Day 215 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Simplifying surds (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Simplify $\sqrt{6} \times \sqrt{20}$, giving your answer in the form $p\sqrt{q}$, or as an integer.

$\sqrt{6} \times \sqrt{20} = \sqrt{120}$

$= 2\sqrt{30}$

Answer: $2\sqrt{30}$

2 Interpreting the PMCC (AQA, Edexcel, OCR, MEI, Eduqas)

The product moment correlation coefficient between hours of sunshine and ice cream sales is r = 0.81.
Interpret this value.

r is close to 1, so there is strong positive linear correlation.
As hours of sunshine increases, ice cream sales tends to increase.
Answer: strong positive linear correlation

3 Moments: balancing a plank (AQA, Edexcel, OCR, MEI)

A light plank rests on a pivot. A child of mass 30 kg sits 1 m from the pivot on one side. Where must a child of mass 15 kg sit on the other side for the plank to balance horizontally?

Moments about the pivot:
$30\text{ g} \times 1 = 15\text{ g} \times d$

$d = \frac{30 \times 1}{15}$

Answer: 2 m from the pivot

4 Systematic sampling (AQA, Edexcel, OCR, MEI, Eduqas)

A systematic sample of 30 students is taken from a numbered list of 450.
The first one selected is number 10. Find the number of the 4th one selected.

Interval = 450 ÷ 30 = 15
Number = 10 + 3 × 15
Answer: 55

5 Small angle approximations (AQA, Edexcel, OCR, MEI, Eduqas)

θ is small and measured in radians.

Use the small angle approximations to find an approximation for $\frac{\sin 2\theta}{\tan \theta}$.

$\sin 2\theta \approx 2\theta$, $\tan \theta \approx \theta$, so the ratio is about 2

So $\frac{\sin 2\theta}{\tan \theta} \approx 2$

Answer: 2

6 Midpoint and length of a line segment (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A is (3, −3) and B is (13, −11).
Find (a) the midpoint of AB,
(b) the length of AB, as a surd in simplest form.

(a) Midpoint = $(\frac{3 + 13}{2}, \frac{-3 + (-11)}{2}) = (8, -7)$

(b) $AB^2 = (10)^2 + (-8)^2 = 100 + 64 = 164$

$AB = \sqrt{164} = 2\sqrt{41}$

Answer: (a) (8, −7) (b) $2\sqrt{41}$

7 Stationary points from a sketch (diagram) (All boards)

The diagram shows the curve $y = x^3 - 3x^2 + 5$.
A and B are turning points. Find the coordinates of A and B.

$dy/dx = 3x^2 - 6x$
$dy/dx = 0$ gives $x = 0$ or $x = 2$
Substitute: $y = 5$ at $x = 0$ and $y = 1$ at $x = 2$
Answer: A (0, 5), B (2, 1)

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

The line $y = 2x + k$ is a tangent to the curve
$y = x^2 + 6x + 2$.
Find the value of k.

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

9 Differentiating displacement to find velocity (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A particle P moves in a straight line. Its displacement from O at time t seconds is s metres, where $s = 2t^3 + 3t^2 - 6t$.
Find its velocity when t = 2.

$v = \frac{ds}{dt} = 6t^2 + 6t - 6$
When t = 2: $v = 6 \times 2^2 + 6 \times 2 - 6$
Answer: $30\ \text{m s}^{-1}$

10 Identity then solve ($\sin^2$ to cos) (All boards)

Solve $-8\sin^2 x + 6 = 0$
for $0° \leq x \leq 360°$.

Use $\sin^2 x = 1 - \cos^2 x$: $8\cos^2 x - 2 = 0$
Factorise and solve: $\cos x = -\frac{1}{2}$ or $\cos x = \frac{1}{2}$
$x = 60°, 120°, 240°, 300°$
Answer: $x = 60°, 120°, 240°, 300°$