Day 4 **A Level Maths: C Tier 10-a-day: Model Solutions**

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

Simplify $\sqrt{5} + \sqrt{180}$, giving your answer in the form $p\sqrt{5}$.

$\sqrt{5} = 1\sqrt{5}$ and $\sqrt{180} = 6\sqrt{5}$

Sum = $(1 + 6)\sqrt{5}$

Answer: $7\sqrt{5}$

2 Double angle: find sin 2A and cos 2A (All boards)

A is acute and $\cos A = \frac{5}{13}$.

Find the exact values of sin 2A and cos 2A.

$\sin A = \sqrt{1 - \cos^2 A} = \frac{12}{13}$

$\sin 2A = 2 \sin A \cos A = 2 \times \frac{12}{13} \times \frac{5}{13} = \frac{120}{169}$

$\cos 2A = 2\cos^2 A - 1 = 2 \times \frac{25}{169} - 1 = -\frac{119}{169}$

Answer: $\sin 2A = \frac{120}{169}$, $\cos 2A = -\frac{119}{169}$

3 Resolving a force into components (All boards)

A string pulls a box with a force of 16 N at an angle of 30° above the horizontal. Find the horizontal and vertical components of the force, to 3 s.f.

Horizontal = 16 cos 30°

Vertical = 16 sin 30°

Answer: horizontal 13.9 N, vertical 8.00 N

4 Combined mean (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The mean of 30 ages of the men is 67. The mean of 10 ages of the women is 59.
Find the mean of all 40 values.

Total of first group = 30 × 67 = 2010

Total of second group = 10 × 59 = 590

Mean = 2600 ÷ 40

Answer: 65

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

A train starts from rest and accelerates uniformly at 1.5 m s^{-2} for 10 s, then travels at constant speed for a further 30 s. Find the total distance travelled.

Speed reached: $v = 1.5 \times 10 = 15$ m s^{-1}

Stage 1: $s = \frac{1}{2} \times 15 \times 10 = 75$

Stage 2: $s = 15 \times 30 = 450$

Answer: 525 m

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

Sketch $y = |3x - 3|$. 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 $3x - 3 = 0$: $x = 1$

$x = 0$: $y = |-3| = 3$

Answer: Vertex (1, 0) ; y-axis (0, 3)

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7 Integrate using partial fractions (All boards)

$\frac{-5x-14}{(x+4)(x+2)} \equiv \frac{A}{x+4} + \frac{B}{x+2}$.

Find A and B, and hence find $\int \frac{-5x-14}{(x+4)(x+2)}\,dx$.

$-5x - 14 \equiv A(x+2) + B(x+4)$

$x = -4$ gives $A = -3$; $x = -2$ gives $B = -2$

$\int \left(\frac{-3}{x+4} + \frac{-2}{x+2}\right) dx = -3\ln|x+4| + -2\ln|x+2| + c$

Answer: $A = -3, B = -2$; $-3\ln|x+4| - 2\ln|x+2| + c$

8 Tree diagrams (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The tree diagram shows probabilities for events R and L.
Find the probability that exactly one of R and L happens.

Exactly one: (R and L′) or (R′ and L)

$= 0.6 \times 0.4 + 0.4 \times 0.2$

Answer: 0.32

9 Trapezium rule: strips shown (diagram) (AQA, Edexcel, OCR, MEI, Eduqas)

The diagram shows the curve $y = e^x$ from $x = 0$ to $x = 4$ divided into 6 strips of equal width.
Use the trapezium rule with these strips to estimate the shaded area to 3 s.f.

h = 0.6666666666666666; y values: 1.000, 1.948, 3.794, 7.389, 14.39, 28.03, 54.60

Area $\approx \frac{0.6666666666666666}{2}[1.000 + 54.60 + 2(55.55)]$

= 55.6

Answer: 55.6

10 Algebraic division (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Divide $f(x) = 2x^4 - 8x^3 + 2x^2 + 8x + 12$ by $(x - 3)$.
Find the quotient and the remainder.

Use synthetic division with a = 3:

Bottom row: 2, −2, −4, −4, 0

Quotient: $2x^3 - 2x^2 - 4x - 4$

Remainder: 0

Answer: Quotient $2x^3 - 2x^2 - 4x - 4$, remainder 0