Day 253 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Box plots (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The box plot summarises the delivery times, in minutes, of a pizza company.
Find the range and the interquartile range.

Range = 70 − 10 = 60
IQR = 55 − 25 = 30
Answer: range = 60, IQR = 30

2 Position of a point relative to a circle (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A circle has equation $(x + 3)^2 + (y - 4)^2 = 36$.
Determine whether the point P(−4, −7) is inside, outside or on the circle.

Distance^2 from the centre (−3, 4) to P:
$(-4 - (-3))^2 + (-7 - 4)^2 = 1 + 121 = 122$
$r^2 = 36$, and $122 > 36$.
Answer: P is outside the circle

3 Power of an engine: driving force (CIE)

A train's engine works at a constant rate of 30 kW. Find the driving force when the vehicle is moving at 30 m s^{-1}.

$P = Fv$
$30000 = F \times 30$
Answer: 1000 N

4 Vector equation of a line (3D) (CIE)

A line has equation $\mathbf{r} = \begin{pmatrix}1\\3\\0\end{pmatrix} + t\begin{pmatrix}-2\\1\\2\end{pmatrix}$.
Show that the point (−3, 5, 4) lies on the line.

Equate the first coordinates: $1 + (-2)t = -3$, so $t = 2$
Check the others: $3 + 1 \times 2 = 5$ and $0 + 2 \times 2 = 4$
All three agree, so the point is on the line
Answer: Shown (t = 2)

5 Smooth inclined plane: acceleration and speed (All boards)

A particle of mass 3 kg slides from rest down a smooth plane inclined at angle α to the horizontal, where $\sin\alpha = \frac{3}{5}$. Take $g = 9.8$ m s^{-2}.
Find (a) its acceleration, (b) its speed after 2 s.

(a) Parallel to slope: $mg\sin\alpha = ma$
$a = 9.8 \times \frac{3}{5}$
(b) $v = u + at = 0 + 5.88 \times 2$
Answer: (a) 5.88 m s^{-2} (b) 11.76 m s^{-1}

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

Sketch $y = |2x - 1|$. 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 $2x - 1 = 0$: $x = \frac{1}{2}$
$x = 0$: $y = |-1| = 1$
Answer: Vertex $(\frac{1}{2}, 0)$; y-axis (0, 1)

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7 Separable differential equations (All boards)

Given that dy/dx = 4xy and y = 1 when x = 0,
find y in terms of x.

$\frac{1}{y}$ dy = 4x dx, so ln y = $2x^2$ + c

x = 0, y = 1: c = ln 1

y = 1 e^{2x^2}

Answer: y = e^{2x^2}

8 Partial fractions (Edexcel, OCR, MEI, CIE, AQA, Eduqas)

Express $\frac{-2x + 8}{(x - 1)(x + 1)}$ in partial fractions.

Write $\frac{-2x + 8}{(x - 1)(x + 1)} = \frac{A}{(x - 1)} + \frac{B}{(x + 1)}$

$-2x + 8 = A(x + 1) + B(x - 1)$

x = 1: 6 = A(2) so A = 3

x = −1: 10 = B(−2) so B = −5

Answer: $\frac{3}{(x - 1)} + \frac{-5}{(x + 1)}$

9 Simplify using identities (All boards)

Simplify 3 $\sin^2 x$ + 3 $\cos^2 x$.

Take out the factor 3: 3($\sin^2 x$ + $\cos^2 x$) = 3 × 1

Answer: 3

10 Normal approximation to the binomial (CIE)

X ~ B(40, 0.5). Use a normal approximation to find P(X ≤ 17), to 3 s.f.

np = 20 and npq = 10, so use Y ~ N(20, 10)

Continuity correction: P(Y < 17.5)

z = (17.5 − 20) ÷ $\sqrt{10}$

Answer: 0.215