Day 154 **A Tier 10-a-day: Model Solutions**

1 Standard form notation

(a) Write 0.000036 in standard form.

(b) Write 3.4×10^5 as an ordinary number.

(a) Move the decimal point 5 places to get 3.6: 3.6×10^{-5}

(b) Move the decimal point 5 places to the right: 340,000

Answer: (a) 3.6×10^{-5} (b) 340,000

2 Speed, distance and time

A coach travels 180 km in 2 hours 15 minutes.

Work out the average speed in km/h.

Time = 2.25 hours

Speed = distance ÷ time = 180 ÷ 2.25 = 80 km/h

Answer: 80 km/h

3 Direct and inverse proportion

y is inversely proportional to x.

When x = 1, y = 5.

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

(b) Work out the value of y when x = 5.

(a) $y = \frac{k}{x}$. Substitute x = 1 and y = 5: $5 = \frac{k}{1}$, so $k = 5 \times 1 = 5$

$y = \frac{5}{x}$

(b) $y = \frac{5}{5} = 1$

Answer: (a) $y = \frac{5}{x}$ (b) 1

4 Negative and fractional indices

Work out the value of

(a) $1000^{\frac{-1}{3}}$

(b) $100^{\frac{1}{2}}$

(a) $1000^{\frac{-1}{3}} = \frac{1}{1000^{\frac{1}{3}}} = \frac{1}{(\sqrt[3]{1000})} = \frac{1}{10}$

(b) $100^{\frac{1}{2}} = \sqrt{100} = 10$

Answer: (a) $\frac{1}{10}$ (b) 10

5 Distance-time graphs

A runner makes a journey. The distance-time graph shows the journey.

(a) For how many minutes did the runner stop?

(b) Work out the speed during the final part of the journey. Give your answer in km/h.

(a) The graph is horizontal from 60 to 80 minutes, so the stop is 80 − 60 = 20 minutes

(b) Final part: distance 9 km in 54 minutes

Speed = distance ÷ time = $9 \div \frac{54}{60} = 10$ km/h

Answer: (a) 20 minutes (b) 10 km/h

Day 154 **A Tier 10-a-day: Model Solutions**

6 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 = 5
So $y = (x - 4)(x - 5)$
Expand: $y = x^2 - 9x + 20$
b = −9 and c = 20
Answer: b = −9, c = 20

7 Venn diagram probability

The Venn diagram shows information about 33 people.
One person is chosen at random.
(a) The person is in set Tea. Find the probability that they are also in set Coffee.
(b) The person is not in set Coffee. Find the probability that they are in set Tea.

(a) In Tea: 9 + 10 = 19 people, of whom 10 are also in Coffee: $\frac{10}{19}$

(b) Not in Coffee: 9 + 4 = 13 people, of whom 9 are in Tea: $\frac{9}{13}$

Answer: (a) $\frac{10}{19}$ (b) $\frac{9}{13}$

8 Volume of cones and spheres

A cone has height 17 cm and base radius 9 cm.
Work out the volume of the cone. Give your answer in terms of π.

Volume = $\frac{1}{3} \times \pi \times r^2 \times h$

$= \frac{1}{3} \times \pi \times 9^2 \times 17$

$= 459\pi$

Answer: 459π cm^3

9 Rationalising with conjugates

Rationalise the denominator of $\frac{12}{3 - \sqrt{6}}$

Give your answer in the form $a + b\sqrt{c}$ where a and b are integers.

Multiply top and bottom by the conjugate $3 + \sqrt{6}$: $\frac{12(3 + \sqrt{6})}{(3 - \sqrt{6})(3 + \sqrt{6})}$

Denominator: 9 − 6 = 3

$\frac{12(3 + \sqrt{6})}{3} = 4(3 + \sqrt{6})$

$= 12 + 4\sqrt{6}$

Answer: $12 + 4\sqrt{6}$

10 Angles in regular polygons around a point

A square and a regular decagon share the side AB and are on opposite sides of it.
The two shapes meet at the point A.
Work out the size of the angle at A that is not inside either shape.

Interior angle of the square = 180 − 360 ÷ 4 = 90°
Interior angle of the regular decagon = 180 − 360 ÷ 10 = 144°
Angles round a point add up to 360°
360 − 90 − 144 = 126
Answer: 126°