Day 355 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Linear inequalities (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve $2x + 6 < x + 4$.

Collect x terms: $x < -2$
Divide by 1: $x < -2$
Answer: $x < -2$

2 Natural logs and e^x (All boards)

Solve (a) $e^x = 3$ (b) $\ln x = 2.5$
Give answers to 3 significant figures.

(a) $x = \ln 3 = 1.10$
(b) $x = e^{2.5} = 12.2$
Answer: (a) $x = 1.10$ (b) $x = 12.2$

3 Velocity-time: constant deceleration to rest (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A car decelerates uniformly from 16 m s^{-1} to rest in 8 s. Find (a) the deceleration, (b) the distance travelled while decelerating.

(a) $a = \frac{v - u}{t} = \frac{0 - 16}{8}$

(b) $s = \frac{(u + v)}{2} t = 8 \times 8$

Answer: (a) 2 m s^{-2} (b) 64 m

4 Binomial: P(X = k) (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

X ~ B(13, 0.7). Find P(X = 11), giving your answer to 3 s.f.

$P(X = 11) = {}^{13}C_{11} \times 0.7^{11} \times 0.3^2$
$= 78 \times 0.7^{11} \times 0.3^2$
Answer: 0.139

5 Work done and kinetic energy (CIE)

A constant force of 20 N pulls a crate 8 m along rough horizontal ground against a constant frictional force of 10 N. Find (a) the work done by the pulling force, (b) the work done against friction.

(a) Work done = force × distance = 20 × 8
(b) Work done against friction = 10 × 8
Answer: (a) 160 J (b) 80 J

6 Transforming a graph with a labelled turning point (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows the curve y = f(x). The maximum point is shown. Write down the coordinates of the maximum point on the curve with equation
(a) y = f(x + 2) (b) y = f(x) + 2

(a) y = f(x + 2): the maximum point moves to (2, 4).
(b) y = f(x) + 2: the maximum point moves to (4, 6).
Answer: (a) (2, 4) (b) (4, 6)

7 Integration by parts (All boards)

Use integration by parts to find
$\int x e^{4x} dx$.

$u = x$, $dv/dx = e^{4x}$; $du/dx = 1$, $v = e^{4x}/4$
$\int u (dv/dx) dx = uv - \int v (du/dx) dx$
Evaluate the remaining integral and simplify
Answer: $\frac{e^{4x}(4x - 1)}{16} + c$

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8 Modulus graphs (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Sketch y = |2x + 1|. Write down the coordinates of the vertex and of the point where the graph meets the y-axis.

The vertex is on the x-axis where 2x + 1 = 0: $x = -\frac{1}{2}$

x = 0: y = |1| = 1

Answer: Vertex $(-\frac{1}{2}, 0)$; y-axis (0, 1)

9 Vector geometry with a diagram (OAB) (All boards)

In the diagram, OA = $\mathbf{a}$, OB = $\mathbf{b}$, and P lies on AB with AP : PB = 3 : 4.
Find AB and OP in terms of $\mathbf{a}$ and $\mathbf{b}$.

AB = OB − OA = $\mathbf{b} - \mathbf{a}$

AP = $\frac{3}{7}$ AB = $\frac{3}{7}(\mathbf{b} - \mathbf{a})$

OP = OA + AP = $\mathbf{a} + \frac{3}{7}(\mathbf{b} - \mathbf{a})$

= $\frac{4}{7}\mathbf{a} + \frac{3}{7}\mathbf{b}$

Answer: AB = $\mathbf{b} - \mathbf{a}$; OP = $\frac{4}{7}\mathbf{a} + \frac{3}{7}\mathbf{b}$

10 Regression: prediction and reliability (AQA, Edexcel, OCR, MEI, Eduqas)

For 7 data pairs, with advertising spend (£s hundreds) from 12 to 22, the regression line is S = 15 + 6a.
Estimate sales (£s thousands) when a = 21 and comment on the reliability.

S = 15 + 6 × 21 = 141

21 is inside the range 12 to 22, so this is interpolation.

Answer: S = 141; estimate is reliable, as 21 is within the data range (interpolation)