Day 101 **A Level Maths: C Tier 10-a-day: Model Solutions**

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

A model relates the temperature, T °C, of a cooling drink to the time, t minutes, since pouring by $T = 71 - 3t$.
Interpret the value 3 in this context.

The gradient is the change in T for each 1 unit of t.
For each extra minute, T decreases by 3 °C.
Answer: each extra minute, T decreases by 3 °C

2 Connected rates of change (All boards)

The volume of a sphere increases at 24 cm^3/s.
Find the rate of increase of the radius when r = 4. Give your answer to 3 s.f.

$V = \frac{4}{3}\pi r^3$, so $\frac{dV}{dr} = 4\pi r^2$

$\frac{dr}{dt} = \frac{dV}{dt} \div \frac{dV}{dr} = \frac{24}{4\pi \times 4^2} = 0.119$

Answer: 0.119 cm/s

3 Sampling methods (AQA, Edexcel, OCR, MEI, Eduqas)

A reporter asks the first 10 people who walk out of a town for their views.
Name the sampling method used.

This is opportunity sampling: people are chosen only because they are available at the time.
Answer: opportunity sampling

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

The graph shows the velocity of a cyclist over 24 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 = $\frac{8}{4}$

(b) distance = area of trapezium

$= \frac{1}{2}(12 + 24) \times 8$

Answer: (a) 2 m s^{-2} (b) 144 m

5 Reciprocal graphs and asymptotes (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Sketch $y = \frac{-4}{x + 3} + 3$.

Write down the equations of the asymptotes and the coordinates where the curve meets the axes.

Asymptotes: $x = -3$ and $y = 3$.

$y = 0$: $\frac{-4}{x + 3} = -3$, so $x = -\frac{5}{3}$

$x = 0$: $y = \frac{-4}{3} + 3 = \frac{5}{3}$

Answer: $x = -3$, $y = 3$; $(-\frac{5}{3}, 0)$, $(0, \frac{5}{3})$

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

The graph shows the velocity of a car.
(a) Find the acceleration in the first 8 s.
(b) Find the deceleration in the last 2 s.
(c) Find the total distance travelled.

(a) $a = \frac{14 - 2}{8}$

(b) $a = \frac{14 - 0}{2}$, a deceleration of 7

(c) area $= \frac{1}{2}(2 + 14) \times 8 + 14 \times 8 + \frac{1}{2} \times 2 \times 14$

Answer: (a) 1.5 m s^{-2} (b) 7 m s^{-2} (c) 190 m

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7 Line through two axis intercepts (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows a line meeting the axes at A and B.
Find (a) the equation of AB in the form $px + qy = r$ with integers p, q and r, (b) the length AB.

Gradient = $\frac{5 - 0}{0 - (-6)} = \frac{5}{6}$

Using $y = mx + c$ with $c = 5$: $y = \frac{5}{6}x + 5$, so $5x - 6y = -30$

$AB^2 = 6^2 + 5^2 = 61$

Answer: (a) $5x - 6y = -30$ (b) $\sqrt{61}$

8 Maximum value from R form (All boards)

$f(x) = 7 \sin x + 24 \cos x + 2$.
Write f(x) in the form $R \sin(x + \alpha) + 2$, with α in degrees to 1 d.p., and state the maximum value of f(x).

$R = \sqrt{7^2 + 24^2} = 25$, $\tan \alpha = \frac{24}{7}$ so $\alpha = 73.7°$

$f(x) = 25 \sin(x + 73.7°) + 2$
$\sin(x + \alpha)$ has maximum value 1, so f(max) = 25 + 2
Answer: f(x) = 25 sin(x + 73.7°) + 2; maximum 27

9 Algebraic division (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Divide $f(x) = x^3 + 7x^2 + 14x + 8$ by $(x + 4)$.
Find the quotient and the remainder.

Use synthetic division with $a = -4$:
Bottom row: 1, 3, 2, 0
Quotient: $x^2 + 3x + 2$
Remainder: 0
Answer: Quotient $x^2 + 3x + 2$, remainder 0

10 Arc length and perimeter of a sector (All boards)

A sector has radius 15 cm and angle $\frac{\pi}{3}$ radians.
Find the arc length, leaving π in your answer, and the perimeter.

Arc length = $r\theta = 15 \times \frac{\pi}{3} = 5\pi$ cm
Perimeter = arc + 2r = $5\pi + 30$ cm
Answer: Arc 5π cm; perimeter $(5\pi + 30)$ cm