Day 59 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 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 $h = 7 + 1.3d$.
Interpret the value 1.3 in this context.

The gradient is the change in h for each 1 unit of d.
For each extra day, h increases by 1.3 cm.
Answer: each extra day, h increases by 1.3 cm

2 Equilibrium of forces given as vectors (AQA, Edexcel, OCR, MEI, Eduqas)

Three forces $(-5\mathbf{i})$ N, $(\mathbf{i} - 4\mathbf{j})$ N and $(p\mathbf{i} + q\mathbf{j})$ N act on a particle which is in equilibrium. $\mathbf{i}$ and $\mathbf{j}$ are perpendicular unit vectors. Find the values of p and q.

Sum of forces = 0:
i components: $p + (-5) + (1) = 0$
j components: $q + (0) + (-4) = 0$
Answer: $p = 4$, $q = 4$

3 Simplifying algebraic indices (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Simplify $\sqrt{4x^6} \times 5x^2$.

$\sqrt{4x^6} = (4x^6)^{\frac{1}{2}} = 2x^3$
$2x^3 \times 5x^2 = 10x^5$
Answer: $10x^5$

4 Laws of logarithms: single log (All boards)

Write $2 \log a + 2 \log b - \log c$ as a single logarithm.

$2 \log a = \log a^2$ and $2 \log b = \log b^2$

$\log a^2 + \log b^2 - \log c = \log \frac{a^2b^2}{c}$

Answer: $\log \frac{a^2b^2}{c}$

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

$f(x) = 3x - 2$ and $g(x) = x^2 + 4$.
Find (a) fg(x), (b) gf(x).

$fg(x) = f(x^2 + 4) = 3x^2 + 10$
$gf(x) = (3x - 2)^2 + 4 = 9x^2 - 12x + 8$
Answer: (a) $3x^2 + 10$ (b) $9x^2 - 12x + 8$

6 Moments: reactions on a uniform beam (AQA, Edexcel, OCR, MEI)

A uniform beam AB of mass 40 kg and length 6 m rests horizontally on supports at A and B. A load of mass 5 kg is placed on the beam 1.5 m from A. Take $g = 9.8$ m s^{-2}. Find the reaction at B.

Moments about A:
$R_B \times 6 = 40 \times 9.8 \times 3 + 5 \times 9.8 \times 1.5$
$R_B \times 6 = 1249.5$
Answer: 208.25 N

7 Maximum value from R form (All boards)

$f(x) = 21 \sin x + 20 \cos x + 2$.
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).

$R = \sqrt{21^2 + 20^2} = 29$, $\tan \alpha = \frac{20}{21}$ so $\alpha = 43.6°$
$f(x) = 29 \sin(x + 43.6°) + 2$
$\sin(x + \alpha)$ has maximum value 1, so f(max) = 29 + 2
Answer: $f(x) = 29 \sin(x + 43.6°) + 2$; maximum 31

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8 Binomial: finding parameters (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

X ~ B(n, p) has mean 8 and variance 4.8.
Find n and p.

np = 8 and npq = 4.8
q = 4.8 ÷ 8 = 0.6, so p = 0.4
n = 8 ÷ 0.4
Answer: n = 20, p = 0.4

9 Integration by parts (All boards)

Use integration by parts to find
$\int x \cos 2x \, dx$.

u = x, dv/dx = cos 2x; du/dx = 1, $v = \frac{\sin 2x}{2}$
$\int u \frac{dv}{dx} dx = uv - \int v \frac{du}{dx} dx$
Evaluate the remaining integral and simplify
Answer: $\frac{x \sin 2x}{2} + \frac{\cos 2x}{4} + c$

10 Expanding brackets with surds (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Expand and simplify $(7 - \sqrt{2})(4 + \sqrt{2})$.

$= 28 + 7\sqrt{2} - 4\sqrt{2} - 2$
$= 26 + 3\sqrt{2}$
Answer: $26 + 3\sqrt{2}$