Edexcel International A Level Mathematics

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★ Learn it: not in the Pearson Edexcel IAL formulae booklet 🕮 In the booklet

P1 · Pure 1

★ **Quadratic formula:** $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$

★ **Discriminant** $b^2 - 4ac$**:** > 0 **two real roots,** $= 0$ **equal roots,** < 0 **no real roots**

★ **Completing the square:**
$x^2 + bx + c = \left(x + \frac{b}{2}\right)^2 + c - \frac{b^2}{4}$

★ **Indices; surds:** $a^{-n} = \frac{1}{a^n}$, $a^{\frac{m}{n}} = \sqrt[n]{a^m}$; $\frac{1}{\sqrt{a}} = \frac{\sqrt{a}}{a}$

Scan to practise

★ **Lines:** $y - y_1 = m(x - x_1)$, $m = \frac{y_2 - y_1}{x_2 - x_1}$, $m_1 m_2 = -1$

★ **Transformations:** $f(x) + a$ **up** a; $f(x + a)$ **left** a; $af(x)$ **vertical** $\times a$; $f(ax)$ **horizontal** $\times \frac{1}{a}$

🕮 Mensuration: sphere $A = 4\pi r^2$, cone curved $A = \pi r l$

★ **Sine rule:** $\frac{a}{\sin A} = \frac{b}{\sin B}$

🕮 Cosine rule: $a^2 = b^2 + c^2 - 2bc\cos A$

★ **Area; arc; sector (radians):** $\frac{1}{2}ab\sin C$; $s = r\theta$; $\frac{1}{2}r^2\theta$

★ **Differentiate / integrate** x^n**:** $\frac{d}{dx}x^n = nx^{n-1}$, $\int x^n\,dx = \frac{x^{n+1}}{n+1} + c\ (n \neq -1)$

★ **Tangent; normal:** $y - y_1 = m(x - x_1)$, $m_n = -\frac{1}{m}$

S1 · Statistics 1

★ **Mean; variance:** $\bar{x} = \frac{\sum fx}{\sum f}$, $\sigma^2 = \frac{\sum fx^2}{\sum f} - \bar{x}^2$

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★ **Coding** $y = \frac{x-a}{b}$**:** $\bar{x} = a + b\bar{y}$, $\sigma_x = |b|\sigma_y$

★ **Median by interpolation:**
$Q_2 = L + \frac{\frac{n}{2} - F}{f} \times w$

★ **Outliers (if asked):** $< Q_1 - k(Q_3 - Q_1)$ **or** $> Q_3 + k(Q_3 - Q_1)$

🕮 Union: $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

🕮 Intersection: $P(A \cap B) = P(A)P(B \mid A)$

★ **Conditional; independent:**
$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$; $P(A \cap B) = P(A)P(B)$

🕮 Discrete r.v.: $E(X) = \sum xP(X = x)$, $\mathrm{Var}(X) = \sum x^2 P(X = x) - \mu^2$

🕮 Function of X: $E\big(g(X)\big) = \sum g(x)P(X = x)$

★ **Linear:** $E(aX + b) = aE(X) + b$, $\mathrm{Var}(aX + b) = a^2\mathrm{Var}(X)$

★ **Discrete uniform on** $1, \ldots, n$**:** $E(X) = \frac{n+1}{2}$, $\mathrm{Var}(X) = \frac{n^2-1}{12}$

🕮 S_{xx}, S_{xy}: $S_{xx} = \sum x^2 - \frac{(\sum x)^2}{n}$, $S_{xy} = \sum xy - \frac{\sum x \sum y}{n}$

🕮 PMCC: $r = \frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}}$

🕮 Regression line $y = a + bx$: $b = \frac{S_{xy}}{S_{xx}}$, $a = \bar{y} - b\bar{x}$

★ **Normal:** $Z = \frac{X - \mu}{\sigma} \sim N(0, 1)$

P2 · Pure 2

★ **Factor & remainder theorems:**
$f(a) = 0 \iff (x - a)$ **a factor; remainder** $f(a)$

★ **Circle:** $(x - a)^2 + (y - b)^2 = r^2$**; tangent** $\perp$ **radius**

🕮 Arithmetic series:
$S_n = \frac{1}{2}n(a + l) = \frac{1}{2}n[2a + (n-1)d]$

🕮 nth terms: $u_n = a + (n-1)d$, $u_n = ar^{n-1}$

Scan to practise

🕮 Geometric series:
$S_n = \frac{a(1-r^n)}{1-r}$, $S_\infty = \frac{a}{1-r}\ (|r| < 1)$

🕮 Binomial, $n \in \mathbb{N}$: $(a + b)^n = a^n + \binom{n}{1}a^{n-1}b + \cdots + b^n$, $\binom{n}{r} = \frac{n!}{r!(n-r)!}$

★ **Log laws:** $\log_a xy = \log_a x + \log_a y$, $\log_a \frac{x}{y} = \log_a x - \log_a y$, $\log_a x^k = k\log_a x$

🕮 Change of base: $\log_a x = \frac{\log_b x}{\log_b a}$

★ **Trig:** $\tan\theta = \frac{\sin\theta}{\cos\theta}$, $\sin^2\theta + \cos^2\theta = 1$

🕮 Trapezium rule, $h = \frac{b-a}{n}$: $\int_a^b y\,dx \approx \frac{1}{2}h\{(y_0 + y_n) + 2(y_1 + \cdots + y_{n-1})\}$

★ **Stationary points:** $f'(x) = 0$; $f'' < 0$ **max,** $f'' > 0$ **min**

★ **Area under a curve:** $\int_a^b y\,dx$

P4 · Pure 4

🕮 Binomial, $|x| < 1, n \in \mathbb{Q}$:
$(1 + x)^n = 1 + nx + \frac{n(n-1)}{1\times 2}x^2 + \cdots$

★ **Partial fractions:** $\frac{\ldots}{(x-a)(x-b)} = \frac{A}{x-a} + \frac{B}{x-b}$, $\frac{\ldots}{(x-a)^2(x-b)} = \frac{A}{x-a} + \frac{B}{(x-a)^2} + \frac{C}{x-b}$

★ **Parametric; implicit:** $\frac{dy}{dx} = \frac{dy/dt}{dx/dt}$; $\frac{d}{dx}y^2 = 2y\frac{dy}{dx}$

🕮 Integrals:
$\int \sec^2 kx\,dx = \frac{1}{k}\tan kx$,
$\int \tan x\,dx = \ln|\sec x|$,
$\int \cot x\,dx = \ln|\sin x|$

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🕮 More integrals:
$\int \mathrm{cosec}\,x\,dx = -\ln|\mathrm{cosec}\,x + \cot x|$,
$\int \sec x\,dx = \ln|\sec x + \tan x|$

🕮 By parts: $\int u\frac{dv}{dx}\,dx = uv - \int v\frac{du}{dx}\,dx$

★ **Reverse chain:** $\int \frac{f'(x)}{f(x)}\,dx = \ln|f(x)| + c$

★ **Volume of revolution:** $V = \pi\int_a^b y^2\,dx$

★ **Separable DE:** $\int \frac{dy}{g(y)} = \int f(x)\,dx$

★ **Vectors:** $\mathbf{a}\cdot\mathbf{b} = a_1b_1 + a_2b_2 + a_3b_3 = |\mathbf{a}||\mathbf{b}|\cos\theta$

★ **Line; perpendicular:** $\mathbf{r} = \mathbf{a} + \lambda\mathbf{b}$; $\mathbf{a}\cdot\mathbf{b} = 0$

★ **Magnitude:** $|\mathbf{a}| = \sqrt{a_1^2 + a_2^2 + a_3^2}$

P3 · Pure 3

🕮 Exponential form: $e^{x\ln a} = a^x$

★ **Reciprocal identities:** $\sec^2\theta = 1 + \tan^2\theta$, $\mathrm{cosec}^2\theta = 1 + \cot^2\theta$

🕮 Compound sin: $\sin(A \pm B) = \sin A\cos B \pm \cos A\sin B$

Scan to practise

🕮 Compound cos: $\cos(A \pm B) = \cos A\cos B \mp \sin A\sin B$

🕮 Compound tan: $\tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A\tan B}$

★ **Double angle:** $\sin 2A = 2\sin A\cos A$, $\cos 2A = 2\cos^2 A - 1 = 1 - 2\sin^2 A$, $\tan 2A = \frac{2\tan A}{1 - \tan^2 A}$

★ R **form:** $a\sin\theta \pm b\cos\theta = R\sin(\theta \pm \alpha)$, $R = \sqrt{a^2 + b^2}$, $\tan\alpha = \frac{b}{a}$

★ **Standard derivatives:** $(e^{kx})' = ke^{kx}$, $(\ln x)' = \frac{1}{x}$, $(\sin kx)' = k\cos kx$, $(\cos kx)' = -k\sin kx$

🕮 Trig derivatives: $(\tan kx)' = k\sec^2 kx$, $(\sec x)' = \sec x\tan x$, $(\cot x)' = -\mathrm{cosec}^2 x$, $(\mathrm{cosec}\,x)' = -\mathrm{cosec}\,x\cot x$

★ **Product; chain:** $(uv)' = uv' + vu'$; $\frac{dy}{dx} = \frac{dy}{du}\cdot\frac{du}{dx}$

🕮 Quotient: $\frac{d}{dx}\left(\frac{f}{g}\right) = \frac{f'g - fg'}{g^2}$

★ **Inverse:** $\frac{dx}{dy} = \frac{1}{dy/dx}$

★ **Integrals:** $\int e^{kx}dx = \frac{1}{k}e^{kx} + c$, $\int \frac{1}{x}\,dx = \ln|x| + c$, $\int \cos kx\,dx = \frac{1}{k}\sin kx + c$

★ **Iteration; sign change:** $x_{n+1} = g(x_n)$; $f(a)f(b) < 0 \Rightarrow$ **root in** (a, b)

★ **Functions:** $fg(x) = f(g(x))$; f^{-1} **reflects** f **in** $y = x$**; modulus graphs**

M1 · Mechanics 1 (nothing printed)

★ **suvat:** $v = u + at$, $s = ut + \frac{1}{2}at^2$, $s = vt - \frac{1}{2}at^2$, $s = \frac{1}{2}(u + v)t$, $v^2 = u^2 + 2as$

★ **Vectors:** $\mathbf{v} = \mathbf{u} + \mathbf{a}t$, $\mathbf{r} = \mathbf{r}_0 + \mathbf{v}t$, speed $= |\mathbf{v}|$

Scan to practise

★ **Newton's 2nd law; weight:** $F = ma$, $W = mg$ $(g = 9.8\ \mathrm{m\,s^{-2}})$

★ **Friction:** $F \leq \mu R$**; limiting** $F = \mu R$

★ **Momentum; impulse:** $p = mv$; $I = Ft = mv - mu$

★ **Conservation of momentum:** $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

★ **Moments:** moment $= F \times d_\perp$; equilibrium: $\sum F = 0$, $\sum M = 0$

★ **Slope at** θ**: weight component** $mg\sin\theta$ **down the slope;** $R = mg\cos\theta$ **if nothing else acts perpendicular to it**

★ **Velocity–time graph: gradient = acceleration, area = displacement**

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