Day 304 **A Level Maths: C Tier 10-a-day: Model Solutions**

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

When $x^3 + kx^2 + 3x$ is divided by $(x - 1)$, the remainder is 2. Find the value of k.

f(1) = 2
1 + k + 3 = 2
k = −2
Answer: k = −2

2 Solve basic trig equation (exact, degrees) (All boards)

Solve $\sin x = \frac{\sqrt{2}}{2}$ for $0° \leq x \leq 180°$.

Reference angle: $\sin 45° = \frac{\sqrt{2}}{2}$
sin is positive in the first and second quadrants.
Using the sin graph/CAST and the interval $0° \leq x \leq 180°$:
x = 45°, 135°
Answer: x = 45°, 135°

3 Large data set: handling readings (AQA, Edexcel, OCR, MEI, Eduqas)

Seven daily rainfall readings (mm) from the Large Data Set are: 0, tr, 3.6, 0.2, 0.4, 1.8, tr.
Here 'tr' means a trace, which is treated as 0.
Find the mean daily rainfall to 3 s.f.

Replace each 'tr' by 0
Total = 6
Mean = 6 ÷ 7
Answer: 0.857 mm

4 Parallel vectors (All boards)

$\mathbf{a} = \begin{pmatrix} 3 \\ 6 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} -6 \\ -12 \end{pmatrix}$.

Show that a and b are parallel and find the ratio |b| : |a|.

b = −2 × a, since −2 × 3 = −6 and −2 × 6 = −12
So a and b are parallel and |b| : |a| = 2 : 1
Answer: b = −2 a, so parallel; ratio 2 : 1

5 Constant acceleration: distance from average speed (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A train moving in a straight line with constant acceleration increases its speed from 8 m s^{-1} to 18 m s^{-1} in 7 s.
Find the distance it travels in this time.

$s = \frac{(u + v)}{2} t$

$s = \frac{(8 + 18)}{2} \times 7$

Answer: 91 m

6 Geometric distribution (CIE)

A fair die is rolled until a six appears. X is the number of rolls.
Find P(X = 5), to 3 s.f.

$P(X = 5) = (1 - p)^4 \times p = (\frac{5}{6})^4 \times \frac{1}{6}$

Answer: 0.0804

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7 Geometric series: sum of n terms (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the sum of the first 6 terms of the geometric series 5 + 20 + 80 + ...

$a = 5$, $r = 4$, $n = 6$

$S_n = \frac{a(r^n - 1)}{r - 1} = \frac{5(4^6 - 1)}{4 - 1}$

$= 6825$

Answer: 6825

8 Double angle equation (All boards)

Solve $\sin 2x = -\frac{1}{2}$ for $0° \leq x \leq 180°$.

Let $u = 2x$, so $0° \leq u \leq 360°$

$\sin u = -\frac{1}{2}$: $u = 210°, 330°, 570°, 690°$

Divide by 2: $x = 105°, 165°$

Answer: $x = 105°, 165°$

9 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
$y = x^2 - 2x + 6$.
Find the value of k.

$x^2 - 2x + 6 = 4x + k$

$x^2 - 6x + (6 - k) = 0$

A tangent touches once: discriminant = 0

$(-6)^2 - 4(6 - k) = 0$

Answer: $k = -3$

10 Constant acceleration: $s = ut + \frac{1}{2}at^2$ (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A car moves in a straight line with constant acceleration 2 m s^{-2}. Its initial speed is 4 m s^{-1}. Find the distance travelled in 6 s.

$s = ut + \frac{1}{2}at^2$

$s = 4 \times 6 + \frac{1}{2} \times 2 \times 6^2$

Answer: 60 m