Day 94 **A Level Maths: C Tier 10-a-day: Model Solutions**

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

A particle of mass 8 kg has acceleration 2.5 m s^{-2}. Find the magnitude of the resultant force acting on it.

F = ma
F = 8 × 2.5
Answer: 20 N

2 Position of a point relative to a circle (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A circle has equation $(x - 1)^2 + y^2 = 16$.
Determine whether the point P(7, 1) is inside, outside or on the circle.

Distance^2 from the centre (1, 0) to P:
$(7 - 1)^2 + (1 - 0)^2 = 36 + 1 = 37$
$r^2 = 16$, and $37 > 16$.
Answer: P is outside the circle

3 Inverse trig functions (Edexcel, OCR)

Find the exact value, in radians, of

(a) $\arcsin(-1)$ (b) $\arcsin(-\frac{1}{2})$

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

(b) $y = \arcsin(-\frac{1}{2})$ means $\sin y = -\frac{1}{2}$ with $-\frac{\pi}{2} \le y \le \frac{\pi}{2}$: $y = -\frac{\pi}{6}$

Answer: (a) $-\frac{\pi}{2}$ (b) $-\frac{\pi}{6}$

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

Solve $x^2 - 4x \ge 0$.

Solve $x^2 - 4x = 0$: $(x + 0)(x - 4) = 0$
Critical values $x = 0$ and $x = 4$.
The graph is a ∪-shaped parabola, so take the regions outside the roots.
Answer: $x \le 0$ or $x \ge 4$

5 Rearrange and iterate (All boards)

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

(a) $x^3 = x + 9$, so $x = \sqrt[3]{(x + 9)}$
(b) $x_1 = 2.2240$, $x_2 = 2.2390$
Answer: (a) shown (b) $x_1 = 2.224$, $x_2 = 2.239$

6 Two particles over a smooth pulley (All boards)

Two particles of masses 4 kg and 6 kg hang from the ends of a light inextensible string over a smooth pulley and are released from rest. Take g = 9.8 m s^{-2}. Find the acceleration and the tension in the string.

6 kg: $6 \times 9.8 - T = 6a$
4 kg: $T - 4 \times 9.8 = 4a$
Adding: $19.6 = 10a$, then $T = 4(9.8 + a)$
Answer: $a = 1.96$ m s^{-2}, $T = 47.04$ N

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7 Histograms (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The histogram shows the times, t minutes, taken by some people to complete a puzzle.
Find the number of people who took between 10 and 30 minutes.

Frequency = frequency density × class width
$10 \leq t < 25$: $3 \times 15 = 45$
$25 \leq t < 30$: $6 \times 5 = 30$
Total = 45 + 30
Answer: 75

8 Finding an unknown using the factor theorem (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

When $x^3 + kx^2 - 6x + 15$ is divided by $(x - 2)$, the remainder is -9. Find the value of k.

$f(2) = -9$
$8 + 4k + 3 = -9$
$4k = -20$
Answer: $k = -5$

9 Quadratic in sin or cos (All boards)

Solve $2\sin^2 x + \sin x - 1 = 0$ for $0° \leq x \leq 360°$.

Factorise: $(2 \sin x - 1)(\sin x + 1) = 0$ (as a quadratic in sin x)

$\sin x = \frac{1}{2}$ or $\sin x = -1$

$x = 30°, 150°, 270°$
Answer: $x = 30°, 150°, 270°$

10 Coding (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The values x are coded using $y = (x - 40) \div 4$.

The coded values have mean $\bar{y} = 3.1$ and standard deviation 1.
Find the mean and standard deviation of x.

$x = 40 + 4y$
Mean: $40 + 4 \times 3.1 = 52.4$
Standard deviation: $4 \times 1 = 4$ (adding 40 has no effect)
Answer: mean = 52.4, standard deviation = 4