Day 157 **A Level Maths: C Tier 10-a-day: Model Solutions**

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

Simplify $(2x^4)^2 \div 4x^3$.

$(2x^4)^2 = 4x^8$

$4x^8 \div 4x^3$: divide the numbers and subtract the powers

$= x^5$

Answer: x^5

2 Solve a logarithmic equation (one log) (All boards)

Solve $\log_2 (4x + 3) = 3$.

$4x + 3 = 2^3 = 8$

$4x = 5$

$x = \frac{5}{4}$

Answer: $x = \frac{5}{4}$

3 Equation of a reciprocal graph from asymptotes (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows the graph of $y = \frac{k}{x - a} + c$ with its asymptotes. Find the values of a, c and k.

The asymptotes are $x = -1$ and $y = 1$, so $a = -1$ and $c = 1$.

Through (0, 4): $4 = \frac{k}{0 - (-1)} + 1$

$\frac{k}{1} = 3$, so $k = 3$

Answer: $a = -1$, $c = 1$, $k = 3$

4 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 $\sin 3\theta \tan \theta$.

$\sin 3\theta \approx 3\theta$ and $\tan \theta \approx \theta$

So $\sin 3\theta \tan \theta \approx 3\theta^2$

Answer: $3\theta^2$

5 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) + 1 (b) y = f(x − 1)

(a) y = f(x) + 1: the maximum point moves to (−1, 6).

(b) y = f(x − 1): the maximum point moves to (0, 5).

Answer: (a) (−1, 6) (b) (0, 5)

6 Average speed over two stages (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A runner travels 20 m at a constant speed of 5 m s^{-1}, then a further 16 m at a constant speed of 4 m s^{-1}. Find the average speed for the whole journey.

Time for first stage = 20 ÷ 5 = 4 s

Time for second stage = 16 ÷ 4 = 4 s

Average speed = $\frac{\text{total distance}}{\text{total time}} = \frac{36}{8}$

Answer: 4.5 m s^{-1}

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7 Critical region (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$X \sim B(10, p)$. H_0: $p = 0.5$, H_1: $p > 0.5$.

Find the critical region for a test at the 5% significance level.

$P(X \geq 9) = 0.0107 \leq 0.05$

$P(X \geq 8) = 0.0547 > 0.05$

Answer: $X \geq 9$

8 Solve basic trig equation (exact, degrees) (All boards)

Solve $\cos x = \frac{1}{2}$ for $0° \leq x \leq 180°$.

Reference angle: $\cos 60° = \frac{1}{2}$

cos is positive in the first and fourth quadrants.

Using the cos graph/CAST and the interval $0° \leq x \leq 180°$:

$x = 60°$

Answer: $x = 60°$

9 Two particles over a smooth pulley (All boards)

Two particles of masses 3 kg and 7 kg hang from the ends of a light inextensible string over a smooth pulley and are released from rest. Take $g = 9.8$ m s^{-2}. Find the acceleration and the tension in the string.

7 kg: $7 \times 9.8 - T = 7a$

3 kg: $T - 3 \times 9.8 = 3a$

Adding: $39.2 = 10a$, then $T = 3(9.8 + a)$

Answer: $a = 3.92$ m s^{-2}, $T = 41.16$ N

10 Binomial test using a given probability (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$X \sim B(10, p)$. H_0: $p = 0.2$, H_1: $p > 0.2$.

In a sample, $x = 5$. It is given that $P(X \geq 5) = 0.0328$.

Test H_0 at the 5% significance level.

Compare 0.0328 with 0.05

$0.0328 < 0.05$, so reject H_0

Answer: Reject H_0: evidence that p is greater than 0.2