Day 247 **A Tier 10-a-day: Model Solutions**

1 Inverse proportion

9 painters take 21 days to paint a hall.
All the painters work at the same rate.
How many painters are needed to paint a hall in 9 days?

Total work = 9 × 21 = 189 painter-day
Number needed = 189 ÷ 9 = 21
Answer: 21

2 Laws of indices

Write $(7^5)^2 \div 7^2$ as a single power of 7.

Multiply the powers: $(7^5)^2 = 7^{10}$
Subtract when dividing: $10 - 2 = 8$
$= 7^8$
Answer: 7^8

3 Best buys

A shop sells coffee in 2 different sizes.
Small bag: 400 g for £1.40
Large bag: 1000 g for £3.60
Which bag is the best value for money? You must show your working.

Small bag: 140p ÷ 4 = 35p per 100 g
Large bag: 360p ÷ 10 = 36p per 100 g
The small bag has the lowest price per 100 g, so it is the best value
Answer: The small bag

4 Recurring decimals, show that

(a) Show that $0.\dot{1}\dot{4} = \frac{14}{99}$

(b) Hence write $5.\dot{1}\dot{4}$ as a mixed number in its simplest form.

(a) Let x = 0.141414..., so 100x = 14.1414...

$100x - x = 14$, so $99x = 14$ and $x = \frac{14}{99}$

(b) $5.\dot{1}\dot{4} = 5 + \frac{14}{99} = 5\frac{14}{99}$

Answer: (b) $5\frac{14}{99}$

5 The quadratic formula

Solve $4x^2 + 9x - 8 = 0$
Give your solutions correct to 2 decimal places. (Calculator)

Use $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ with a = 4, b = 9, c = −8

$x = \frac{-9 \pm \sqrt{9^2 - 4 \times 4 \times (-8)}}{8}$

$x = \frac{-9 \pm \sqrt{209}}{8}$

x = 0.68 or x = −2.93
Answer: x = 0.68 or x = −2.93

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6 Volume of a hollow cylinder

The diagram shows the cross-section of a metal pipe.
The outer radius is 11 cm and the inner radius is 10 cm.
The pipe is 25 cm long.
Work out the volume of metal used. Give your answer to 3 significant figures. (Calculator)

Area of the ring = $\pi \times 11^2 - \pi \times 10^2 = \pi(121 - 100) = 21\pi$
Volume = area × length = $21\pi \times 25$
= 1650
Answer: 1650 cm^3

7 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 = 2 and x = 5
So $y = -(x - 2)(x - 5)$
Expand: $y = -x^2 + 7x - 10$
b = 7 and c = −10
Answer: b = 7, c = −10

8 Perimeter and area with algebra

An isosceles triangle has two equal sides of length (2x + 6) cm and (3x + 1) cm.
The third side is 12 cm.
Work out the perimeter of the triangle.

The two equal sides give an equation
2x + 6 = 3x + 1
x = 5
x = 5
Equal sides = 2 × 5 + 6 = 16 cm
Perimeter = 16 + 16 + 12 = 44
Answer: 44 cm

9 Adding algebraic fractions

Write as a single fraction

$$\frac{-2}{(x+1)} + \frac{3}{(x+5)}$$

Common denominator is (x + 1)(x + 5)

$$= \frac{-2(x+5) + 3(x+1)}{(x+1)(x+5)}$$

$$= \frac{x - 7}{(x+1)(x+5)}$$

Answer: $\mathbf{\frac{x - 7}{(x+1)(x+5)}}$

10 Bounds and accuracy

A cyclist travels 610 metres in 4.7 seconds. The distance is correct to the nearest 10 metres and the time to the nearest 0.1 second.
(a) Work out the upper bound and the lower bound of the speed in m/s.
(b) Write the speed to a suitable degree of accuracy. Give a reason for your answer.

(a) Upper bound = 615 ÷ 4.65 = 132.2581
Lower bound = 605 ÷ 4.75 = 127.3684
(b) Both bounds round to 130 to 2 s.f. but not to the same value to 3 s.f.
So the speed is 130 m/s to 2 significant figures.
Answer: (a) 132.2581, 127.3684 (b) 130 m/s (2 s.f.)