Day 327 **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 Modulus graphs (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Sketch y = |2x + 9|. 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 + 9 = 0: $x = -\frac{9}{2}$

x = 0: y = |9| = 9

Answer: Vertex $(-\frac{9}{2}, 0)$; y-axis (0, 9)

3 Connected rates of change (All boards)

The side x cm of a cube increases at 0.25 cm/s.
Find the rate of increase of the volume when x = 2.

$V = x^3$, so $\frac{dV}{dx} = 3x^2$

$\frac{dV}{dt} = \frac{dV}{dx} \times \frac{dx}{dt} = 3 \times 2^2 \times 0.25$

Answer: 3 cm^3/s

4 Binomial: cumulative probabilities (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

X ~ B(13, 0.5). Find P(X ≤ 6), giving your answer to 3 s.f.

Using the cumulative binomial function (or adding P(X = 0) up to P(X = 6))
Answer: 0.500

5 Parametric equations to Cartesian form (Edexcel, OCR, MEI, CIE, AQA, Eduqas)

A curve has parametric equations

$x = 3t$, $y = \frac{1}{t}$, $t \neq 0$.

Find a Cartesian equation of the curve.

$x = 3t$ gives $t = \frac{x}{3}$

$y = \frac{1}{t} = 1 \div \frac{x}{3} = \frac{3}{x}$

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

6 Velocity-time graph: acceleration from two stages (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The graph shows the velocity of a skater.
(a) Find the acceleration in the first 2 s.
(b) Find the deceleration in the last 2 s.
(c) Find the total distance travelled.

(a) $a = \frac{12 - 4}{2}$

(b) $a = \frac{12 - 0}{2}$, a deceleration of 6

(c) area $= \frac{1}{2}(4 + 12) \times 2 + 12 \times 6 + \frac{1}{2} \times 2 \times 12$

Answer: (a) 4 $m\ s^{-2}$ (b) 6 $m\ s^{-2}$ (c) 100 m

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

Solve $\sin x = \frac{1}{2}$ for $0 \leq x \leq 2\pi$.

Give your answers in terms of π.

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

sin is positive in the first and second quadrants.

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

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

8 Integrating velocity to find displacement (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A particle moves in a straight line with velocity $v = (9t^2 + 6t + 3)$ m s^{-1} at time t seconds.
Find the distance travelled between t = 2 and t = 4 (the particle does not turn round).

$s = \int v\,dt = 3t^3 + 3t^2 + 3t$
Distance = $s(4) - s(2)$
$= 252 - 42$
Answer: 210 m

9 Exponential graph through two points (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows the curve $y = ab^x$, where $b > 0$.
Find the values of a and b.

Through (0, 5): $a \times b^0 = 5$, so $a = 5$.
Through (2, 80): $5b^2 = 80$
$b^2 = 16$, so $b = 4$ ($b > 0$)
Answer: a = 5, b = 4

10 Exponential growth and decay model (All boards)

A car is worth £$V = 12000 \times 0.9^t$ after t years.
Find (a) its value after 4 years, (b) when it is worth £6000.
Give answers to 3 s.f.

(a) $V = 12000 \times 0.9^4 = 7870$
(b) $0.9^t = 0.5$, so $t \log 0.9 = \log 0.5$
$t = \frac{\log 0.5}{\log 0.9} = 6.58$
Answer: (a) £7870 (b) 6.58 years