Day 295 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Inverse trig functions (Edexcel, OCR)

Find the exact value, in radians, of
(a) arcsin(−1) (b) arctan(1)

(a) $y = \arcsin(-1)$ means $\sin y = -1$ with $-\frac{\pi}{2} \le y \le \frac{\pi}{2}$: $y = -\frac{\pi}{2}$

(b) $y = \arctan(1)$ means $\tan y = 1$ with $-\frac{\pi}{2} < y < \frac{\pi}{2}$: $y = \frac{\pi}{4}$

Answer: (a) $-\frac{\pi}{2}$ (b) $\frac{\pi}{4}$

2 Parametric equations to Cartesian form (Edexcel, OCR, MEI, CIE, AQA, Eduqas)

A line has parametric equations
$x = 4t - 2$, $y = 4t - 4$.
Find its equation in the form $y = mx + c$.

From $x = 4t - 2$: $t = \frac{x + 2}{4}$

$y = 4 \times \frac{x + 2}{4} - 4$

Answer: $y = x - 2$

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

The journey times in minutes for two groups: Route A has mean 68, standard deviation 14; Route B has mean 71, 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

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

Solve $\tan x = -\frac{\sqrt{3}}{3}$ for $0 \le x \le 2\pi$.

Give your answers in terms of π.

Reference angle: $\frac{\pi}{6}$

tan is negative in the second and fourth quadrants.
$x = \frac{5\pi}{6}, \frac{11\pi}{6}$

Answer: $x = \frac{5\pi}{6}, \frac{11\pi}{6}$

5 Moments: balancing a plank (AQA, Edexcel, OCR, MEI)

A light plank rests on a pivot. A child of mass 30 kg sits 3 m from the pivot on one side. Where must a child of mass 25 kg sit on the other side for the plank to balance horizontally?

Moments about the pivot:
$30\text{ g} \times 3 = 25\text{ g} \times d$
$d = \frac{30 \times 3}{25}$

Answer: 3.6 m from the pivot

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6 Discrete random variable: E(X) and Var(X) (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The discrete random variable X has this distribution.
x: 0, 1, 3, 5
P(X = x): 0.2, 0.2, 0.5, 0.1
Find E(X) and Var(X).

$E(X) = \Sigma xp = 0\times0.2 + 1\times0.2 + 3\times0.5 + 5\times0.1 = 2.2$

$E(X^2) = \Sigma x^2 p = 7.2$

$\text{Var}(X) = 7.2 - 2.2^2$

Answer: E(X) = 2.2, Var(X) = 2.36

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

Solve $x^{\frac{5}{2}} = 1024$.

Raise both sides to the power $\frac{2}{5}$:

$x = 1024^{\frac{2}{5}} = (1024^{\frac{1}{5}})^2$

$= 4^2 = 16$

Answer: x = 16

8 Velocity-time graph: acceleration from two stages (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The graph shows the velocity of a car.
(a) Find the acceleration in the first 8 s.
(b) Find the deceleration in the last 4 s.
(c) Find the total distance travelled.

(a) $a = \frac{10 - 4}{8}$

(b) $a = \frac{10 - 0}{4}$, a deceleration of 2.5

(c) area $= \frac{1}{2}(4 + 10) \times 8 + 10 \times 8 + \frac{1}{2} \times 4 \times 10$

Answer: (a) 0.75 m s^{-2} (b) 2.5 m s^{-2} (c) 156 m

9 Centre and radius of a circle (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A circle has equation $(x - 4)^2 + (y + 3)^2 = 25$.
Write down the centre and the radius of the circle.

Compare with $(x - a)^2 + (y - b)^2 = r^2$.

Centre $(4, -3)$; $r^2 = 25$ so $r = 5$

Answer: Centre (4, −3), radius 5

10 Iteration $x_{n+1} = g(x_n)$ (All boards)

$x_{n+1} = (3x_n + 10)^{\frac{1}{3}}$, with $x_0 = 2$.
Find x_1, x_2 and x_3 to 3 decimal places.

$x_1 = 2.5198$

$x_2 = 2.5992$

$x_3 = 2.6109$

Answer: $x_1 = 2.520$, $x_2 = 2.599$, $x_3 = 2.611$