Day 67 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Constant acceleration: s = ut + ½at² (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A particle moves in a straight line with constant acceleration 1.5 m s^{-2}. Its initial speed is 1 m s^{-1}. Find the distance travelled in 3 s.

$s = ut + \frac{1}{2}at^2$

$s = 1 \times 3 + \frac{1}{2} \times 1.5 \times 3^2$

Answer: 9.75 m

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

Solve $\cos x = -\frac{1}{2}$ for $0° \leq x \leq 360°$.

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

cos is negative in the second and third quadrants.
x = 120°, 240°
Answer: x = 120°, 240°

3 Poisson distribution (CIE)

The number of events in one interval has a Poisson distribution with mean 2.
Find the probability of at most 1 in one such interval, to 3 s.f.

P(X ≤ 1) = P(0) + P(1) + ... + P(1), by calculator
Answer: 0.406

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

Solve $x^{\frac{6}{3}} = 64$.

Raise both sides to the power $\frac{3}{6}$:

$x = 64^{\frac{3}{6}} = (64^{\frac{1}{6}})^3$
$= 2^3 = 8$
Answer: x = 8

5 Stationary points from a sketch (diagram) (All boards)

The diagram shows the curve $y = x^3 - 12x + 5$.
A and B are turning points. Find the coordinates of A and B.

$dy/dx = 3x^2 - 12$
$dy/dx = 0$ gives $x = -2$ or $x = 2$
Substitute: $y = 21$ at $x = -2$ and $y = -11$ at $x = 2$
Answer: A (−2, 21), B (2, −11)

6 Real roots and the discriminant (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the range of values of k for which $kx^2 + 10x + 1 = 0$ has real roots.

Real roots: $b^2 - 4ac \geq 0$
$100 - 4k \geq 0$, so $k \leq 25$
Also $k \neq 0$ for the equation to be a quadratic.
Answer: k ≤ 25, k ≠ 0

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

A particle slides down a rough plane inclined at angle α to the horizontal, where $\sin\alpha = \frac{3}{5}$ and the coefficient of friction is 0.5. Take $g = 9.8$ m s^{-2}. Find the acceleration.

$R = mg\cos\alpha = m \times 9.8 \times \frac{4}{5}$

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

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

Answer: 1.96 m s^{-2}

8 Box plots (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The box plot summarises the delivery times, in minutes, of a pizza company.
Find the range and the interquartile range.

Range $= 70 - 20 = 50$

IQR $= 65 - 35 = 30$

Answer: range = 50, IQR = 30

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

The line $y = 4x + k$ is a tangent to the curve
$y = x^2 + 8x - 2$.
Find the value of k.

$x^2 + 8x - 2 = 4x + k$

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

A tangent touches once: discriminant = 0

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

Answer: k = −6

10 Quotient rule (All boards)

Use the quotient rule to find the derivative of
$y = \frac{x}{x+5}$.

Quotient rule: if $y = \frac{u}{v}$ then $dy/dx = \frac{u'v - uv'}{v^2}$

Differentiate the numerator and denominator, then substitute and simplify.

Answer: $dy/dx = \frac{5}{(x+5)^2}$