Day 151 **B Tier 10-a-day: Model Solutions**

1 Percentage increase and decrease

A coat costs £60. In a sale the price is reduced by 10%.
(a) Work out the new price.
(b) A car is worth £6000. Its value goes down by 25% in a year. Work out its new value.

(a) The multiplier is 0.9, so new price = £60 × 0.9 = £54
(b) The multiplier is 0.75, so new value = £6000 × 0.75 = £4500
Answer: (a) £54 (b) £4500

2 Trigonometry: finding a side

Calculate the length of b. (Calculator)
Give your answer correct to 1 decimal place.
The diagram is not drawn accurately.

Label the sides: b is the opposite and 24 cm is the hypotenuse
We use sin (opposite and hypotenuse)
$\sin 69° = \frac{b}{24}$
b = 24 × sin 69° = 22.406...
b = 22.4 cm (1 d.p.)
Answer: b = 22.4 cm

3 Points on a line

The point (5, k) lies on the line $y = -4x - 5$
Work out the value of k.

Substitute x = 5: $k = -4 \times 5 - 5$
$k = -25$
Answer: k = −25

4 Column vectors

$\mathbf{a} = \begin{pmatrix} -4 \\ 1 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} 7 \\ 2 \end{pmatrix}$
Work out
(a) $2\mathbf{a} + \mathbf{b}$
(b) $3\mathbf{a} - 2\mathbf{b}$

(a) $\begin{pmatrix} -8 \\ 2 \end{pmatrix} + \begin{pmatrix} 7 \\ 2 \end{pmatrix} = \begin{pmatrix} -1 \\ 4 \end{pmatrix}$
(b) $\begin{pmatrix} -12 \\ 3 \end{pmatrix} - \begin{pmatrix} 14 \\ 4 \end{pmatrix} = \begin{pmatrix} -26 \\ -1 \end{pmatrix}$
Answer: (a) $\begin{pmatrix} \mathbf{-1} \\ \mathbf{4} \end{pmatrix}$ **(b)** $\begin{pmatrix} \mathbf{-26} \\ \mathbf{-1} \end{pmatrix}$

5 Comparing fractions and percentages

Zara has $\frac{1}{2}$ of £160.

Mohammed has 45% of £40.
Who has more money? You must show your working.

Zara: 160 ÷ 10 × 5 = £80
Mohammed: 40 ÷ 100 × 45 = £18
£80 is more than £18, so Zara has more
Answer: Zara

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6 Circumference and area of a circle

The diagram shows a circle with radius 13 m.
Work out the circumference of the circle.
Give your answer in terms of π.
The diagram is not drawn accurately.

Circumference = 2 × π × radius
2 × π × 13 = 26π
Answer: 26π m

7 Population density

Town A has a population of 800.
Its area is 4 km^2.
Work out the population density.
Give your answer in people per km^2.

Population density = population ÷ area
800 ÷ 4 = 200
Answer: 200 people per km^2

8 Fraction problems

A fuel tank is $\frac{2}{5}$ full.
30 litres of fuel are added.
The fuel tank is now $\frac{1}{2}$ full.
Work out the capacity of the fuel tank.

Fraction added = $\frac{1}{2} - \frac{2}{5} = \frac{1}{10}$
$\frac{1}{10}$ of the capacity = 30 litres
Whole capacity = 30 × 10 = 300 litres
Answer: 300 litres

9 Speed unit conversion

A skier travels at 10 metres per second.
Work out this speed in kilometres per hour.

In 1 hour (3600 s) it travels 10 × 3600 = 36,000 m
36,000 m = 36 km
Answer: 36 km/h

10 Algebraic proof

Show that $(n + 3)^2 - (n - 3)^2$ is a multiple of 12 for any whole number n.

Expand: $(n + 3)^2 = n^2 + 6n + 9$ and $(n - 3)^2 = n^2 - 6n + 9$
Subtract: the n^2 terms and the 9s cancel, leaving 12n
12n is a multiple of 12
Answer: 12n is a multiple of 12