Day 125 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Simplifying surds (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Write $\sqrt{640}$ in the form $p\sqrt{q}$, where q is an integer as small as possible.

$\sqrt{640} = \sqrt{64 \times 10} = \sqrt{64} \times \sqrt{10}$

$= 8\sqrt{10}$

Answer: $8\sqrt{10}$

2 Binomial: modelling conditions (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

X is the number of tosses of a fair coin needed to get the first head.

Can X be modelled by a binomial distribution? Give a reason.

A binomial model needs: a fixed number of trials, two outcomes, constant probability, independent trials. Here the number of trials is not fixed.

Answer: No, the number of trials is not fixed

3 Reciprocal trig functions: exact values (All boards)

Write down the exact values of

(a) sec 120° (b) cosec 120°

(a) $\sec 120° = \dfrac{1}{\cos 120°} = \dfrac{1}{-\frac{1}{2}} = -2$

(b) $\operatorname{cosec} 120° = \dfrac{1}{\sin 120°} = \dfrac{1}{\frac{\sqrt{3}}{2}} = \dfrac{2\sqrt{3}}{3}$

Answer: (a) -2 (b) $\frac{2\sqrt{3}}{3}$

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

The graph shows the velocity of a train over 30 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 = $\frac{20}{8}$

(b) distance = area of trapezium

$= \frac{1}{2}(12 + 30) \times 20$

Answer: (a) 2.5 m s^{-2} (b) 420 m

5 Vector equation of a line (3D) (CIE)

A line has equation $\mathbf{r} = \begin{pmatrix} 3 \\ -1 \\ 3 \end{pmatrix} + t\begin{pmatrix} -1 \\ 3 \\ -1 \end{pmatrix}$.

Find the coordinates of the point on the line where $t = -1$.

$\mathbf{r} = \begin{pmatrix} 3 \\ -1 \\ 3 \end{pmatrix} + (-1)\begin{pmatrix} -1 \\ 3 \\ -1 \end{pmatrix}$

$= \begin{pmatrix} 4 \\ -4 \\ 4 \end{pmatrix}$

Answer: (4, -4, 4)

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6 Integrating velocity to find displacement (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A particle moves in a straight line with velocity $v = (6t^2 + 6t + 6)$ m s^{-1} at time t seconds.
Find the distance travelled between t = 3 and t = 6 (the particle does not turn round).

$s = \int v\,dt = 2t^3 + 3t^2 + 6t$
Distance = $s(6) - s(3)$
$= 576 - 99$
Answer: 477 m

7 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
$y = x^2 + 8x - 1$.
Find the value of k.

$x^2 + 8x - 1 = 4x + k$
$x^2 + 4x + (-1 - k) = 0$
A tangent touches once: discriminant = 0
$(4)^2 - 4(-1 - k) = 0$
Answer: $k = -5$

8 Critical region (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$X \sim B(30, p)$. H_0: $p = 0.6$, H_1: $p < 0.6$.
Find the critical region for a test at the 1% significance level.

$P(X \leq 11) = 0.00830 \leq 0.01$
$P(X \leq 12) = 0.0212 > 0.01$
Answer: $X \leq 11$

9 Identity then solve (sin² to cos) (All boards)

Solve $-4\cos^2 x + 2\sin x + 4 = 0$
for $0° \leq x \leq 360°$.

Use $\cos^2 x = 1 - \sin^2 x$: $4\sin^2 x + 2\sin x = 0$
Factorise and solve: $\sin x = -\frac{1}{2}$ or $\sin x = 0$
$x = 0°, 180°, 210°, 330°, 360°$
Answer: $x = 0°, 180°, 210°, 330°, 360°$

10 Arithmetic series: sum of terms (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the sum of the first 12 terms of the series
$-8 - 2 + 4 + 10 + \ldots$

$a = -8$, $d = 6$, $n = 12$
$S_n = \frac{n}{2}[2a + (n - 1)d] = \frac{12}{2}[2(-8) + 11 \times 6]$
$= 300$
Answer: 300