Day 299 **A Tier 10-a-day: Model Solutions**

1 Roots and powers

(a) Between which two consecutive whole numbers does $\sqrt{113}$ lie?
(b) Work out $\sqrt{25} \times \sqrt[3]{8}$

(a) $10^2 = 100$ and $11^2 = 121$, and 113 is between these.
(b) $\sqrt{25} = 5$ and $\sqrt[3]{8} = 2$, so $5 \times 2 = 10$
Answer: (a) 10 and 11 (b) 10

2 Area of parallelograms and kites

The diagram shows a kite.
The diagonals are 13 cm and 10 cm and cross at right angles.
Work out the area of the kite.
The diagram is not drawn accurately.

Area $= \frac{1}{2} \times$ (diagonal 1) $\times$ (diagonal 2)

$= \frac{1}{2} \times 13 \times 10$
$= 65$
Answer: 65 cm^2

3 Quadratic sequences

Here are the first five terms of a quadratic sequence.
$-5, -4, -1, 4, 11$
(a) Find an expression for the nth term.
(b) Work out the 15th term.

First differences: 1, 3, 5
Second differences: 2, 2, so $a = 2 \div 2 = 1$
Subtract n^2 from each term (1, 4, 9, 16): $-6, -8, -10, -12$
This is linear: $-2n - 4$
nth term $= n^2 - 2n - 4$
(b) Substitute $n = 15$: $1 \times 15^2 - 2 \times 15 - 4 = 191$
Answer: (a) $n^2 - 2n - 4$ (b) 191

4 Pie charts

The pie chart shows how some students chose a sport.
8 students chose tennis.
(a) Work out the angle for hockey.
(b) How many students chose hockey?

(a) $360 - 150 - 90 - 80 = 40°$
(b) 8 students is 80°, so 1 student is $80 \div 8 = 10°$
Hockey: $40 \div 10 = 4$
Answer: (a) 40° (b) 4

5 Powers and roots in standard form

Work out $\sqrt{2.56 \times 10^{10}}$
Give your answer in standard form.

$\sqrt{2.56 \times 10^{10}} = \sqrt{2.56} \times \sqrt{10^{10}}$
$= 1.6 \times 10^5$
Answer: 1.6×10^5

Day 299 **A Tier 10-a-day: Model Solutions**

6 Exchange rates

£1 = €1.35.
(a) Change £260 to euros.
(b) Change €54 to pounds.

(a) 260 × 1.35 = 351
(b) 54 ÷ 1.35 = 40
Answer: (a) €351 (b) £40

7 Transformations of graphs

The graph of y = f(x) has a maximum point at (2, −5).
Write down the coordinates of the turning point of the graph of
(a) y = f(x) − 4
(b) y = f(−x)

(a) Subtracting 4 from f(x) moves the graph 4 units down
The maximum point is (2, −9)
(b) The graph is reflected in the y-axis, so the x-coordinate changes sign
The maximum point is (−2, −5)
Answer: (a) (2, −9) (b) (−2, −5)

8 Describing transformations

Describe fully the single transformation that maps shape A onto shape B.

Matching points are (x, y) and (−y, −x)
So the mirror line is the diagonal y = −x
Answer: Reflection in the line y = −x

9 Mixing in a ratio

Jug A contains 39 litres of a mixture of orange juice and lemonade in the ratio 7 : 6.
Jug B contains 16 litres of a mixture of orange juice and lemonade in the ratio 7 : 1.
The contents of both jugs are mixed together.
Work out the ratio of orange juice to lemonade in the mixture. Give your answer in its simplest form.

Jug A: orange juice = 7 × 39 ÷ 13 = 21 litres, lemonade = 18 litres
Jug B: orange juice = 14 litres, lemonade = 2 litres
Total: orange juice = 35 litres, lemonade = 20 litres
Ratio = 35 : 20 = 7 : 4
Answer: 7 : 4

10 Rearranging formulae (subject twice)

Make x the subject of $y = \frac{2x - 5}{2x + 3}$

Multiply both sides by (2x + 3): y(2x + 3) = 2x − 5
Expand the bracket: 2xy + 3y = 2x − 5
Collect the x terms on one side: 2xy − 2x = −3y − 5
Factorise: x(2y − 2) = −3y − 5
Divide by (2y − 2): $x = \frac{-3y - 5}{2y - 2}$
Answer: $\mathbf{x = \frac{-3y - 5}{2y - 2}}$