Day 162 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Degrees and radians (All boards)

(a) Convert $\frac{4\pi}{3}$ radians to degrees.

(b) Convert 150° to radians, giving your answer in terms of π.

(a) $\frac{4\pi}{3} \times \frac{180}{\pi} = 240°$

(b) $150 \times \frac{\pi}{180} = \frac{5\pi}{6}$

Answer: (a) 240° (b) $\frac{5\pi}{6}$ radians

2 Disproof by counter-example (AQA, Edexcel, OCR, MEI, Eduqas)

Show, by a counter-example, that the statement "If n^2 is a multiple of 9 then n is a multiple of 9" is false, where n is a positive integer.

Look for n with n^2 divisible by 9 but n not divisible by 9.

Try n = 3: $n^2 = 9 = 9 \times 1$, a multiple of 9.

But 3 is not a multiple of 9, so the statement is false.

Answer: n = 3

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

Here are 15 values: 37, 27, 68, 31, 16, 14, 47, 58, 71, 19, 70, 33, 6, 54, 69

Find the median and the interquartile range.

Ordered: 6, 14, 16, 19, 27, 31, 33, 37, 47, 54, 58, 68, 69, 70, 71

Median = 37, lower quartile = 19, upper quartile = 68

IQR = 68 − 19

Answer: median = 37, IQR = 49

4 Simplifying algebraic indices (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Simplify $\sqrt{25x^4} \times 5x^{-1}$.

$\sqrt{25x^4} = (25x^4)^{\frac{1}{2}} = 5\,x^2$

$5\,x^2 \times 5x^{-1} = 25x$

Answer: 25x

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

X ~ B(n, p) has mean 2.4 and variance 1.92.

Find n and p.

np = 2.4 and npq = 1.92

q = 1.92 ÷ 2.4 = 0.8, so p = 0.2

n = 2.4 ÷ 0.2

Answer: n = 12, p = 0.2

6 Partial fractions: find the constants (All boards)

Express $\frac{3x + 3}{(x + 2)(x + 5)}$ in the form $\frac{A}{x + 2} + \frac{B}{x + 5}$.

Find the values of A and B.

$3x + 3 \equiv A(x + 5) + B(x + 2)$

$x = -2$: $-3 = A(3)$, so $A = -1$

$x = -5$: $-12 = B(-3)$, so $B = 4$

Answer: A = −1, B = 4

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7 Discriminant: equal roots (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The equation $x^2 + 4x + c = 0$ has equal roots.
Find the value of c.

Equal roots: $b^2 - 4ac = 0$
$4^2 - 4 \times 1 \times c = 0$
$16 = 4c$
Answer: c = 4

8 Starting from rest: find the time (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A train starts from rest and moves in a straight line with constant acceleration 4 m s^{-2}.
It travels 162 m. Find the time taken.

$s = ut + \frac{1}{2}at^2$ with $u = 0$

$162 = \frac{1}{2} \times 4 \times t^2$

$t^2 = 81$
Answer: 9 s

9 Find the angle of a sector (All boards)

A sector has radius 10 cm and area 80.0 cm^2.
Find the angle of the sector in radians and the arc length.

$\frac{1}{2} \times 10^2 \times \theta = 80.0$, so $\theta = 1.6$
Arc length $= r\theta = 10 \times 1.6 = 16.0$ cm
Answer: θ = 1.6 radians; arc length 16.0 cm

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

A particle moves in a straight line with velocity $v = (3t^2 + 6t + 7)$ m s^{-1} at time t seconds.
Find the distance travelled between t = 1 and t = 4 (the particle does not turn round).

$s = \int v\,dt = t^3 + 3t^2 + 7t$
Distance $= s(4) - s(1)$
$= 140 - 11$
Answer: 129 m