uv)' = u'v + uv'$

Quotient rule – $(u/v)' = (u'v - uv')/v^2$ – the order of the numerator matters and reversing it is the most common single error in Paper 3.

Chain rule – $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$

Implicit and parametric – Differentiate every term with respect to x , attaching dy/dx by the chain rule. For parametric curves, $\frac{dy}{dx} = \frac{dy/dt}{dx/dt}$.

Stationary points – Set $dy/dx = 0$; classify with the sign of d^2y/dx^2 , or by testing the gradient either side when the second derivative is zero.

You must know – integration

Standard integrals – $\int x^n \, dx = \frac{x^{n+1}}{n+1}$ for $n \neq -1$; $\int \frac{1}{x} \, dx = \ln|x|$; $\int e^{ax} \, dx = \frac{1}{a}e^{ax}$; $\int \sin ax \, dx = -\frac{1}{a} \cos ax$

The reverse chain rule – $\int f'(x)[f(x)]^n \, dx = \frac{[f(x)]^{n+1}}{n+1}$ and $\int \frac{f'(x)}{f(x)} \, dx = \ln|f(x)|$ – recognising this shape saves a substitution on most questions.

Integration by parts – $\int u \frac{dv}{dx} \, dx = uv - \int v \frac{du}{dx} \, dx$. Choose u to be the part that simplifies when differentiated.

Areas and volumes – Area = $\int_a^b y \, dx$; volume of revolution about the x -axis = $\pi \int_a^b y^2 \, dx$. The π and the squaring are both marks.

Trapezium rule $-\int_a^b y \, dx \approx \frac{1}{2}h[(y_0 + y_n) + 2(y_1 + \dots + y_{n-1})]$ with $h = (b - a)/n$. State whether it over- or under-estimates by referring to the curve's concavity.

You must know – algebra, coordinates and vectors

Quadratic discriminant $-b^2 - 4ac$: positive gives two roots, zero gives one repeated root, negative gives none.

Straight line $-y - y_1 = m(x - x_1)$; perpendicular gradients multiply to -1 ; the distance between two points is $\sqrt{(\Delta x)^2 + (\Delta y)^2}$.

Circle $-(x - a)^2 + (y - b)^2 = r^2$. Complete the square to get from the expanded form to the centre and radius.

Logarithm laws $-\log a + \log b = \log ab$, $\log a - \log b = \log(a/b)$, $n \log a = \log a^n$, and change of base. These are not in MF19.

Radian measure $-\text{Arc length } s = r\theta$ and sector area $= \frac{1}{2}r^2\theta$, with θ in radians.

Trigonometric identities $-\sin^2 \theta + \cos^2 \theta = 1$, and the two derived from it: $1 + \tan^2 \theta = \sec^2 \theta$ and $1 + \cot^2 \theta = \csc^2 \theta$.

Vectors $-\text{Magnitude } |\mathbf{a}| = \sqrt{x^2 + y^2 + z^2}$; the scalar product $\mathbf{a} \cdot \mathbf{b} = |\mathbf{a}||\mathbf{b}| \cos \theta$, which is zero for perpendicular vectors.

Exam habits that convert method into marks

Write the rule you are using before applying it. “Using the quotient rule” costs one line and secures the method mark even when the algebra afterwards goes wrong.

Keep exact values – π , surds, $\ln 2$ – until the final line unless a decimal is requested. Rounding early loses accuracy marks that the method has already earned.

For an integral with limits, substitute both and subtract in one visible step. Skipping to the answer forfeits the substitution mark.