Day 316 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Degrees and radians (All boards)

(a) Convert $\frac{3\pi}{2}$ radians to degrees.

(b) Convert 15° to radians, giving your answer in terms of π.

(a) $\frac{3\pi}{2} \times \frac{180}{\pi} = 270°$

(b) $15 \times \frac{\pi}{180} = \frac{\pi}{12}$

Answer: (a) 270° (b) $\frac{\pi}{12}$ radians

2 Straight line through two points (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find an equation of the line through A(−5, 5) and B(−1, −3), in the form ax + by + c = 0, where a, b and c are integers.

Gradient = $\frac{-3-5}{-1-(-5)} = -2$

$y - 5 = -2(x - (-5))$

Multiply out and rearrange to integer coefficients.

Answer: 2x + y + 5 = 0

3 Resultant of perpendicular forces (All boards)

Two forces of magnitudes 5 N and 12 N act on a small ring at right angles to each other. Find (a) the magnitude of the resultant, (b) the angle it makes with the 5 N force, to 1 d.p.

(a) $R^2 = 5^2 + 12^2 = 169$

$R = \sqrt{169}$

(b) $\tan\theta = \frac{12}{5}$

Answer: (a) 13 N (b) 67.4°

4 Standard deviation from raw data (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Here are 7 values: 10, 3, 7, 18, 20, 5, 15

Find the mean and the standard deviation, to 3 s.f.

$\Sigma x = 78$, $\Sigma x^2 = 1132$, $n = 7$

Mean = 78 ÷ 7 = 11.14

Variance = $\frac{1132}{7} - (11.14)^2 = 37.55$

Standard deviation = $\sqrt{37.55}$

Answer: mean = 11.1, standard deviation = 6.13

5 Moments: rod on a pivot with a particle (AQA, Edexcel, OCR, MEI)

A uniform rod AB of mass 8 kg and length 6 m is supported by a pivot 0.75 m from A. A particle of mass m kg is attached at A and the rod rests horizontally in equilibrium. Find m.

Moments about the pivot:

$m\,g \times 0.75 = 8\,g \times (3 - 0.75)$

$m = \frac{8 \times 2.25}{0.75}$

Answer: 24 kg

6 Implicit differentiation (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A curve has equation $x^2 + y^2 = 169$.

Find dy/dx in terms of x and y, and hence the gradient at (−5, 12).

Differentiate both sides with respect to x (using dy/dx for y terms)

$\frac{dy}{dx} = -\frac{x}{y}$

At (−5, 12): $\frac{dy}{dx} = \frac{5}{12}$

Answer: $\frac{dy}{dx} = -\frac{x}{y}$; gradient $\frac{5}{12}$

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7 Gradient of a tangent to a circle (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The circle $(x - 2)^2 + (y + 3)^2 = 5$ passes through P(1, −1).
Find the gradient of the tangent to the circle at P.

Centre C(2, −3).

Gradient of CP = $\frac{-1 - (-3)}{1 - 2} = -2$

The tangent is perpendicular to CP: gradient = $-1 \div (-2)$

Answer: $\frac{1}{2}$

8 Parametric differentiation (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A curve has parametric equations
$x = 2t$, $y = 6t^2 + 1$.
Find the gradient at the point where $t = 1$.

$dx/dt = 2$, $dy/dt = 12t$

$dy/dx = \frac{12t}{2}$

At $t = 1$: $dy/dx = 6$

Answer: 6

9 Midpoint and length of a line segment (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

M(−9, 0) is the midpoint of the line segment AB.
A is the point (−5, 0). Find the coordinates of B.

x-coordinate: $\frac{-5 + x_B}{2} = -9$, so $x_B = -13$

y-coordinate: $\frac{0 + y_B}{2} = 0$, so $y_B = 0$

Answer: B(−13, 0)

10 Normal approximation to the binomial (CIE)

$X \sim B(100, 0.3)$. Use a normal approximation to find $P(X \leq 28)$, to 3 s.f.

$np = 30$ and $npq = 21$, so use $Y \sim N(30, 21)$
Continuity correction: $P(Y < 28.5)$

$z = (28.5 - 30) \div \sqrt{21}$

Answer: 0.372