Day 351 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Combining two inequalities (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the set of values of x satisfying both

$3x - 1 > 2$ and $x^2 - 4x - 5 < 0$.

$3x - 1 > 2$ gives $x > 1$.

$x^2 - 4x - 5 < 0$: $(x + 1)(x - 5) < 0$, so $-1 < x < 5$.

Both are true where the two ranges overlap.

Answer: $1 < x < 5$

2 F = ma: find the force or the mass (All boards)

A particle of mass 2 kg has acceleration 1 m s^{-2}. Find the magnitude of the resultant force acting on it.

$F = ma$

$F = 2 \times 1$

Answer: 2 N

3 Frequency density (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

In a histogram, the class 10 to 30 has frequency 60 and is drawn with a bar of height 6 cm.

The class 30 to 35 has frequency 20. Find the height of its bar.

Frequency density = frequency ÷ class width

First bar: 60 ÷ 20 = 3, so 6 cm represents 3

Second bar: 20 ÷ 5 = 4

Height = $6 \times \frac{4}{3}$

Answer: 8 cm

4 Trapezium rule from a table (AQA, Edexcel, OCR, MEI, Eduqas)

The table shows values of y = f(x).

x: 2 2.25 2.5 2.75 3

y: 5.1 9 8.5 5.8 8.3

Use the trapezium rule to estimate the area under the curve between x = 2 and x = 3.

h = 0.25 with 4 strips

Area $\approx \frac{0.25}{2}[5.1 + 8.3 + 2(9 + 8.5 + 5.8)]$

$= \frac{0.25}{2} \times 60$

$= 7.5$

Answer: 7.5

5 Hypothesis test for correlation (AQA, Edexcel, OCR, MEI, Eduqas)

30 pairs of data on age of a car and its value have r = 0.16.

Test, at the 5% significance level, for evidence of positive correlation. The critical value is 0.3061.

H_0: $\rho = 0$, H_1: $\rho > 0$

r = 0.16 is not beyond the critical value 0.3061

Do not reject H_0

Answer: Do not reject H_0: there is not enough evidence of positive correlation

6 Solving equations with indices (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve $2^{3x+2} = 8$.

$8 = 2^3$, so $3x + 2 = 3$

$3x = 1$

Answer: $x = \frac{1}{3}$

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7 Double angle equation (All boards)

Solve $\sin 3x = \frac{\sqrt{2}}{2}$ for $0° \leq x \leq 120°$.

Let $u = 3x$, so $0° \leq u \leq 360°$

$\sin u = \frac{\sqrt{2}}{2}$: $u = 45°, 135°, 405°, 495°, 765°, 855°$

Divide by 3: $x = 15°, 45°$

Answer: $x = 15°, 45°$

8 Free fall: dropped from a height (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A stone is dropped from rest from the top of a cliff of height 122.5 m. Take $g = 9.8$ m s^{-2} and ignore air resistance. Find (a) the time taken to reach the ground, (b) its speed on hitting the ground.

(a) $s = ut + \frac{1}{2}at^2$: $122.5 = \frac{1}{2} \times 9.8 \times t^2$

$122.5 = 4.9t^2$, so $t^2 = 25$

(b) $v = u + at = 9.8 \times 5$

Answer: (a) 5 s (b) 49 m s^{-1}

9 Product rule (All boards)

Use the product rule to differentiate

$y = x^1e^{3x}$.

$u = x^1$, $v = e^{3x}$

$u' = 1$, $v' = 3\,e^{3x}$

$dy/dx = u'v + uv'$, which simplifies to the answer below

Answer: $dy/dx = e^{3x}(3x + 1)$

10 Partial fractions (Edexcel, OCR, MEI, CIE, AQA, Eduqas)

Express $\frac{2x + 7}{(x - 2)^2}$ in the form $\frac{A}{(x - 2)} + \frac{B}{(x - 2)^2}$.

$2x + 7 = A(x - 2) + B$

Coefficient of x: $A = 2$

Constant: $7 = 4 + B$, so $B = 11$

Answer: $A = 2$, $B = 11$