Day 311 **A Tier 10-a-day: Model Solutions**

1 Bearings

The bearing of Y from X is 215°.
Work out the bearing of X from Y.
The diagram is not drawn accurately.

The north lines at X and Y are parallel
Back bearing = 215° − 180° = 35°
Answer: 035°

2 Forming and solving equations

Sam is x years old.
His gran is 2 times as old as Sam, plus 6 years.
The sum of their ages is 48 years.
Work out how old his gran is.

Let Sam's age be x, so his gran's age is 2x + 6
x + (2x + 6) = 48
3x = 42
x = 14
His gran's age = 2 × 14 + 6 = 34
Answer: 34 years

3 Area of a trapezium

The diagram shows a trapezium.
Work out the area of the trapezium.
The diagram is not drawn accurately.

Area = $\frac{1}{2}$ × (12 + 17) × 3

= $\frac{1}{2}$ × 29 × 3

= 43.5

Answer: 43.5 cm^2

4 Counting

A cafe menu has 3 starters, 4 main courses and 4 desserts.
(a) How many different three-course meals are possible?
(b) A customer chooses a main course and either a starter or a dessert (not both). How many different meals are possible?

(a) 3 × 4 × 4 = 48
(b) 4 choices of main course × (3 + 4) choices of starter or dessert = 4 × 7 = 28
Answer: (a) 48 (b) 28

5 Simple and compound interest

Dev and Harry each invest £4000 for 2 years. (Calculator)
Dev's account pays 3% simple interest per year.
Harry's account pays 3% compound interest per year.
Work out how much more interest Harry earns than Dev.

Simple interest = £4000 × 3% × 2 = £240
Compound: £4000 × 1.03^2 = £4243.60, so interest = £243.60
Difference = 243.60 − 240 = £3.60 (to the nearest penny)
Answer: £3.60

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6 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 large triangle to the small triangle = $10 \div 25 = \frac{2}{5}$

$x = 40 \times \frac{2}{5} = 16$

Answer: x = 16 cm

7 Simultaneous equations in context

2 footballs and 3 netballs cost £39.
1 football and 1 netball cost £17.
Work out the cost of one netball.

Let f = cost of one football in £ and n = cost of one netball in £
2f + 3n = 39 (1)
f + n = 17 (2)
Multiply (2) by 3 to make the n coefficients match
2f + 3n = 39 (1)
3f + 3n = 51 (2)
The n terms have the same sign, so subtract equation (1) from equation (2)
f = 12
Substitute f = 12 into equation (1) to find n = 5
Answer: £5

8 Direct proportion formulae

y is directly proportional to the square root of x.
When x = 4, y = 16.
(a) Find a formula for y in terms of x.
(b) Work out the positive value of x when y = 40.

(a) $y = k\sqrt{x}$. Substitute: $16 = k \times 2$, so $k = 8$
$y = 8\sqrt{x}$
(b) $40 = 8\sqrt{x}$, so $\sqrt{x} = 40 \div 8 = 5$, so $x = 5^2 = 25$
Answer: (a) $y = 8\sqrt{x}$ (b) x = 25

9 Finding an interest rate

Noah invests £2000 in a savings account. (Calculator)
The account pays compound interest at a fixed rate each year.
After 2 years there is £2080.80 in the account.
Work out the annual rate of interest.

Let the yearly multiplier be m. Then $2000 \times m^2 = 2080.8$
$m^2 = 2080.8 \div 2000 = 1.0404$
$m = \sqrt{1.0404} = 1.02$
Rate = $(1.02 - 1) \times 100 = 2\%$
Answer: 2%

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10 Rationalising with conjugates

Rationalise the denominator of $\frac{18}{5-\sqrt{7}}$

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

Multiply top and bottom by the conjugate $5 + \sqrt{7}$: $\frac{18(5+\sqrt{7})}{(5-\sqrt{7})(5+\sqrt{7})}$

Denominator: $25 - 7 = 18$

$\frac{18(5+\sqrt{7})}{18} = 1(5+\sqrt{7})$

$= 5 + \sqrt{7}$

Answer: $5 + \sqrt{7}$