Day 339 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Scatter diagrams and correlation (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The scatter diagram shows shoe size and reading age for a group.
Describe the correlation.

The points show no pattern: as shoe size increases, reading age shows no consistent trend.
Answer: no correlation

2 Lift: tension in the cable (All boards)

A lift of mass 600 kg is lowered by a vertical cable with constant acceleration 0.25 m s^{-2} downwards. Take g = 9.8 m s^{-2}.
Find the tension in the cable.

Resolving downwards: $600 \times 9.8 - T = 600 \times 0.25$
$T = 5880 - 150$
Answer: 5730 N

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

$x_{n+1} = \sqrt{5x_n + 3}$, with $x_0 = 3$.
Find x_1, x_2 and x_3 to 3 decimal places.

$x_1 = 4.2426$
$x_2 = 4.9207$
$x_3 = 5.2539$
Answer: $x_1 = 4.243$, $x_2 = 4.921$, $x_3 = 5.254$

4 Normal distribution: symmetry (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$X \sim N(130, 8^2)$ and $P(X < 114) = 0.15$.
Find $P(X > 146)$.

114 and 146 are the same distance from the mean 130
By symmetry the upper tail equals the lower tail
Answer: 0.15

5 Rationalising the denominator (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Rationalise the denominator of $\frac{5}{\sqrt{7}}$.

Give your answer in its simplest form.

$$\frac{5}{\sqrt{7}} = \frac{5 \times \sqrt{7}}{\sqrt{7} \times \sqrt{7}} = \frac{5\sqrt{7}}{7}$$

Answer: $\frac{5}{7}\sqrt{7}$

6 Product rule (All boards)

Use the product rule to differentiate
$y = x^3 \sin 4x$.

$u = x^3$, $v = \sin 4x$
$u' = 3x^2$, $v' = 4 \cos 4x$
$dy/dx = u'v + uv'$, which simplifies to the answer below
Answer: $dy/dx = x^2(3 \sin 4x + 4x \cos 4x)$

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

$f(x) = 2x^3 - 4x^2 - 2x + 4$
(a) Show that (x + 1) is a factor of f(x).
(b) Factorise f(x) completely.

$f(-1) = (-2) + (-4) + 2 + 4 = 0$, so (x + 1) is a factor.
$f(x) = (x + 1)(2x^2 - 6x + 4)$
$2x^2 - 6x + 4 = 2(x - 1)(x - 2)$
Answer: (b) $f(x) = 2(x + 1)(x - 1)(x - 2)$

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8 Constant acceleration: v = u + at (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A cyclist moving in a straight line has initial speed 4 m s^{-1} and constant acceleration 0.5 m s^{-2}.
Find her speed after 6 s.

$v = u + at$
$v = 4 + 0.5 \times 6$
Answer: 7 m s^{-1}

9 Small angle approximations (AQA, Edexcel, OCR, MEI, Eduqas)

θ is small and measured in radians.
Use the small angle approximations to find an approximation for $\cos\theta + \theta \sin 3\theta$.

$\cos\theta \approx 1 - \frac{\theta^2}{2}$, $\theta \sin 3\theta \approx 3\theta^2$

So $\cos\theta + \theta \sin 3\theta \approx 1 + \frac{5\theta^2}{2}$

Answer: $1 + \frac{5\theta^2}{2}$

10 Tangent condition for a line and a curve (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The line $y = -4x + k$ is a tangent to the curve
$y = x^2 - 6x + 2$.
Find the value of k.

$x^2 - 6x + 2 = -4x + k$
$x^2 - 2x + (2 - k) = 0$
A tangent touches once: discriminant = 0
$(-2)^2 - 4(2 - k) = 0$
Answer: $k = 1$