Day 364 **A Level Maths: C Tier 10-a-day: Model Solutions**

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

Simplify $\sqrt{27} + \sqrt{108}$, giving your answer in the form $p\sqrt{3}$.

$\sqrt{27} = 3\sqrt{3}$ and $\sqrt{108} = 6\sqrt{3}$

Sum = $(3 + 6)\sqrt{3}$

Answer: $9\sqrt{3}$

2 Median and interquartile range (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Here are 7 values: 63, 65, 66, 42, 73, 18, 47

Find the median and the interquartile range.

Ordered: 18, 42, 47, 63, 65, 66, 73

Median = 63, lower quartile = 42, upper quartile = 66

IQR = 66 − 42

Answer: median = 63, IQR = 24

3 Arc length and perimeter of a sector (All boards)

A sector has radius 6 cm and angle $\frac{\pi}{2}$ radians.

Find the arc length, leaving π in your answer, and the perimeter.

Arc length = $r\theta = 6 \times \frac{\pi}{2} = 3\pi$ cm

Perimeter = arc + 2r = $3\pi + 12$ cm

Answer: Arc 3π cm; perimeter $(3\pi + 12)$ cm

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

Find the sum of the first 30 terms of the series

$-8 - 2 + 4 + 10 + \ldots$

$a = -8$, $d = 6$, $n = 30$

$S_n = \frac{n}{2}[2a + (n - 1)d] = \frac{30}{2}[2(-8) + 29 \times 6]$

$= 2370$

Answer: 2370

5 Solve a logarithmic equation (one log) (All boards)

Solve $\log_2 (5x + 4) = 3$.

$5x + 4 = 2^3 = 8$

$5x = 4$

$x = \frac{4}{5}$

Answer: $x = \frac{4}{5}$

6 Catching up: constant speed against acceleration (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Car A passes a point O at constant speed 10.5 m s^{-1}.

At that instant car B starts from rest at O with constant acceleration 1.5 m s^{-2} in the same direction. Find the time when B catches up A.

Distances equal: $10.5\,t = \frac{1}{2} \times 1.5 \times t^2$

$t(10.5 - 0.75\,t) = 0$, so $t = 0$ or $t = 10.5 \div 0.75$

Answer: 14 s

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7 Hypothesis test for a normal mean (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A population is $N(\mu, 8^2)$. H_0: $\mu = 120$, H_1: $\mu > 120$.

A sample of 25 has mean $\bar{x} = 124.48$.
Test at the 5% level. Critical value: $z = 1.645$.

$z = (\bar{x} - \mu) \div (\sigma \div \sqrt{n}) = (124.48 - 120) \div (8 \div 5)$
$z = 2.80$
2.80 is inside the critical region, so reject H_0
Answer: $z = 2.80$; reject H_0

8 Solve with a shifted angle (All boards)

Solve $\cos(x - 60°) = -\frac{\sqrt{3}}{2}$ for $0° \leq x \leq 360°$.

Let $u = x - 60°$, so $-60° \leq u \leq 300°$

$\cos u = -\frac{\sqrt{3}}{2}$: $u = 150°, 210°$

$x = u + 60°$: $x = 210°, 270°$
Answer: $x = 210°, 270°$

9 Line through two axis intercepts (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows a line meeting the axes at A and B.
Find (a) the equation of AB in the form $px + qy = r$ with integers p, q and r, (b) the length AB.

Gradient $= \frac{4 - 0}{0 - 1} = -4$
Using $y = mx + c$ with $c = 4$: $y = -4x + 4$, so $4x + y = 4$
$AB^2 = 1^2 + 4^2 = 17$
Answer: (a) $4x + y = 4$ (b) $\sqrt{17}$

10 Free fall: dropped from a height (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A ball is dropped from rest from the top of a tower of height 122.5 m. Take $g = 9.8$ m s^{-2} and ignore air resistance. Find (a) the time taken to reach the ground, (b) its speed on hitting the ground.

(a) $s = ut + \frac{1}{2}at^2$: $122.5 = \frac{1}{2} \times 9.8 \times t^2$

$122.5 = 4.9t^2$, so $t^2 = 25$
(b) $v = u + at = 9.8 \times 5$
Answer: (a) 5 s (b) 49 m s^{-1}