Day 258 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Natural logs and e^x (All boards)

Solve 4 ln x = 2.
Give your answer to 3 significant figures.

$\ln x = \frac{1}{2}$

$x = e^{\frac{1}{2}} = 1.65$

Answer: x = 1.65

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

A model relates the height, h cm, of a plant to the days, d, since planting by h = 3 + 2d.
Interpret the value 3 in this context.

The constant is the predicted value of h when d = 0.
So the predicted h at d = 0 is 3 cm.

Answer: predicted h is 3 cm when d = 0

3 Friction: constant speed, find the coefficient (All boards)

A trunk of mass 2 kg is pulled along rough horizontal ground at constant speed by a horizontal force of 11.76 N. Take g = 9.8 m s^{-2}. Find the coefficient of friction between the trunk and ground.

R = 2 × 9.8 = 19.6
Constant speed: F = P = 11.76
F = μR: 11.76 = μ × 19.6

Answer: 0.6

4 Solving quadratics: surd answers (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve $x^2 - 6x + 4 = 0$, giving your answers in the form $p \pm \sqrt{q}$.

Complete the square: $(x - 3)^2 - 9 + 4 = 0$
$(x - 3)^2 = 5$
$x - 3 = \pm\sqrt{5}$

Answer: $x = 3 \pm \sqrt{5}$

5 Two-stage motion: acceleration then constant speed (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A cyclist starts from rest and accelerates uniformly at 2 m s^{-2} for 4 s, then travels at constant speed for a further 30 s. Find the total distance travelled.

Speed reached: v = 2 × 4 = 8 m s^{-1}
Stage 1: $s = \frac{1}{2} \times 8 \times 4 = 16$
Stage 2: s = 8 × 30 = 240

Answer: 256 m

6 Gradient of a tangent to a circle (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The circle $(x - 2)^2 + (y - 2)^2 = 10$ passes through P(1, 5).
Find the gradient of the tangent to the circle at P.

Centre C(2, 2).
Gradient of $CP = \frac{5 - 2}{1 - 2} = -3$
The tangent is perpendicular to CP: gradient = $-1 \div (-3)$

Answer: $\frac{1}{3}$

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7 Mean from a frequency table (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The table summarises the number of goals scored in a game by 20 people.
Goals, x: 0, 1, 2, 3, 4
Frequency, f: 3, 2, 7, 2, 6
Find the mean.

$\Sigma fx = 3\times0 + 2\times1 + 7\times2 + 2\times3 + 6\times4 = 46$
Mean = $\Sigma fx \div \Sigma f = 46 \div 20$
Answer: 2.3

8 Integrate (ax + b)^n and related (All boards)

Find $\int \cos(2x + 2)\,dx$.

$\int \cos(ax + b)\,dx = \frac{1}{a}\sin(ax + b)$

Here $a = 2$

Answer: $\mathbf{\frac{1}{2}\sin(2x + 2) + c}$

9 Composite functions (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$f(x) = 4x - 6$ and $g(x) = 2x + 4$.
Solve $fg(x) = 2$.

$fg(x) = f(2x + 4) = 8x + 10$
$8x + 10 = 2$
Answer: $x = -1$

10 Differentiate tan, sec, cosec, cot (AQA, Edexcel, OCR, MEI, Eduqas)

Differentiate $y = \text{cosec } 4x$ with respect to x.

Use the standard result: $d/dx(\text{cosec } kx) = -k \text{ cosec } kx \cot kx$
Answer: $dy/dx = -4 \text{ cosec } 4x \cot 4x$