Day 230 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Constant acceleration: finding the initial speed (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A particle moving in a straight line with constant acceleration 2 m s^{-2} travels 33 m in 3 s.
Find its initial speed.

$s = ut + \frac{1}{2}at^2$

$33 = 3u + \frac{1}{2} \times 2 \times 3^2$

$3u = 24$

Answer: 8 m s^{-1}

2 Addition rule (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

For events A and B, P(A) = 0.6, P(B) = 0.45 and P(A ∪ B) = 0.8.
(a) Find P(A ∩ B).
(b) Find P(A′ ∩ B′).

(a) P(A ∩ B) = P(A) + P(B) − P(A ∪ B) = 0.6 + 0.45 − 0.8 = 0.25
(b) A′ ∩ B′ is outside both, so P = 1 − P(A ∪ B) = 1 − 0.8
Answer: (a) 0.25 (b) 0.2

3 Equation of a tangent or normal (All boards)

Find the equation of the tangent to the curve
$y = 4\sqrt{x} - x$ at the point where x = 9.

dy/dx = −1 + 2/sqrt(x), so the gradient of the curve at x = 9 is $-\frac{1}{3}$

At x = 9, y = 3

$y - 3 = (-\frac{1}{3})(x - 9)$

Answer: $y = -\frac{1}{3}x + 6$

4 Algebraic division (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Divide $f(x) = 2x^4 + 4x^3 - 20x^2 - 17x + 3$ by (x + 4).
Find the quotient and the remainder.

Use synthetic division with a = −4:
Bottom row: 2, −4, −4, −1, 7
Quotient: $2x^3 - 4x^2 - 4x - 1$
Remainder: 7
Answer: Quotient $2x^3 - 4x^2 - 4x - 1$, remainder 7

5 Solve trig equation in radians (exact) (All boards)

Solve $\cos x = -\frac{\sqrt{3}}{2}$ for $0 \le x \le 2\pi$.

Give your answers in terms of π.

Reference angle: $\frac{\pi}{6}$

cos is negative in the second and third quadrants.

$x = \frac{5\pi}{6}, \frac{7\pi}{6}$

Answer: $x = \frac{5\pi}{6}, \frac{7\pi}{6}$

6 Modulus graphs (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Sketch y = |3x + 3|. Write down the coordinates of the vertex and of the point where the graph meets the y-axis.

The vertex is on the x-axis where 3x + 3 = 0: x = −1
x = 0: y = |3| = 3
Answer: Vertex (−1, 0) ; y-axis (0, 3)

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7 Integration by parts (All boards)

Use integration by parts to find
$\int x\, e^{5x}\, dx$.

$u = x$, $dv/dx = e^{5x}$; $du/dx = 1$, $v = e^{5x}/5$
$\int u\, (dv/dx)\, dx = uv - \int v\, (du/dx)\, dx$
Evaluate the remaining integral and simplify

Answer: $\frac{e^{5x}(5x - 1)}{25} + c$

8 Solving quadratics: surd answers (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve $x^2 - 8x - 2 = 0$, giving your answers in the form $p \pm \sqrt{q}$.

Complete the square: $(x - 4)^2 - 16 - 2 = 0$
$(x - 4)^2 = 18$
$x - 4 = \pm\sqrt{18}$
Answer: $x = 4 \pm 3\sqrt{2}$

9 Normal distribution: probabilities (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$X \sim N(30, 2^2)$. Find $P(X < 34)$, giving your answer to 3 s.f.

Standardise: $z = (34 - 30) \div 2 = 2$
$P(Z < 2)$ from calculator
Answer: 0.977

10 Friction: constant speed, find the coefficient (All boards)

A crate of mass 4 kg is pulled along rough horizontal ground at constant speed by a horizontal force of 23.52 N. Take $g = 9.8$ m s^{-2}. Find the coefficient of friction between the crate and ground.

$R = 4 \times 9.8 = 39.2$
Constant speed: $F = P = 23.52$
$F = \mu R$: $23.52 = \mu \times 39.2$
Answer: 0.6