Day 119 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Types of data (AQA, Edexcel, OCR, MEI, Eduqas)

Classify each variable as qualitative, discrete or continuous.
(a) the volume of water in a bottle
(b) the number of texts sent in a day
(c) the make of a car

(a) continuous: it is measured, so can take any value in a range
(b) discrete: it is counted, so takes separate values
(c) qualitative: it is described by words, not numbers
Answer: (a) continuous; (b) discrete; (c) qualitative

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

Find an equation of the line through A(−3, 1) and B(−2, 6), in the form ax + by + c = 0, where a, b and c are integers.

Gradient = $\frac{6-1}{-2-(-3)} = 5$
$y - 1 = 5(x - (-3))$
Multiply out and rearrange to integer coefficients.
Answer: $5x - y + 16 = 0$

3 Reciprocal trig functions: exact values (All boards)

Write down the exact values of
(a) sec 150° (b) cot 225°

(a) $\sec 150° = \frac{1}{\cos 150°} = \frac{1}{-\frac{\sqrt{3}}{2}} = -\frac{2\sqrt{3}}{3}$

(b) $\cot 225° = \frac{1}{\tan 225°} = \frac{1}{1} = 1$

Answer: (a) $-\frac{2\sqrt{3}}{3}$ (b) 1

4 Lift: tension in the cable (All boards)

A lift of mass 250 kg is raised by a vertical cable with constant acceleration 1 m s^{-2} upwards. Take g = 9.8 m s^{-2}.
Find the tension in the cable.

Resolving upwards: $T - 250 \times 9.8 = 250 \times 1$
$T = 2450 + 250$
Answer: 2700 N

5 Comparing distributions (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The heights in cm for two groups: Group A has mean 67, standard deviation 18; Group B has mean 62, standard deviation 11.
Compare the two sets of data.

The mean measures the average: Group A has the higher mean.
The standard deviation measures spread: Group B has the smaller standard deviation, so it is more consistent.
Answer: Group A has the higher mean; Group B is more consistent

6 Driving force and resistance (All boards)

A car of mass 800 kg is driven along a straight horizontal road by a driving force of 1200 N against a constant resistance of 400 N.
Find the acceleration of the car.

Resultant force = 1200 − 400 = 800 N
F = ma: 800 = 800 a
Answer: 1 m s^{-2}

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7 Angle between vectors (scalar product) (CIE)

$\mathbf{a} = 3\mathbf{i} - 3\mathbf{j} - 3\mathbf{k}$ and $\mathbf{b} = \mathbf{i} - 3\mathbf{k}$.

Find the angle between a and b, to 1 decimal place.

$\mathbf{a}.\mathbf{b} = (3)(1) + (-3)(0) + (-3)(-3) = 12$

$|\mathbf{a}| = \sqrt{27}$, $|\mathbf{b}| = \sqrt{10}$

$\cos\theta = \frac{12}{\sqrt{27} \times \sqrt{10}}$, so $\theta = 43.1°$

Answer: 43.1°

8 Proof by contradiction (AQA, Edexcel, OCR, MEI, Eduqas)

Prove by contradiction that there are no integers x and y such that $2x + 4y = 111$.

Assume that integers x and y exist with $2x + 4y = 111$.

Then $2(x + 2y) = 111$, so 111 would be a multiple of 2.

But $111 = 2 \times 55 + 1$, so it is not a multiple of 2.

This is a contradiction, so no such integers exist.

Answer: Proved

9 Compound growth: find n (All boards)

£2000 invested at 2% compound interest per year.

After how many whole years will it first exceed £4000?

$2000 \times 1.02^n > 4000$, so $1.02^n > 2$

$n > \frac{\log 2}{\log 1.02} = 35.00$

The least whole number of years is 36

Answer: 36 years

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

The circle $(x + 3)^2 + y^2 = 25$ passes through $P(-7, -3)$.

Find the gradient of the tangent to the circle at P.

Centre $C(-3, 0)$.

Gradient of $CP = \frac{-3 - 0}{-7 - (-3)} = \frac{3}{4}$

The tangent is perpendicular to CP: gradient $= -1 \div \frac{3}{4}$

Answer: $-\frac{4}{3}$