Day 2 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Standard deviation from raw data (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Here are 5 values: 6, 5, 18, 12, 4
Find the mean and the standard deviation, to 3 s.f.

$\Sigma x = 45$, $\Sigma x^2 = 545$, $n = 5$
Mean $= 45 \div 5 = 9.000$
Variance $= \frac{545}{5} - (9.000)^2 = 28.00$
Standard deviation $= \sqrt{28.00}$
Answer: mean = 9.00, standard deviation = 5.29

2 Inverse trig functions (Edexcel, OCR)

Find the exact value, in radians, of

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

(a) $y = \arccos(-1)$ means $\cos y = -1$ with $0 \leq y \leq \pi$: $y = \pi$
(b) $y = \arcsin(-\frac{1}{2})$ means $\sin y = -\frac{1}{2}$ with $-\frac{\pi}{2} \leq y \leq \frac{\pi}{2}$: $y = -\frac{\pi}{6}$
Answer: (a) π (b) $-\frac{\pi}{6}$

3 Intercepts of a cubic graph (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Sketch $y = (x + 5)(x - 1)(x - 3)$. Write down the coordinates of the points where the curve meets the axes.

$y = 0$: $x = -5, 1, 3$
$x = 0$: $y = 5 \times (-1) \times (-3) = 15$
Answer: (−5, 0), (1, 0), (3, 0), (0, 15)

4 Double angle equation (All boards)

Solve $\sin 3x = -\frac{1}{2}$ for $0° \leq x \leq 120°$.

Let $u = 3x$, so $0° \leq u \leq 360°$
$\sin u = -\frac{1}{2}$: $u = 210°, 330°, 570°, 690°, 930°, 1050°$
Divide by 3: $x = 70°, 110°$
Answer: x = 70°, 110°

5 Binomial: finding parameters (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

X ~ B(n, p) has mean 4 and variance 3.2.
Find n and p.

$np = 4$ and $npq = 3.2$
$q = 3.2 \div 4 = 0.8$, so $p = 0.2$
$n = 4 \div 0.2$
Answer: n = 20, p = 0.2

6 Car towing a caravan (All boards)

A car of mass 1200 kg tows a caravan of mass 800 kg on a level road with acceleration 1 m s^{-2}. Resistances: 300 N on the car, 150 N on the caravan. Find the driving force and the tow bar tension.

Whole system: $D - 300 - 150 = 2000 \times 1$
Caravan: $T - 150 = 800 \times 1$
Answer: D = 2450 N, T = 950 N

7 Describing transformations of graphs (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Describe the single transformation that maps the graph of $y = f(x)$ onto the graph of $y = f(x - 4)$.

$y = f(x - 4)$ is obtained from $y = f(x)$ by a:

translation by the vector $\begin{pmatrix} 4 \\ 0 \end{pmatrix}$

Answer: translation by the vector $\begin{pmatrix} \mathbf{4} \\ \mathbf{0} \end{pmatrix}$

8 Velocity-time graph: acceleration and distance (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The graph shows the velocity of a lift over 22 seconds as it moves in a straight line.
(a) Find its acceleration in the first 8 s.
(b) Find the total distance travelled.

(a) acceleration = gradient = $\frac{15}{8}$

(b) distance = area of trapezium

$= \frac{1}{2}(10 + 22) \times 15$

Answer: (a) 1.875 m s^{-2} (b) 240 m

9 The factor theorem and factorising (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$f(x) = x^3 - 2x^2 - 16x + 32$
(a) Show that $(x - 4)$ is a factor of $f(x)$.
(b) Factorise $f(x)$ completely.

$f(4) = 64 + (-32) + (-64) + 32 = 0$, so $(x - 4)$ is a factor.

$f(x) = (x - 4)(x^2 + 2x - 8)$

$x^2 + 2x - 8 = (x + 4)(x - 2)$

Answer: (b) $f(x) = (x + 4)(x - 2)(x - 4)$

10 Parallel vectors (All boards)

$\mathbf{a} = 4\mathbf{i} + 3\mathbf{j}$ and $\mathbf{b} = -8\mathbf{i} + k\mathbf{j}$, where k is a constant.
Given that a and b are parallel, find the value of k.

Parallel: $\mathbf{b} = \lambda\mathbf{a}$, so $-8 = \lambda \times 4$, giving $\lambda = -2$

$k = \lambda \times 3 = -6$

Answer: $k = -6$