Day 354 **A Tier 10-a-day: Model Solutions**

1 Cumulative frequency graphs

The cumulative frequency graph shows information about the age of 100 visitors.
Use the graph to find an estimate for
(a) the median,
(b) the number of visitors with a age greater than 40 years.

(a) Median at cumulative frequency 100 ÷ 2 = 50
Read across from 50 to the graph, then down to the axis
Median = 85 years
(b) At 40 years the cumulative frequency is 6
100 − 6 = 94
Answer: (a) 85 years (b) 94

2 Expanding and simplifying

Expand and simplify
$(x - 2)^2 - (x - 5)(x + 1)$

$(x - 2)^2 = x^2 - 4x + 4$
$(x - 5)(x + 1) = x^2 - 4x - 5$
Subtract (take care with the signs): $(x^2 - 4x + 4) - (x^2 - 4x - 5)$
$= 9$
Answer: 9

3 Inverse proportion

7 painters take 12 days to paint a hall.
All the painters work at the same rate.
How many painters are needed to paint a hall in 14 days?

Total work = 7 × 12 = 84 painter-day
Number needed = 84 ÷ 14 = 6
Answer: 6

4 Area of a trapezium

The area of this trapezium is 63 cm^2.
Work out the value of x.
The diagram is not drawn accurately.

$\frac{1}{2} \times (8 + 13) \times x = 63$
$10.5\ x = 63$
$x = 63 \div 10.5 = 6$
Answer: x = 6

5 Fractions of an amount

Oscar has £120.
Oscar spends $\frac{2}{3}$ of the money on a coat and $\frac{2}{5}$ of the money that is left on some shoes.
How much money does Oscar have left?

$\frac{2}{3}$ of £120 = £80, so after buying a coat, £40 is left.
$\frac{2}{5}$ of £40 = £16
£40 − £16 = £24
Answer: £24

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6 Perimeter and area with algebra

An isosceles triangle has two equal sides of length $(4x - 1)$ cm and $(3x + 8)$ cm.
The third side is 20 cm.
Work out the perimeter of the triangle.

The two equal sides give an equation
$4x - 1 = 3x + 8$
$x = 9$
$x = 9$
Equal sides $= 4 \times 9 - 1 = 35$ cm
Perimeter $= 35 + 35 + 20 = 90$
Answer: 90 cm

7 Successive percentage changes

The price of a product increases by 40% each year for 2 years.
Work out the overall percentage increase over the 2 years.

Multiplier for each year = 1.4
Overall multiplier $= 1.4^2 = 1.96$
Percentage increase = 96%
Answer: 96%

8 Mixing in a ratio

Jug A contains 8 litres of a mixture of concentrate and water in the ratio 1 : 7.
Jug B contains 9 litres of a mixture of concentrate and water in the ratio 5 : 4.
The contents of both jugs are mixed together.
Work out the ratio of concentrate to water in the mixture. Give your answer in its simplest form.

Jug A: concentrate $= 1 \times 8 \div 8 = 1$ litres, water = 7 litres
Jug B: concentrate = 5 litres, water = 4 litres
Total: concentrate = 6 litres, water = 11 litres
Ratio = 6 : 11 = 6 : 11
Answer: 6 : 11

9 Equations with algebraic fractions

Solve $\frac{6}{(x-1)} + \frac{3}{(x+3)} = 1$

Multiply every term by $(x - 1)(x + 3)$
$6(x + 3) + 3(x - 1) = (x - 1)(x + 3)$
$9x + 15 = x^2 + 2x - 3$
$x^2 - 7x - 18 = 0$
$(x + 2)(x - 9) = 0$
$x = -2$ or $x = 9$
Answer: $x = -2$ or $x = 9$

10 Rationalising with conjugates

Rationalise the denominator of $\frac{46}{5 - \sqrt{2}}$

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

Multiply top and bottom by the conjugate $5 + \sqrt{2}$: $\frac{46(5 + \sqrt{2})}{(5 - \sqrt{2})(5 + \sqrt{2})}$

Denominator: $25 - 2 = 23$
$\frac{46(5 + \sqrt{2})}{23} = 2(5 + \sqrt{2})$
$= 10 + 2\sqrt{2}$
Answer: $10 + 2\sqrt{2}$