Day 57 **A Level Maths: C Tier 10-a-day: Model Solutions**

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

A resultant force of 1.5 N gives a body an acceleration of 0.5 m s^{-2}. Find the mass of the body.

F = ma
1.5 = m × 0.5
Answer: 3 kg

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

Solve $\tan x = \sqrt{3}$ for $0° \leq x \leq 180°$.

Reference angle: $\tan 60° = \sqrt{3}$
tan is positive in the first and third quadrants.
Using the tan graph/CAST and the interval $0° \leq x \leq 180°$:
$x = 60°$
Answer: $x = 60°$

3 Braking: deceleration and time (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A lorry travelling at 24 m s^{-1} brakes uniformly and comes to rest after travelling 60 m.
(a) Find the deceleration.
(b) Find the time taken to stop.

(a) $v^2 = u^2 + 2as$: $0 = 24^2 + 2 \times a \times 60$
so $a = -4.8$, a deceleration of 4.8
(b) $s = \frac{(u + v)}{2} t$: $60 = 12 t$
Answer: (a) 4.8 m s^{-2} (b) 5 s

4 Transforming a point on a graph (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The point P(−2, 3) lies on the curve y = f(x).
Write down the coordinates of the image of P on
(a) y = f(x) + 3 (b) y = f(−x)

(a) y = f(x) + 3 adds 3 to y, so P maps to (−2, 6).
(b) y = f(−x) changes the sign of x, so P maps to (2, 3).
Answer: (a) (−2, 6) (b) (2, 3)

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

$X \sim B(25, p)$. H_0: $p = 0.3$, H_1: $p < 0.3$.
In a sample, $x = 5$. It is given that $P(X \leq 5) = 0.1935$.
Test H_0 at the 10% significance level.

Compare 0.1935 with 0.1
0.1935 > 0.1, so do not reject H_0
Answer: Do not reject H_0: insufficient evidence that p is less than 0.3

6 Gradient of a tangent to a circle (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The circle $(x + 3)^2 + y^2 = 13$ passes through P(−1, −3).
Find the gradient of the tangent to the circle at P.

Centre C(−3, 0).

Gradient of CP = $\frac{-3 - 0}{-1 - (-3)} = -\frac{3}{2}$

The tangent is perpendicular to CP: gradient = $-1 \div (-\frac{3}{2})$

Answer: $\frac{2}{3}$

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7 Integrate using partial fractions (All boards)

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

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

$x \equiv A(x+2) + B(x+4)$

$x = -4$ gives $A = 2$; $x = -2$ gives $B = -1$

$\int \left(\frac{2}{x+4} + \frac{-1}{x+2}\right) dx = 2 \ln|x+4| + -1 \ln|x+2| + c$

Answer: $A = 2$, $B = -1$; $2 \ln|x+4| - \ln|x+2| + c$

8 Grouped data: estimated median (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The table shows grouped data.

Class: $20 \le x < 30$; $30 \le x < 40$; $40 \le x < 50$; $50 \le x < 60$

Frequency: 14, 16, 14, 16

Estimate the median, to 3 s.f.

$n = 60$, so the median is the 30 th value, in class $30 \le x < 40$

Cumulative frequency before this class = 14

Median $\approx 30 + \frac{(30 - 14)}{16} \times 10$

Answer: 40.0

9 Product rule (All boards)

Use the product rule to differentiate

$y = x^4 \ln x$.

$u = x^4$, $v = \ln x$

$u' = 4x^3$, $v' = \frac{1}{x}$

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

Answer: $dy/dx = x^3(4 \ln x + 1)$

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

The line $y = 3x + k$ is a tangent to the curve

$y = x^2 + x - 4$.

Find the value of k.

$x^2 + x - 4 = 3x + k$

$x^2 - 2x + (-4 - k) = 0$

A tangent touches once: discriminant = 0

$(-2)^2 - 4(-4 - k) = 0$

Answer: $k = -5$