Day 227 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Mean from a frequency table (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The table summarises the number of goals scored in a game by 25 people.
Goals, x: 1, 2, 3, 4, 5
Frequency, f: 5, 3, 11, 3, 3
Find the mean.

$\Sigma fx = 5\times1 + 3\times2 + 11\times3 + 3\times4 + 3\times5 = 71$
Mean = $\Sigma fx \div \Sigma f = 71 \div 25$
Answer: 2.84

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

Simplify $\sqrt{112} + \sqrt{7}$, giving your answer in the form $p\sqrt{7}$.

$\sqrt{112} = 4\sqrt{7}$ and $\sqrt{7} = 1\sqrt{7}$
Sum = $(4 + 1)\sqrt{7}$
Answer: $5\sqrt{7}$

3 Double angle equation (All boards)

Solve $\tan 3x = \frac{\sqrt{3}}{3}$ for $0° \le x \le 120°$.

Let $u = 3x$, so $0° \le u \le 360°$
$\tan u = \frac{\sqrt{3}}{3}$: $u = 30°, 210°, 390°, 570°, 750°, 930°$
Divide by 3: $x = 10°, 70°$
Answer: $x = 10°, 70°$

4 Resolving a force into components (All boards)

A rope pulls a box with a force of 12 N at an angle of 45° above the horizontal. Find the horizontal and vertical components of the force, to 3 s.f.

Horizontal = $12 \cos 45°$
Vertical = $12 \sin 45°$
Answer: horizontal 8.49 N, vertical 8.49 N

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

$X \sim N(65, 3^2)$ and $P(X < 60.5) = 0.04$.
Find $P(X > 69.5)$.

60.5 and 69.5 are the same distance from the mean 65
By symmetry the upper tail equals the lower tail
Answer: 0.04

6 Quotient rule (All boards)

Use the quotient rule to find the derivative of
$y = \frac{x^2}{x + 3}$.

Quotient rule: if $y = \frac{u}{v}$ then $dy/dx = \frac{u'v - uv'}{v^2}$
Differentiate the numerator and denominator, then substitute and simplify.
Answer: $dy/dx = \frac{x(x + 6)}{(x + 3)^2}$

7 Combining two inequalities (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the set of values of x satisfying both
$3x + 5 < 5$ and $x^2 + x - 2 < 0$.

$3x + 5 < 5$ gives $x < 0$.
$x^2 + x - 2 < 0$: $(x + 2)(x - 1) < 0$, so $-2 < x < 1$.
Both are true where the two ranges overlap.
Answer: $-2 < x < 0$

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

A ball is projected from level ground with velocity $(3\mathbf{i} + 29.4\mathbf{j})$ 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: $0 = 29.4\,t - 4.9t^2$

$t = \frac{29.4}{4.9} = 6$

(b) Range = 3×6

Answer: (a) 6 s (b) 18 m

9 Integrate using double angle formulae (All boards)

Use a double angle formula to find
$\int \sin 4x \cos 4x \, dx$.

$\sin 2\theta = 2 \sin\theta \cos\theta$, so $\sin 4x \cos 4x = \frac{1}{2} \sin 8x$

Integrate term by term

Answer: $-\frac{\cos 8x}{16} + c$

10 Solving equations with indices (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve $x^{\frac{2}{3}} = 4$.

Raise both sides to the power $\frac{3}{2}$:

$x = 4^{\frac{3}{2}} = (4^{\frac{1}{2}})^3$

$= 2^3 = 8$

Answer: x = 8