Day 309 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Intercepts of a cubic graph (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Sketch $y = (x + 1)(x - 2)(x - 4)$. Write down the coordinates of the points where the curve meets the axes.

$y = 0$: $x = -1, 2, 4$
$x = 0$: $y = 1 \times (-2) \times (-4) = 8$
Answer: $(-1, 0), (2, 0), (4, 0), (0, 8)$

2 Differentiating velocity to find acceleration (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A particle moves in a straight line. Its velocity at time t seconds is v m s^{-1}, where $v = 3t^2 - 24t + 5$.
(a) Find its acceleration when $t = 3$.
(b) Find the time when its acceleration is zero.

$a = \frac{dv}{dt} = 6t - 24$
(a) $t = 3$: $a = 6 \times 3 - 24$
(b) $6t - 24 = 0$, so $t = \frac{24}{6}$
Answer: (a) -6 m s^{-2} (b) 4 s

3 Disproof by counter-example (AQA, Edexcel, OCR, MEI, Eduqas)

Show, by a counter-example, that the statement "If n^2 is a multiple of 45 then n is a multiple of 45" is false, where n is a positive integer.

Look for n with n^2 divisible by 45 but n not divisible by 45.
Try $n = 15$: $n^2 = 225 = 45 \times 5$, a multiple of 45.
But 15 is not a multiple of 45, so the statement is false.
Answer: $n = 15$

4 Find the angle of a sector (All boards)

A sector has radius 8 cm and area 40.0 cm^2.
Find the angle of the sector in radians and the arc length.

$\frac{1}{2} \times 8^2 \times \theta = 40.0$, so $\theta = 1.25$
Arc length $= r\theta = 8 \times 1.25 = 10.0$ cm
Answer: $\theta = 1.25$ radians; arc length 10.0 cm

5 Modulus equations (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve $|x + 5| > 4$.

$x + 5 > 4$ or $x + 5 < -4$
Add -5 to each side.
Answer: $x < -9$ or $x > -1$

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

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

P(L) = P(R and L) + P(R′ and L)
$= 0.4 \times 0.2 + 0.6 \times 0.6$
Answer: 0.44

7 Separable differential equations (All boards)

Given that $dy/dx = 5x^2$ and $y = 2$ when $x = 0$,
find y in terms of x.

$y = \int 5x^2 \, dx = \frac{5x^3}{3} + c$
$x = 0$, $y = 2$: $c = 2$
Answer: $y = \frac{5x^3}{3} + 2$

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8 Scatter diagrams and correlation (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The scatter diagram shows distance from city and house price for a group.
Describe the correlation.

The points show no pattern: as distance from city increases, house price shows no consistent trend.

Answer: no correlation

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

The table shows values of y = f(x).
x: 0 2 4 6 8
y: 9 5.5 7 2.4 3.1
Use the trapezium rule to estimate the area under the curve between x = 0 and x = 8.

h = 2 with 4 strips

Area $\approx \frac{2}{2}[9 + 3.1 + 2(5.5 + 7 + 2.4)]$

$= \frac{2}{2} \times 41.9$

$= 41.9$

Answer: 41.9

10 Rough slope: limiting equilibrium or sliding (All boards)

A particle slides down a rough plane inclined at angle α to the horizontal, where $\sin\alpha = \frac{4}{5}$ and the coefficient of friction is 0.5. Take g = 9.8 m s^{-2}. Find the acceleration.

$R = mg\cos\alpha = m \times 9.8 \times \frac{3}{5}$

$mg\sin\alpha - \mu R = ma$

$a = 9.8 \times \frac{4}{5} - 0.5 \times 9.8 \times \frac{3}{5}$

Answer: 4.9 m s^{-2}