Day 141 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Constant acceleration: distance from average speed (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A lorry moving in a straight line with constant acceleration increases its speed from 2 m s^{-1} to 15 m s^{-1} in 12 s.
Find the distance it travels in this time.

$s = \frac{(u + v)}{2} t$

$s = \frac{(2 + 15)}{2} \times 12$

Answer: 102 m

2 Expanding brackets with surds (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Expand and simplify $(3 + \sqrt{3})(3 - \sqrt{3})$.

$= 3^2 - (\sqrt{3})^2$
$= 9 - 3$
Answer: 6

3 Solve a logarithmic equation (one log) (All boards)

Solve $\log_2 (2x + 1) = 2$.

$2x + 1 = 2^2 = 4$
$2x = 3$
$x = \frac{3}{2}$

Answer: $x = \frac{3}{2}$

4 Linear and quadratic simultaneous equations (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve the simultaneous equations:
$y = x^2 + 2x$, $y = -3x - 4$.

$x^2 + 2x = -3x - 4$
$x^2 + 5x + 4 = 0$
$(x + 1)(x + 4) = 0$
Use $y = -3x - 4$ to find each y.
Answer: $x = -4$, $y = 8$ and $x = -1$, $y = -1$

5 Projectile launched with velocity components (AQA, Edexcel, OCR, MEI)

A golf ball is projected from level ground with velocity $(15\mathbf{i} + 9.8\mathbf{j})$ m s^{-1} ($\mathbf{i}$ horizontal, $\mathbf{j}$ vertically up). Take g = 9.8 m s^{-2}.
(a) Find the time of flight.
(b) Find the horizontal range.

(a) Vertically: $0 = 9.8\,t - 4.9t^2$

$t = \frac{9.8}{4.9} = 2$

(b) Range = 15 × 2
Answer: (a) 2 s (b) 30 m

6 Interpreting the PMCC (AQA, Edexcel, OCR, MEI, Eduqas)

For data set A, r = 0.42. For data set B, r = 0.87.
Which data set has the stronger linear correlation? Give a reason.

Strength depends on the size of r, ignoring the sign.
|0.42| = 0.42 and |0.87| = 0.87.
Answer: data set B, as |r| is larger

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7 Optimisation (algebraic set-up) (All boards)

A farmer has 60 m of fencing for three sides of a rectangular pen; the fourth side is a wall.
Find the maximum area of the pen.

Two sides of length x m: $A = x(60 - 2x) = 60x - 2x^2$
$dA/dx = 60 - 4x = 0$, so $x = 15$
$d^2A/dx^2 = -4 < 0$ (maximum); $A = 15 \times 30$
Answer: 450 m²

8 Normal approximation to the binomial (CIE)

X ~ B(40, 0.25). Use a normal approximation to find P(X ≥ 10), to 3 s.f.

np = 10 and npq = 7.5, so use Y ~ N(10, 7.5)
Continuity correction: P(Y > 9.5)
$z = (9.5 - 10) \div \sqrt{7.5}$
Answer: 0.572

9 Quadratic in sin or cos (All boards)

Solve $2\sin^2 x + 3\sin x + 1 = 0$ for $0° \leq x \leq 360°$.

Factorise: (2 sin x + 1)(sin x + 1) = 0 (as a quadratic in sin x)
$\sin x = -\frac{1}{2}$ or $\sin x = -1$
x = 210°, 270°, 330°
Answer: x = 210°, 270°, 330°

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

Sketch y = |2x − 6|. 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 2x − 6 = 0: x = 3
x = 0: y = |−6| = 6
Answer: Vertex (3, 0) ; y-axis (0, 6)