Day 104 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Comparing distributions (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The journey times in minutes for two groups: Route A has mean 50, standard deviation 11; Route B has mean 77, standard deviation 9.
Compare the two sets of data.

The mean measures the average: Route B has the higher mean.
The standard deviation measures spread: Route B has the smaller standard deviation, so it is more consistent.
Answer: Route B has the higher mean; Route B is more consistent

2 Parametric equations: finding points (Edexcel, OCR, MEI, CIE, AQA, Eduqas)

A curve has parametric equations
$x = t - 4$, $y = 3t^2 - 6$.
Find the coordinates of the point where $t = 3$.

$x = 1 \times 3 - 4 = -1$
$y = 3 \times 3^2 - 6 = 21$
Answer: $(-1, 21)$

3 Natural logs and e^x (All boards)

Solve (a) $e^x = 12$ (b) $\ln x = 1$
Give answers to 3 significant figures.

(a) $x = \ln 12 = 2.48$
(b) $x = e^1 = 2.72$
Answer: (a) $x = 2.48$ (b) $x = 2.72$

4 Constant acceleration: time to reach a speed (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A car moving in a straight line increases its speed from 1 m s^{-1} to 17 m s^{-1} with constant acceleration 4 m s^{-2}. Find the time taken.

$v = u + at$
$17 = 1 + 4\,t$
Answer: 4 s

5 Quadratic inequalities (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve $x + 4 < 12$.

Solve $x^2 + 4x - 12 = 0$: $(x + 6)(x - 2) = 0$
Critical values $x = -6$ and $x = 2$.
The graph is a ∪-shaped parabola, so take the region between the roots.
Answer: $-6 < x < 2$

6 Particle on a smooth table connected to a hanging particle (All boards)

A 2 kg particle on a smooth horizontal table is joined by a light string over a smooth pulley to a hanging 2 kg particle, as shown. The system is released from rest. Take g = 9.8 m s^{-2}. Find the tension.

Table particle: $T = 2\,a$
Hanging particle: $2 \times 9.8 - T = 2\,a$
Adding: $19.6 = 4\,a$
Answer: 9.8 N

7 Rearrange and iterate (All boards)

(a) Show that $x^3 - 3x - 9 = 0$ can be rearranged to $x = (3x + 9)^{\frac{1}{3}}$.
(b) Use $x_{n+1} =$ this formula with $x_0 = 2$ to find x_1, x_2 to 3 d.p.

(a) $x^3 = 3x + 9$, so $x = \sqrt[3]{(3x + 9)}$
(b) $x_1 = 2.4662$, $x_2 = 2.5406$
Answer: (a) shown (b) $x_1 = 2.466$, $x_2 = 2.541$

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8 Domain and range (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$f(x) = \frac{1}{x+1} + 2$, $x \neq -1$.

Find the range of f.

$\frac{1}{x+1}$ takes every real value except 0.

Adding 2: f(x) takes every value except 2.

Answer: f(x) takes all real values except 2

9 Continuous random variable: probability and mean (CIE)

X has probability density function $f(x) = \frac{1}{9}x^2$ for $0 \leq x \leq 3$, and 0 otherwise.

Find E(X).

$E(X) = \int$ from 0 to 3 of $x\,f(x)\,dx = \int$ from 0 to 3 of $\frac{1}{9}x^3\,dx$

$= \frac{1}{9} \times \frac{3^4}{4}$

Answer: $\frac{9}{4}$

10 Solve trig equation in radians (exact) (All boards)

Solve $\cos x = \frac{\sqrt{2}}{2}$ for $0 \leq x \leq 2\pi$.

Give your answers in terms of π.

Reference angle: $\frac{\pi}{4}$

cos is positive in the first and fourth quadrants.

$x = \frac{\pi}{4}, \frac{7\pi}{4}$

Answer: $x = \frac{\pi}{4}, \frac{7\pi}{4}$