Day 149 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Transforming a point on a graph (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The point P(4, 1) lies on the curve y = f(x).
Write down the coordinates of the image of P on
(a) y = f(x − 2) (b) y = 3f(x)

(a) y = f(x − 2) adds 2 to x, so P maps to (6, 1).
(b) y = 3f(x) multiplies y by 3, so P maps to (4, 3).
Answer: (a) (6, 1) (b) (4, 3)

2 Resultant of perpendicular forces (All boards)

Two forces of magnitudes 24 N and 10 N act on a bead at right angles to each other. Find (a) the magnitude of the resultant, (b) the angle it makes with the 24 N force, to 1 d.p.

(a) $R^2 = 24^2 + 10^2 = 676$
$R = \sqrt{676}$
(b) $\tan\theta = \frac{10}{24}$
Answer: (a) 26 N (b) 22.6°

3 Describing transformations of graphs (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Describe the single transformation that maps the graph of y = f(x) onto the graph of $y = f(\frac{x}{6})$.

$y = f(\frac{x}{6})$ is obtained from y = f(x) by a:
stretch parallel to the x-axis, scale factor 6
Answer: stretch parallel to the x-axis, scale factor 6

4 Trapezium rule from a function (AQA, Edexcel, OCR, MEI, Eduqas)

Use the trapezium rule with 6 strips to estimate
$\int_0^6 2^x\,dx$,
giving your answer to 3 significant figures.

$h = \frac{6-0}{6} = 1$; x = 0, 1, 2, 3, 4, 5, 6
y = 1.000, 2.000, 4.000, 8.000, 16.00, 32.00, 64.00
Area $\approx \frac{h}{2}$[first + last + 2(sum of the rest)] = $\frac{1}{2}$[1.000 + 64.00 + 2 × 62.00]
= 94.5
Answer: 94.5

5 Standard deviation from raw data (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Here are 6 values: 11, 13, 5, 13, 2, 16
Find the mean and the standard deviation, to 3 s.f.

$\Sigma x = 60$, $\Sigma x^2 = 744$, n = 6
Mean = 60 ÷ 6 = 10.00
Variance = $\frac{744}{6} - (10.00)^2 = 24.00$
Standard deviation = $\sqrt{24.00}$
Answer: mean = 10.0, standard deviation = 4.90

Day 149 **A Level Maths: C Tier 10-a-day: Model Solutions**

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

A particle of mass 8 kg slides from rest down a smooth plane inclined at angle α to the horizontal, where $\sin\alpha = \frac{4}{5}$. Take $g = 9.8$ m s^{-2}.
Find (a) its acceleration, (b) its speed after 2 s.

(a) Parallel to slope: $mg\sin\alpha = ma$

$a = 9.8 \times \frac{4}{5}$

(b) $v = u + at = 0 + 7.84 \times 2$

Answer: (a) 7.84 m s^{-2} (b) 15.68 m s^{-1}

7 Stationary points from a sketch (diagram) (All boards)

The diagram shows the curve $y = x^3 - 3x^2 + 1$.
A and B are turning points. Find the coordinates of A and B.

$dy/dx = 3x^2 - 6x$
$dy/dx = 0$ gives $x = 0$ or $x = 2$
Substitute: $y = 1$ at $x = 0$ and $y = -3$ at $x = 2$
Answer: A (0, 1), B (2, −3)

8 Combining two inequalities (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the set of values of x satisfying both
$2x + 3 < -3$ and $x^2 + 5x + 4 < 0$.

$2x + 3 < -3$ gives $x < -3$.
$x^2 + 5x + 4 < 0$: $(x + 4)(x + 1) < 0$, so $-4 < x < -1$.
Both are true where the two ranges overlap.
Answer: $-4 < x < -3$

9 Straight line from logarithmic graph (All boards)

Variables x and y satisfy $y = ab^x$. A graph of $\log_{10} y$ against x is a straight line with gradient 0.5 and intercept 0.3.
Find a and b to 3 significant figures.

$\log y = \log a + x \log b$
$\log b = 0.5$ so $b = 10^{0.5} = 3.16$
$\log a = 0.3$ so $a = 10^{0.3} = 2.00$
Answer: a = 2.00, b = 3.16

10 Critical region (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$X \sim B(20, p)$. H_0: $p = 0.4$, H_1: $p > 0.4$.
Find the critical region for a test at the 1% significance level.

$P(X \geq 14) = 0.00647 \leq 0.01$
$P(X \geq 13) = 0.0210 > 0.01$
Answer: $X \geq 14$