Day 280 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Velocity-time graph: acceleration and distance (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The graph shows the velocity of a car over 21 seconds as it moves in a straight line.
(a) Find its acceleration in the first 4 s.
(b) Find the total distance travelled.

(a) acceleration = gradient = $\frac{20}{4}$

(b) distance = area of trapezium

= $\frac{1}{2}(12 + 21) \times 20$

Answer: (a) 5 m s^{-2} (b) 330 m

2 Straight line through two points (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find an equation of the line through A(−4, 1) and B(7, 3), in the form ax + by + c = 0, where a, b and c are integers.

Gradient = $\frac{3 - 1}{7 - (-4)} = \frac{2}{11}$

$y - 1 = \frac{2}{11}(x - (-4))$

Multiply out and rearrange to integer coefficients.

Answer: 2x − 11y + 19 = 0

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

Two cyclists start at the same time from points P and Q, 65 m apart, and cycle directly towards each other at constant speeds of 8 m s^{-1} and 5 m s^{-1}. Find the time until they meet.

Closing speed = 8 + 5 = 13 m s^{-1}

Time = $\frac{65}{13}$

Answer: 5 s

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

Solve tan x = 1 for 0° ≤ x ≤ 360°.

Reference angle: tan 45° = 1
tan is positive in the first and third quadrants.
x = 45°, 225°

Answer: x = 45°, 225°

5 Histograms (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The histogram shows the times, t minutes, taken by some people to complete a puzzle.
Find the number of people who took between 0 and 5 minutes.

Frequency = frequency density × class width
0 ≤ t < 5: 1 × 5 = 5

Answer: 5

6 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 0.7 and intercept 1.2.
Find a and b to 3 significant figures.

log y = log a + x log b
log b = 0.7 so $b = 10^{0.7} = 5.01$
log a = 1.2 so $a = 10^{1.2} = 15.8$

Answer: a = 15.8, b = 5.01

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7 Real roots and the discriminant (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the range of values of k for which $kx^2 + 8x + 1 = 0$ has real roots.

Real roots: $b^2 - 4ac \geq 0$
$64 - 4k \geq 0$, so $k \leq 16$
Also $k \neq 0$ for the equation to be a quadratic.
Answer: $k \leq 16, k \neq 0$

8 Solve a logarithmic equation (two logs) (All boards)

Solve $\log x + \log (x - 4) = \log 21$, $x > 4$.

$\log [x(x - 4)] = \log 21$, so $x^2 - 4x = 21$
$x^2 - 4x - 21 = 0$, $(x - 7)(x + 3) = 0$
$x = 7$ or $x = -3$; $x > 4$, so $x = 7$
Answer: $x = 7$

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

$X \sim B(15, p)$. H_0: $p = 0.5$, H_1: $p > 0.5$.
Find the critical region for a test at the 1% significance level.

$P(X \geq 13) = 0.00369 \leq 0.01$
$P(X \geq 12) = 0.0176 > 0.01$
Answer: $X \geq 13$

10 Tangent condition for a line and a curve (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The line $y = -x + k$ is a tangent to the curve
$y = x^2 + 5x + 2$.
Find the value of k.

$x^2 + 5x + 2 = -x + k$
$x^2 + 6x + (2 - k) = 0$
A tangent touches once: discriminant = 0
$(6)^2 - 4(2 - k) = 0$
Answer: $k = -7$