Day 354 **B Tier 10-a-day: Model Solutions**

1 Standard form

Write each number in standard form.
(a) 43,000
(b) 0.0000088

(a) Move the decimal point 4 places: 4.3×10^4
(b) Move the decimal point 6 places the other way: 8.8×10^{-6}
Answer: (a) 4.3×10^4 (b) 8.8×10^{-6}

2 Median and range

Here are the temperatures at noon in a town.
28, 10, 16, 32, 15, 18, 5, 7
(a) Find the median.
(b) Work out the range.

(a) Put in order: 5, 7, 10, 15, 16, 18, 28, 32
The middle two values are 15 and 16, so the median is 31 ÷ 2 = 15.5
(b) Range = largest − smallest = 32 − 5 = 27
Answer: (a) 15.5 (b) 27

3 Cost formulae

A photographer charges £9 plus £4 for each hour of a wedding.
(a) Work out the total cost for 4 hours.
(b) The total cost is £69. Work out the number of hours.

(a) 4 × 4 = 16, then 9 + 16 = 25
(b) Take off the fixed charge: 69 − 9 = 60
Divide by the cost for each: 60 ÷ 4 = 15
Answer: (a) £25 (b) 15

4 Sample space of two dice

Two fair dice, numbered 1 to 4 and 1 to 4, are rolled.
Work out the probability that the product of the two scores is odd.

There are 4 × 4 = 16 equally likely outcomes
The product is odd only when both scores are odd: 2 × 2 = 4 outcomes
P = 4 out of 16
Answer: $\frac{1}{4}$

5 Column vectors

$\mathbf{a} = \begin{pmatrix} -6 \\ 7 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} -1 \\ -3 \end{pmatrix}$
Work out
(a) $3\mathbf{a} + \mathbf{b}$
(b) $4\mathbf{a} + \mathbf{b}$

(a) $\begin{pmatrix} -18 \\ 21 \end{pmatrix} + \begin{pmatrix} -1 \\ -3 \end{pmatrix} = \begin{pmatrix} -19 \\ 18 \end{pmatrix}$
(b) $\begin{pmatrix} -24 \\ 28 \end{pmatrix} + \begin{pmatrix} -1 \\ -3 \end{pmatrix} = \begin{pmatrix} -25 \\ 25 \end{pmatrix}$
Answer: (a) $\begin{pmatrix} -19 \\ 18 \end{pmatrix}$ (b) $\begin{pmatrix} -25 \\ 25 \end{pmatrix}$

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6 Negative and zero indices

Work out

(a) 4^{-3}

(b) $7^0 + \sqrt{81}$

(a) A negative power means the reciprocal: $4^{-3} = \frac{1}{4^3} = \frac{1}{64}$

(b) Anything to the power 0 is 1, so $7^0 = 1$

$\sqrt{81} = 9$, so $1 + 9 = 10$

Answer: (a) $\frac{1}{64}$ (b) 10

7 Perimeter with algebra

An isosceles triangle has two equal sides of length (2x + 4) m and a third side of length (2x) m.
The perimeter of the triangle is 44 m.
Work out the value of x.

$2(2x + 4) + (2x) = 44$
$6x + 8 = 44$
$6x = 36$
$x = 6$
Answer: x = 6

8 Fraction problems

A water tank is $\frac{1}{2}$ full.

42 litres of water are added.

The water tank is now $\frac{4}{5}$ full.

Work out the capacity of the water tank.

Fraction added = $\frac{4}{5} - \frac{1}{2} = \frac{3}{10}$

$\frac{3}{10}$ of the capacity = 42 litres

$\frac{1}{10}$ of the capacity = 42 ÷ 3 = 14 litres

Whole capacity = 14 × 10 = 140 litres

Answer: 140 litres

9 Average speed

A coach travels at 30 km/h for 1.5 hours and then at 90 km/h for 1.5 hours.
Work out its average speed for the whole journey.

Distance: 30 × 1.5 = 45 km and 90 × 1.5 = 135 km
Total distance = 180 km and total time = 3 hours
Average speed = 180 ÷ 3 = 60
Answer: 60 km/h

10 Algebraic proof

Show that $(n + 9)(n + 3) - n(n + 12)$ has the same value for every whole number n.

Expand the first part: $n^2 + 3n + 9n + 27 = n^2 + 12n + 27$

Expand the second part: $n^2 + 12n$

Subtract: the n^2 terms and the n terms cancel, leaving 27

Answer: The value is always 27