Day 94 **A Tier 10-a-day: Model Solutions**

1 Pythagoras' theorem

Work out the length of x. (Calculator)
Give your answer to 3 significant figures.
The diagram is not drawn accurately.

$17^2 = x^2 + 6^2$

$x^2 = 289 - 36 = 253$

$x = \sqrt{253} = 15.9$

Answer: x = 15.9 cm

2 Substitution

$s = ut + \frac{1}{2}at^2$

Work out the value of s when u = 1, a = 6 and t = 5

$s = 1 \times 5 + \frac{1}{2} \times (6) \times 5^2$

$= 5 + (75)$

$= 80$

Answer: 80

3 Percentages in context

A television costs £120 plus VAT at 20%.
In a sale, the price including VAT is reduced by 25%.
Work out the sale price of the television.

VAT = 20% of £120 = £24, so the price with VAT is £144
Reduction = 25% of £144 = £36
Sale price = £144 − £36 = £108

Answer: £108

4 Trigonometry: finding a side

Work out the value of x. (Calculator)
Give your answer to 3 significant figures.
The diagram is not drawn accurately.

x is the opposite and 21 m is the adjacent, so use tan

$\tan 49° = \frac{x}{21}$

$x = 21 \times \tan 49°$

$x = 24.2$

Answer: x = 24.2 m

5 Converting area and volume units

A swimming pool holds 24 m^3 of water.
How many litres is this?

$1\ m^3 = 1000$ litres

$24 \times 1000 = 24000$

Answer: 24000 litres

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6 Fractions of an amount

Tom has £450.

Tom spends $\frac{1}{3}$ of the money on a phone case and $\frac{1}{3}$ of the money that is left on headphones.

How much money does Tom have left?

$\frac{1}{3}$ of £450 = £150, so after buying a phone case, £300 is left.

$\frac{1}{3}$ of £300 = £100

£300 − £100 = £200

Answer: £200

7 Expanding three brackets

Expand and simplify

$(x - 1)(x - 4)(x + 1)$

Expand the first two brackets: $(x - 1)(x - 4) = x^2 - 5x + 4$

Multiply by the third bracket: $(x^2 - 5x + 4)(x + 1)$

$= x^3 - 5x^2 + 4x + x^2 - 5x + 4$

$= x^3 - 4x^2 - x + 4$

Answer: $x^3 - 4x^2 - x + 4$

8 Vector geometry

OAB is a triangle. $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

P is the point on AB such that AP : PB = 2 : 3.

Find $\overrightarrow{OP}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.

$\overrightarrow{AB} = -\mathbf{a} + \mathbf{b}$

$\overrightarrow{AP} = \frac{2}{5}\overrightarrow{AB} = \frac{2}{5}(\mathbf{b} - \mathbf{a})$

$\overrightarrow{OP} = \overrightarrow{OA} + \overrightarrow{AP} = \mathbf{a} + \frac{2}{5}(\mathbf{b} - \mathbf{a})$

$= \frac{3}{5}\mathbf{a} + \frac{2}{5}\mathbf{b}$

Answer: $\overrightarrow{OP} = \frac{3}{5}\mathbf{a} + \frac{2}{5}\mathbf{b}$

9 Reverse compound change

The value of a car falls by 20% each year. (Calculator)

After 3 years it is worth £3,328.

Work out its value at the start.

Yearly multiplier = 0.8

Overall multiplier = $0.8^3 = 0.512$

Original value = £3,328 ÷ 0.512 = £6,500

Answer: £6,500

10 Direct and inverse proportion

y is inversely proportional to x.

When x = 1, y = 16.

(a) Find a formula for y in terms of x.

(b) Work out the value of y when x = 4.

(a) $y = \frac{k}{x}$. Substitute x = 1 and y = 16: $16 = \frac{k}{1}$, so $k = 16 \times 1 = 16$

$y = \frac{16}{x}$

(b) $y = \frac{16}{4} = 4$

Answer: (a) $y = \frac{16}{x}$ (b) 4