Day 108 **A Tier 10-a-day: Model Solutions**

1 Mixed number addition and subtraction

Work out $2\frac{1}{5} + 3\frac{1}{2}$

Give your answer as a mixed number in its simplest form.

Write as improper fractions: $2\frac{1}{5} = \frac{11}{5}$ and $3\frac{1}{2} = \frac{7}{2}$

Common denominator 10: $\frac{22}{10} + \frac{35}{10}$

$= \frac{57}{10}$

$= 5\frac{7}{10}$

Answer: $\mathbf{5\frac{7}{10}}$

2 Direct and inverse proportion

y is directly proportional to the square of x.
When x = 3, y = 72.
(a) Find a formula for y in terms of x.
(b) Work out the value of y when x = 5.

(a) $y = kx^2$. Substitute x = 3 and y = 72: $72 = k \times 9$, so $k = 8$
$y = 8x^2$
(b) $y = 8 \times 5^2 = 8 \times 25 = 200$
Answer: (a) $\mathbf{y = 8x^2}$ **(b) 200**

3 Density

A solid cuboid measures 6 cm by 10 cm by 3 cm.
It is made of a material with density 2.7 g/cm^3.
Work out the mass of the cuboid in kilograms.

Volume = $6 \times 10 \times 3 = 180$ cm^3
Mass = $2.7 \times 180 = 486$ g
486 g = 0.486 kg
Answer: 0.486 kg

4 Bearings

The bearing of M from L is 320°.
Work out the bearing of L from M.
The diagram is not drawn accurately.

The north lines at L and M are parallel
Back bearing = 320° − 180° = 140°
Answer: 140°

5 Growth and decay

A house is worth £200000. (Calculator)
Its value increases by 25% each year.
Work out its value after 3 years., to the nearest pound.

Multiplier = 100% + 25% = 1.25
$200000 \times 1.25^3 = 390625.00$
= £390625 to the nearest whole number
Answer: £390625

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6 Perimeter and area with algebra

An isosceles triangle has two equal sides of length (4x + 7) cm and (3x + 13) cm.
The third side is 13 cm.
Work out the perimeter of the triangle.

The two equal sides give an equation
4x + 7 = 3x + 13
x = 6
x = 6
Equal sides = 4 × 6 + 7 = 31 cm
Perimeter = 31 + 31 + 13 = 75
Answer: 75 cm

7 Reverse compound change

The value of a car falls by 20% each year. (Calculator)
After 2 years it is worth £4,160.
Work out its value at the start.

Yearly multiplier = 0.8
Overall multiplier = $0.8^2 = 0.64$
Original value = £4,160 ÷ 0.64 = £6,500
Answer: £6,500

8 Probabilities adding to 1

The table shows the probabilities of the outcomes of a biased spinner.
(a) Work out the value of x.
(b) The spinner is spun 200 times. Estimate the number of times it lands on 3.

(a) Probabilities add to 1: 0.25 + x + 2x + 0.3 = 1
0.55 + 3x = 1, so 3x = 0.45
x = 0.15
(b) P(3) = 0.3, so expected number = 0.3 × 200 = 60
Answer: (a) x = 0.15 (b) 60

9 Index equations

Solve $9^x = \frac{1}{27}$

Write both sides as powers of 3: $9 = 3^2$, so $9^x = 3^{2x}$
$\frac{1}{27} = 3^{-3}$, so $2x = -3$
$x = -\frac{3}{2}$

Answer: $x = -\frac{3}{2}$

10 Rearranging formulae (subject twice)

Make x the subject of $y = \frac{2x - 5}{x - 6}$

Multiply both sides by (x − 6): y(x − 6) = 2x − 5
Expand the bracket: xy − 6y = 2x − 5
Collect the x terms on one side: xy − 2x = 6y − 5
Factorise: x(y − 2) = 6y − 5
Divide by (y − 2): $x = \frac{6y - 5}{y - 2}$

Answer: $x = \frac{6y - 5}{y - 2}$