Day 15 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Regression: interpreting coefficients (AQA, Edexcel, OCR, MEI, Eduqas)

A model relates the value, £V, of a car to its age, t years by $V = 9000 - 1100t$.
Interpret the value 1100 in this context.

The gradient is the change in V for each 1 unit of t.
For each extra year, V decreases by £1100.
Answer: each extra year, V decreases by £1100

2 Equation of a circle (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A circle has centre (4, 0) and passes through the point (7, 4). Find the equation of the circle.

$r^2 = (7 - 4)^2 + (4 - 0)^2$
$= 9 + 16 = 25$
Equation: $(x - a)^2 + (y - b)^2 = r^2$
Answer: $(x - 4)^2 + y^2 = 25$

3 Median and interquartile range (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Here are 7 values: 9, 29, 48, 50, 6, 77, 67
Find the median and the interquartile range.

Ordered: 6, 9, 29, 48, 50, 67, 77
Median = 48, lower quartile = 9, upper quartile = 67
IQR = 67 − 9
Answer: median = 48, IQR = 58

4 Friction: acceleration along rough ground (All boards)

A block of mass 2 kg is pulled along rough horizontal ground by a horizontal force of 8.9 N. The coefficient of friction is 0.25. Take g = 9.8 m s^{-2}. Find the acceleration.

$R = 2 \times 9.8 = 19.6$
$F = \mu R = 0.25 \times 19.6 = 4.9$
$P - F = ma$: $8.9 - 4.9 = 2a$
Answer: 2 m s^{-2}

5 Quotient rule (All boards)

Use the quotient rule to find the derivative of $y = \frac{\cos x}{x}$.

Quotient rule: if $y = \frac{u}{v}$ then $dy/dx = \frac{u'v - uv'}{v^2}$

Differentiate the numerator and denominator, then substitute and simplify.

Answer: $dy/dx = \frac{-x \sin x - \cos x}{x^2}$

6 Equation of a reciprocal graph from asymptotes (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows the graph of $y = \frac{k}{x - a} + c$ with its asymptotes. Find the values of a, c and k.

The asymptotes are $x = 2$ and $y = 1$, so $a = 2$ and $c = 1$.
Through (0, 2): $2 = \frac{k}{0 - 2} + 1$
$\frac{k}{-2} = 1$, so $k = -2$
Answer: $a = 2$, $c = 1$, $k = -2$

7 Quadratic in sin or cos (All boards)

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

Factorise: $(\sin x - 1)(2 \sin x + 1) = 0$ (as a quadratic in sin x)

$\sin x = 1$ or $\sin x = -\frac{1}{2}$

$x = 90°, 210°, 330°$

Answer: x = 90°, 210°, 330°

8 Arithmetic series: smallest n (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

An arithmetic series has first term 2 and common difference 5. Find the smallest n for which the sum of the first n terms exceeds 400.

$S_n = \frac{n}{2}[4 + 5(n - 1)] = \frac{n(5n - 1)}{2}$

$S_{12} = 354$ and $S_{13} = 416$

The sum first exceeds 400 when n = 13.

Answer: n = 13

9 Two objects moving towards each other (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Two cyclists start at the same time from points X and Y, 50 m apart, and cycle directly towards each other at constant speeds of 4 m s^{-1} and 6 m s^{-1}. Find the time until they meet.

Closing speed = 4 + 6 = 10 m s^{-1}

Time = $\frac{50}{10}$

Answer: 5 s

10 Natural logs and e^x (All boards)

Solve (a) $e^x = 7$ (b) $\ln x = 0.5$

Give answers to 3 significant figures.

(a) $x = \ln 7 = 1.95$

(b) $x = e^{0.5} = 1.65$

Answer: (a) x = 1.95 (b) x = 1.65