Day 321 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Scatter diagrams and correlation (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The scatter diagram shows shoe size and reading age for a group.
Describe the correlation.

The points lie loosely around a line with positive gradient.
As shoe size increases, reading age tends to increase.
Answer: weak positive correlation

2 Intercepts of a cubic graph (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Sketch $y = 2(x - 1)(x - 4)(x - 5)$. Write down the coordinates of the points where the curve meets the axes.

$y = 0$: $x = 1, 4, 5$
$x = 0$: $y = (-1) \times (-4) \times (-5) \times 2 = -40$
Answer: (1, 0), (4, 0), (5, 0), (0, −40)

3 Solve basic trig equation (exact, degrees) (All boards)

Solve $\sin x = \frac{\sqrt{3}}{2}$ for $0° \leq x \leq 180°$.

Reference angle: $\sin 60° = \frac{\sqrt{3}}{2}$
sin is positive in the first and second quadrants.
Using the sin graph/CAST and the interval $0° \leq x \leq 180°$:
$x = 60°, 120°$
Answer: x = 60°, 120°

4 Position vector under constant velocity (AQA, Edexcel, OCR, MEI, Eduqas)

A boat moves with constant velocity $(-4\mathbf{i} + 3\mathbf{j})$ m s^{-1}.
At time $t = 0$ its position vector is $(6\mathbf{i} + \mathbf{j})$ m.
(a) Find its position vector when $t = 3$.
(b) Find the distance it travels in 3 s.

(a) $\mathbf{r} = \mathbf{r}_0 + \mathbf{v}t = (6\mathbf{i} + \mathbf{j}) + 3(-4\mathbf{i} + 3\mathbf{j})$

(b) speed $= \sqrt{4^2 + 3^2} = 5$ m s^{-1}
distance $= 5 \times 3$
Answer: (a) (−6i + 10j) m (b) 15 m

5 Modulus equations (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve $|x + 4| < 2$.

$-2 < x + 4 < 2$
Add -4 to each part.
Answer: $-6 < x < -2$

6 Catching up: constant speed against acceleration (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Car P passes a point O at constant speed 9 m s^{-1}.
At that instant car Q starts from rest at O with constant acceleration 2 m s^{-2} in the same direction. Find the time when Q catches up P.

Distances equal: $9t = \frac{1}{2} \times 2 \times t^2$
$t(9 - 1t) = 0$, so $t = 0$ or $t = 9 \div 1$
Answer: 9 s

Day 321 **A Level Maths: C Tier 10-a-day: Model Solutions**

7 Proof by exhaustion (AQA, Edexcel, OCR, MEI, Eduqas)

Use proof by exhaustion to show that $n^2 + n + 4$ is divisible by 2 for every integer n with $1 \leq n \leq 5$.

Substitute each value of n:
n = 1: 6 = 2 × 3 ; n = 2: 10 = 2 × 5
n = 3: 16 = 2 × 8 ; n = 4: 24 = 2 × 12
n = 5: 34 = 2 × 17
Every value is a multiple of 2, so the statement is true for $1 \leq n \leq 5$.
Answer: Shown

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

A line has equation $\mathbf{r} = \begin{pmatrix}2\\3\\1\end{pmatrix} + t\begin{pmatrix}1\\2\\3\end{pmatrix}$.

Write down a vector equation of the line through the origin, parallel to this line.

Parallel lines have the same direction vector
The line passes through O, so the position vector is the zero vector
Answer: $\mathbf{r} = s\begin{pmatrix}\mathbf{1}\\\mathbf{2}\\\mathbf{3}\end{pmatrix}$

9 Mutually exclusive events (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A and B are mutually exclusive, with P(A) = 0.2 and P(B) = 0.15.
(a) Find $P(A \cup B)$.
(b) Find the probability that neither A nor B happens.

(a) Mutually exclusive, so $P(A \cap B) = 0$
$P(A \cup B) = 0.2 + 0.15 = 0.35$
(b) $1 - 0.35 = 0.65$
Answer: (a) 0.35 (b) 0.65

10 Find the angle of a sector (All boards)

A sector has radius 5 cm and area 20.0 cm^2.
Find the angle of the sector in radians and the arc length.

$\frac{1}{2} \times 5^2 \times \theta = 20.0$, so $\theta = 1.6$
Arc length = $r\theta = 5 \times 1.6 = 8.00$ cm
Answer: θ = 1.6 radians; arc length 8.00 cm