Day 208 **A Tier 10-a-day: Model Solutions**

1 Laws of indices

Simplify fully

(a) $\frac{10x^2y^2}{4xy^5}$

(b) $(4x^4y)^3$

(a) Divide the numbers: $10 \div 4 = \frac{5}{2}$

Subtract the powers: $x^2 \div x = x$ and $y^2 \div y^5 = y^{-3}$

$= \frac{5x}{2y^3}$

(b) Raise every part to the power 3: $4^3 = 64$, $(x^4)^3 = x^{12}$, $y^3 = y^3$

$= 64x^{12}y^3$

Answer: (a) $\frac{5x}{2y^3}$ (b) $64x^{12}y^3$

2 Best buys

A shop sells rice in 3 different sizes.
Small bag: 200 g for £1.70
Medium bag: 400 g for £3.20
Large bag: 1000 g for £8.35
Which bag is the best value for money? You must show your working.

Small bag: 170p ÷ 2 = 85p per 100 g
Medium bag: 320p ÷ 4 = 80p per 100 g
Large bag: 835p ÷ 10 = 83.5p per 100 g
The medium bag has the lowest price per 100 g, so it is the best value
Answer: The medium bag

3 Compound interest

Mo invests £1,000 in an investment bond. (Calculator)
The account pays compound interest at 1.5% per year.
Work out the value of the investment after 3 years.

Multiplier = 1 + 1.5 ÷ 100 = 1.015
£1,000 × 1.015^3 = £1,045.68
Answer: £1,045.68

4 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 = 18 ÷ 30 = $\frac{3}{5}$

x = 40 × $\frac{3}{5}$ = 24

Answer: x = 24 m

5 Sequences

Here are the first four terms of a geometric sequence.
1, 5, 25, 125
(a) Write down the next two terms.
(b) Work out the 6th term.

Divide each term by the one before: 5 ÷ 1 = 5, so each term is multiplied by 5
(a) 125 × 5 = 625 and 625 × 5 = 3125
(b) Keep multiplying: 6th term = 1 × 5^5 = 3125
Answer: (a) 625, 3125 (b) 3125

Day 208 **A Tier 10-a-day: Model Solutions**

6 Stem and leaf diagrams

The stem and leaf diagram shows the ages of 11 people.
Key: 3 | 5 represents 35 years
(a) Work out the median age.
(b) Work out the interquartile range.

(a) 11 values, so the median is the 6th value
Counting along the leaves gives 44
(b) LQ is the middle of the lower 5 values = 39
UQ is the middle of the upper 5 values = 62
IQR = 62 − 39 = 23
Answer: (a) 44 years (b) 23 years

7 Quadratic sequences

Here are the first five terms of a quadratic sequence.
8, 13, 22, 35, 52
(a) Find an expression for the nth term.
(b) Work out the 20th term.

First differences: 5, 9, 13
Second differences: 4, 4, so a = 4 ÷ 2 = 2
Subtract $2n^2$ from each term (2, 8, 18, 32): 6, 5, 4, 3
This is linear: $-n + 7$
nth term = $2n^2 - n + 7$
(b) Substitute n = 20: $2 \times 20^2 - 1 \times 20 + 7 = 787$
Answer: (a) $2n^2 - n + 7$ (b) 787

8 Cumulative frequency graphs

The cumulative frequency graph shows information about the age of 80 visitors.
Use the graph to find an estimate for
(a) the median,
(b) the number of visitors with a age greater than 30 years.

(a) Median at cumulative frequency 80 ÷ 2 = 40
Read across from 40 to the graph, then down to the axis
Median = 34 years
(b) At 30 years the cumulative frequency is 34
80 − 34 = 46
Answer: (a) 34 years (b) 46

9 Bounds and accuracy

A cyclist travels 310 metres in 17.1 seconds. The distance is correct to the nearest 10 metres and the time to the nearest 0.1 second.
(a) Work out the upper bound and the lower bound of the speed in m/s.
(b) Write the speed to a suitable degree of accuracy. Give a reason for your answer.

(a) Upper bound = 315 ÷ 17.05 = 18.4751
Lower bound = 305 ÷ 17.15 = 17.7843
(b) Both bounds round to 18 to 2 s.f. but not to the same value to 3 s.f.
So the speed is 18 m/s to 2 significant figures.
Answer: (a) 18.4751, 17.7843 (b) 18 m/s (2 s.f.)

Day 208 **A Tier 10-a-day: Model Solutions**

10 Bearings with the cosine rule

Ship A sails 12 miles from a port on a bearing of 240°.
Ship B sails 25 miles from the same port on a bearing of 345°. (Calculator)
Work out the distance between the two ships.
Give your answer to 3 significant figures.

The angle between the two paths = $|240° - 345°| = 105°$

$d^2 = 12^2 + 25^2 - 2 \times 12 \times 25 \times \cos 105°$

$d^2 = 924.29$

$d = 30.4$

Answer: 30.4 miles