**Day 22** **A Tier 10-a-day: Model Solutions**

## 1 Laws of indices

Write $10^8 \times 10^2 \div 10^2$ as a single power of 10.

Add the powers when multiplying: 8 + 2 = 10
Subtract when dividing: 10 − 2 = 8
$= 10^8$

**Answer: $10^8$**

## 2 Map scales

The scale of a map is 1 : 200000.
A road is 3 km long.
Work out the length of the road on the map, in centimetres.

3 km = 300000 cm
Length on map = 300000 ÷ 200000 = 1.5 cm
**Answer: 1.5 cm**

## 3 Converting units of area and volume

Convert 250 $mm^2$ into $cm^2$.

1 cm = 10 mm, so 1 $cm^2$ = 10 × 10 = 100 $mm^2$
250 ÷ 100 = 2.5
**Answer: 2.5 $cm^2$**

## 4 Simultaneous equations

Solve the simultaneous equations
6x − 4y = −10
4x − 2y = −4

Multiply (2) by 2 to make the y coefficients match
6x − 4y = −10 (1)
8x − 4y = −8 (2)
The y terms have the same sign, so subtract equation (1) from equation (2)
2x = 2, so x = 1
Substitute x = 1 into equation (1) to find y = 4
**Answer: x = 1, y = 4**

## 5 Midpoints and length of a line segment

M is the midpoint of AB.
A is the point (1, −4) and M is the point (2, 3).
Work out the coordinates of B.

From A to M: x changes by 1 and y changes by 7
Do the same again from M to get B
B = (2 + 1, 3 + 7) = (3, 10)
**Answer: (3, 10)**

## 6 Error intervals

m = 0.2 is rounded to 1 significant figure.
Write down the error interval for m.

The rounding unit is 0.1, so the value could be up to half of this, 0.05, either side.
Lower bound = 0.2 − 0.05 = 0.15, upper bound = 0.2 + 0.05 = 0.25
**Answer: $0.15 \leq m < 0.25$**

**Day 22** **A Tier 10-a-day: Model Solutions**

## 7 Quadratic sequences

Here are the first five terms of a quadratic sequence.
6, 20, 42, 72, 110
(a) Find an expression for the nth term.
(b) Work out the 10th term.

First differences: 14, 22, 30
Second differences: 8, 8, so a = 8 ÷ 2 = 4
Subtract $4n^2$ from each term (4, 16, 36, 64): 2, 4, 6, 8
This is linear: 2n
nth term = $4n^2 + 2n$
(b) Substitute n = 10: $4 \times 10^2 + 2 \times 10 = 420$
**Answer: (a) $4n^2 + 2n$ (b) 420**

## 8 Surd fractions

Show that $\frac{\sqrt{63} - \sqrt{28}}{\sqrt{7}}$ is an integer, and find its value.

$\sqrt{63} = 3\sqrt{7}$ and $\sqrt{28} = 2\sqrt{7}$
Numerator = $3\sqrt{7} - 2\sqrt{7} = \sqrt{7}$
$\frac{\sqrt{7}}{\sqrt{7}} = 1$
**Answer: 1**

## 9 Best buys

A shop sells cereal in 2 different sizes.
Small bag: 250 g for £2.20
Large bag: 400 g for £3.10
Which bag is the best value for money? You must show your working.

Small bag: 220p ÷ 2.5 = 88p per 100 g
Large bag: 310p ÷ 4 = 77.5p per 100 g
The large bag has the lowest price per 100 g, so it is the best value
**Answer: The large bag**

## 10 Simultaneous equations (one quadratic)

Solve the simultaneous equations
$y = x^2 + 6x + 19$
$y = -x + 7$

Set the y values equal: $x^2 + 6x + 19 = -x + 7$
$x^2 + 7x + 12 = 0$
$(x + 4)(x + 3) = 0$
$x = -4$ or $x = -3$
Substitute into $y = -x + 7$: y = 11 and y = 10
**Answer: x = −4, y = 11 and x = −3, y = 10**