Day 172 **A Tier 10-a-day: Model Solutions**

1 Quadratic graph from its roots

The diagram shows the graph of $y = x^2 + bx + c$.
Find the value of b and the value of c.

The curve crosses the x-axis at $x = -4$ and $x = -3$
So $y = (x + 4)(x + 3)$
Expand: $y = x^2 + 7x + 12$
$b = 7$ and $c = 12$
Answer: b = 7, c = 12

2 Column vectors

$\mathbf{v} = \begin{pmatrix} 8 \\ 15 \end{pmatrix}$.
Work out the magnitude (length) of $\mathbf{v}$.

Magnitude $= \sqrt{(8)^2 + (15)^2}$
$= \sqrt{64 + 225} = \sqrt{289}$
$= 17$
Answer: 17

3 Pie charts

The pie chart shows how some students chose a sport.
4 students chose rugby.
(a) Work out the angle for hockey.
(b) How many students chose hockey?

(a) $360 - 105 - 20 - 160 = 75°$
(b) 4 students is 20°, so 1 student is $20 \div 4 = 5°$
Hockey: $75 \div 5 = 15$
Answer: (a) 75° (b) 15

4 Profit and loss

Tom sells a guitar for £224 and makes a profit of 12%.
Work out how much Tom paid for the guitar.

Selling price = 112% of the cost price
112% = £224, so 1% = £2
100% = £200
Answer: £200

5 Rates of flow

A tank is in the shape of a cuboid measuring 60 cm by 80 cm by 150 cm.
It already contains 20 litres of water.
Water flows in at 8 litres per minute until the tank is full.
Work out how long this takes. Give your answer in minutes.

Volume $= 60 \times 80 \times 150 = 720000$ cm^3 = 720 litres
Water needed $= 720 - 20 = 700$ litres
Time $= 700 \div 8 = 87.5$ minutes
Answer: 87.5 minutes

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6 Direct and inverse proportion

y is directly proportional to the cube of x.
When x = 3, y = 243.
(a) Find a formula for y in terms of x.
(b) Work out the value of y when x = 6.

(a) $y = kx^3$. Substitute x = 3 and y = 243: 243 = k × 27, so k = 9
$y = 9x^3$
(b) $y = 9 \times 6^3 = 9 \times 216 = 1944$
Answer: (a) $y = 9x^3$ (b) 1944

7 Counting

A cafe menu has 5 starters, 6 main courses and 3 desserts.
(a) How many different three-course meals are possible?
(b) A customer chooses a main course and either a starter or a dessert (not both). How many different meals are possible?

(a) 5 × 6 × 3 = 90
(b) 6 choices of main course × (5 + 3) choices of starter or dessert = 6 × 8 = 48
Answer: (a) 90 (b) 48

8 Bounds in measurement

The length and width of a rectangular garden are 18.0 m and 10.9 m.
Each measurement is correct to 1 decimal place.
Work out the upper bound for the area.

Upper bound of length = 18.1 m, upper bound of width = 10.9 m
Upper bound of area = 18.05 × 10.95 = 197.6475
Answer: 197.6475 m^2

9 Finding a rate of compound change

Ella invests £1,500 in a savings account. (Calculator)
Compound interest is paid at a fixed rate each year.
After 2 years the investment is worth £1,749.60.
Work out the annual rate of interest.

Overall multiplier = £1,749.60 ÷ £1,500 = 1.1664
Take the square root: $\sqrt{1.1664} = 1.08$
Rate = (1.08 − 1) × 100 = 8%
Answer: 8%

10 The sine rule

Work out the size of angle x. (Calculator)
Give your answer to 1 decimal place.
The diagram is not drawn accurately.

$$\frac{\sin x}{9} = \frac{\sin 87°}{11}$$
$$\sin x = \frac{9 \times \sin 87°}{11}$$
$x = \sin^{-1}(0.8171)$
$x = 54.8°$
Answer: x = 54.8°