Day 229 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Amplitude and period from a graph (diagram) (All boards)

The diagram shows the graph of $y = a \sin bx$ for $0° \leq x \leq 360°$, where a and b are positive integers.
Find a and b.

The maximum value of y is 3, so a = 3

The graph completes 3 full cycles in 360°, so the period is 120° and $b = \frac{360}{120} = 3$

Answer: a = 3, b = 3

2 Line through two axis intercepts (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows a line meeting the axes at A and B.
Find (a) the equation of AB in the form px + qy = r with integers p, q and r, (b) the length AB.

Gradient $= \frac{5 - 0}{0 - 3} = -\frac{5}{3}$

Using y = mx + c with c = 5: $y = -\frac{5}{3}x + 5$, so 5x + 3y = 15

$AB^2 = 3^2 + 5^2 = 34$

Answer: (a) 5x + 3y = 15 (b) $\sqrt{34}$

3 Parallel vectors (All boards)

$\mathbf{a} = \begin{pmatrix} 5 \\ 2 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} -15 \\ -6 \end{pmatrix}$.

Show that a and b are parallel and find the ratio |b| : |a|.

$\mathbf{b} = -3 \times \mathbf{a}$, since $-3 \times 5 = -15$ and $-3 \times 2 = -6$
So a and b are parallel and |b| : |a| = 3 : 1
Answer: b = −3 a, so parallel; ratio 3 : 1

4 Driving force and resistance (All boards)

A car of mass 1000 kg is driven along a straight horizontal road by a driving force of 1800 N against a constant resistance of 300 N.
Find the acceleration of the car.

Resultant force = 1800 − 300 = 1500 N
F = ma: 1500 = 1000 a
Answer: 1.5 m s^{-2}

5 Definite integrals (exact) (All boards)

Find the exact value of

$\int_0^2 2\,e^{3x}\,dx$.

$[\frac{2}{3}\,e^{3x}]$ from 0 to 2

$= \frac{2}{3}\,e^6 - \frac{2}{3}$

$= \frac{2(e^6 - 1)}{3}$

Answer: $\frac{2(e^6 - 1)}{3}$

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

Find the set of values of k for which
$x^2 + kx + 49 = 0$ has two distinct real roots.

$b^2 - 4ac > 0$

$k^2 - 196 > 0$, so $k^2 > 196$

Answer: k < −14 or k > 14

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7 Catching up: constant speed against acceleration (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Car P passes a point O at constant speed 8 m s^{-1}.
At that instant car Q starts from rest at O with constant acceleration 4 m s^{-2} in the same direction. Find the time when Q catches up P.

Distances equal: $8t = \frac{1}{2} \times 4 \times t^2$
$t(8 - 2t) = 0$, so $t = 0$ or $t = 8 \div 2$
Answer: 4 s

8 Binomial: cumulative probabilities (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$X \sim B(9, 0.3)$. Find $P(X \geq 4)$, giving your answer to 3 s.f.

$P(X \geq 4) = 1 - P(X \leq 3)$
$P(X \leq 3) = 0.7297$
Answer: 0.270

9 Solving quadratics: surd answers (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve $x^2 - 2x - 2 = 0$, giving your answers in the form $p \pm \sqrt{q}$.

Complete the square: $(x - 1)^2 - 1 - 2 = 0$
$(x - 1)^2 = 3$
$x - 1 = \pm\sqrt{3}$
Answer: $x = 1 \pm \sqrt{3}$

10 Normal distribution: diagram and symmetry (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows the density of $X \sim N(135, 8^2)$.
a and b are equal distances from the mean. The shaded area is 0.84.
Find $P(X > b)$.

Unshaded area = $1 - 0.84 = 0.16$
The two tails are equal by symmetry, so $P(X > b) = 0.16 \div 2$
Answer: 0.08