Day 195 **A Level Maths: C Tier 10-a-day: Model Solutions**

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

An arithmetic series has first term -3, last term 73 and 20 terms. Find the sum of the series.

$S_n = \frac{n}{2}(a + l) = \frac{20}{2}(-3 + 73)$

$= 700$

Answer: 700

2 Speed and direction from a velocity vector (AQA, Edexcel, OCR, MEI, Eduqas)

The velocity of a ball is $(9\mathbf{i} + 12\mathbf{j})$ m s^{-1}, where $\mathbf{i}$ and $\mathbf{j}$ are perpendicular unit vectors.
(a) Find the speed.
(b) Find the acute angle between the direction of motion and the line of $\mathbf{i}$. Give 1 d.p.

(a) speed $= \sqrt{9^2 + 12^2} = \sqrt{225}$

(b) $\tan\theta = \frac{12}{9}$

$\theta = \tan^{-1}(\frac{12}{9})$

Answer: (a) 15 m s^{-1} (b) 53.1°

3 Estimate with a small angle (AQA, Edexcel, OCR, MEI, Eduqas)

Use $\sin\theta \approx \theta$ to estimate sin 4°, giving your answer to 3 significant figures.

Convert to radians: $4° = \frac{4\pi}{180} = 0.06981$ rad

$\sin 4° \approx 0.0698$

Answer: 0.0698

4 Composite functions (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

f(x) = 3x − 1 and g(x) = 3x + 2.
Find the value of gf(−2).

f(−2) = −7

g(−7) = −19

Answer: −19

5 Normal distribution: diagram and symmetry (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows the density of $X \sim N(95, 5^2)$.
a and b are equal distances from the mean. The shaded area, P(X > b), is 0.34.
Find P(a < X < b).

By symmetry P(X < a) = 0.34

P(a < X < b) = 1 − 2 × 0.34

Answer: 0.32

6 Collinear points using vectors (All boards)

A(−2, −2), B(7, 1) and C(22, k).
Given that A, B and C are collinear, find k.

$\text{AB} = \begin{pmatrix}9\\3\end{pmatrix}$, $\text{AC} = \begin{pmatrix}24\\k+2\end{pmatrix}$

AC $= \frac{8}{3}$ AB, so $24 = \frac{8}{3} \times 9$, giving the multiple $\frac{8}{3}$

$k + 2 = \frac{8}{3} \times 3$, so $k = 6$

Answer: k = 6

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7 Two-tailed binomial test (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$X \sim B(25, p)$. H_0: $p = 0.2$, H_1: $p \neq 0.2$. In a sample, $x = 1$.

Test at the 10% significance level.

Two-tailed test, so compare with $0.1 \div 2 = 0.05$

$P(X \leq 1) = 0.0274$

$0.0274 < 0.05$, so reject H_0

Answer: Reject H_0 ($P(X \leq 1) = 0.0274$)

8 Chain rule: gradient at a point (All boards)

Find the gradient of the curve $y = (5x - 3)^3$

at the point where $x = 0$.

Use the chain rule: $dy/dx = 5 \times 3(5x - 3)^2$

At $x = 0$: $dy/dx = 135$

Answer: 135

9 Projectile launched with velocity components (AQA, Edexcel, OCR, MEI)

A golf ball is projected from level ground with velocity $(15\mathbf{i} + 39.2\mathbf{j})$ m s^{-1} ($\mathbf{i}$ horizontal, $\mathbf{j}$ vertically up). Take $g = 9.8$ m s^{-2}.

(a) Find the time of flight.

(b) Find the horizontal range.

(a) Vertically: $0 = 39.2\,t - 4.9t^2$

$t = \frac{39.2}{4.9} = 8$

(b) Range $= 15 \times 8$

Answer: (a) 8 s (b) 120 m

10 Rationalising the denominator (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Rationalise the denominator of $\frac{6}{\sqrt{6}}$.

Give your answer in its simplest form.

$$\frac{6}{\sqrt{6}} = \frac{6 \times \sqrt{6}}{\sqrt{6} \times \sqrt{6}} = \frac{6\sqrt{6}}{6}$$

Answer: $\sqrt{6}$