Day 106 **A Tier 10-a-day: Model Solutions**

1 Direct proportion

Here are the ingredients for 12 flapjacks.
Oats: 240 g
Butter: 240 g
Flour: 600 g
(a) Work out how much oats is needed for 5 flapjacks.
(b) Hannah has 472 g of butter. What is the greatest number of flapjacks she can make?

(a) oats for one: 240 ÷ 12 = 20 g
For 5: 20 × 5 = 100 g
(b) butter for one: 240 ÷ 12 = 20 g
472 ÷ 20 = 23 remainder 12, so she can make 23
Answer: (a) 100 g (b) 23

2 Similar shapes: finding a length

The two triangles are similar.
Work out the value of x.
The diagrams are not drawn accurately.

Scale factor from the small triangle to the large triangle = 24 ÷ 8 = 3
x = 7 × 3 = 21
Answer: x = 21 cm

3 Decimal calculations

(a) Work out 0.8 × 0.08
(b) Work out 0.60 ÷ 0.06

(a) 8 × 8 = 64, and there are 3 decimal places in total, so 0.064
(b) Multiply both numbers by 100: 60 ÷ 6 = 10
Answer: (a) 0.064 (b) 10

4 Similar shapes: area and volume

Two similar models are 15 cm and 25 cm tall.
The surface area of the smaller model is 180 cm^2.
Work out the surface area of the larger model.

Length scale factor = 25 ÷ 15 = $\frac{5}{3}$

Area scale factor = $(\frac{5}{3})^2 = \frac{25}{9}$

Area = $180 \times \frac{25}{9} = 500$

Answer: 500 cm^2

5 Adding and subtracting in standard form

Work out $(4.8 \times 10^{-1}) - (2.4 \times 10^{-3})$
Give your answer in standard form.

Write both numbers using 10^{-3}: $4.8 \times 10^{-1} = 480 \times 10^{-3}$
$(480 - 2.4) \times 10^{-3} = 477.6 \times 10^{-3}$
In standard form: 4.776×10^{-1}
Answer: 4.776×10^{-1}

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6 Simple and compound interest

Priya and Nia each invest £5000 for 2 years. (Calculator)
Priya's account pays 5% simple interest per year.
Nia's account pays 5% compound interest per year.
Work out how much more interest Nia earns than Priya.

Simple interest = £5000 × 5% × 2 = £500
Compound: £5000 × 1.05^2 = £5512.50, so interest = £512.50
Difference = 512.50 − 500 = £12.50 (to the nearest penny)
Answer: £12.50

7 Algebraic proof

Prove that the sum of five consecutive integers is always a multiple of 5.

Let the integers be n, n + 1, n + 2, n + 3 and n + 4
Sum = 5n + 10
= 5(n + 2), which is 5 × an integer, so it is a multiple of 5
Answer: Proved

8 Compound shapes with circles

The diagram shows a shape made from a rectangle and a semicircle.
Work out the perimeter of the shape.
Give your answer in terms of π.
The diagram is not drawn accurately.

Curved edge: $\frac{1}{2} \times \pi \times 18 = 9\pi$
Straight edges: 18 + 11 + 11 = 40
Total = 40 + 9π
Answer: 40 + 9π cm

9 Quadratic sequences

Here are the first five terms of a quadratic sequence.
7, 23, 47, 79, 119
(a) Find an expression for the nth term.
(b) Work out the 15th term.

First differences: 16, 24, 32
Second differences: 8, 8, so a = 8 ÷ 2 = 4
Subtract $4n^2$ from each term (4, 16, 36, 64): 3, 7, 11, 15
This is linear: 4n − 1
nth term = $4n^2 + 4n - 1$
(b) Substitute n = 15: $4 \times 15^2 + 4 \times 15 - 1 = 959$
Answer: (a) $4n^2 + 4n - 1$ (b) 959

10 Finding a rate of compound change

Ben invests £14,500 in a savings account. (Calculator)
Compound interest is paid at a fixed rate each year.
After 2 years the investment is worth £17,545.
Work out the annual rate of interest.

Overall multiplier = £17,545 ÷ £14,500 = 1.21
Take the square root: $\sqrt{1.21} = 1.1$
Rate = (1.1 − 1) × 100 = 10%
Answer: 10%