Day 172 **B Tier 10-a-day: Model Solutions**

1 Column vectors

$\mathbf{a} = \begin{pmatrix} 7 \\ -6 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} 5 \\ -5 \end{pmatrix}$

Work out

(a) $3\mathbf{a} + \mathbf{b}$

(b) $3\mathbf{a} - \mathbf{b}$

(a) $\begin{pmatrix} 21 \\ -18 \end{pmatrix} + \begin{pmatrix} 5 \\ -5 \end{pmatrix} = \begin{pmatrix} 26 \\ -23 \end{pmatrix}$

(b) $\begin{pmatrix} 21 \\ -18 \end{pmatrix} - \begin{pmatrix} 5 \\ -5 \end{pmatrix} = \begin{pmatrix} 16 \\ -13 \end{pmatrix}$

Answer: (a) $\begin{pmatrix} \mathbf{26} \\ \mathbf{-23} \end{pmatrix}$ **(b)** $\begin{pmatrix} \mathbf{16} \\ \mathbf{-13} \end{pmatrix}$

2 Laws of indices

Simplify fully

(a) $(3y^2)^2$

(b) $4y^7 \div 2y^4$

(a) $3^2 = 9$ and the powers multiply: $2 \times 2 = 4$

(b) Divide the numbers: $4 \div 2 = 2$. Subtract the powers: $7 - 4 = 3$

Answer: (a) $\mathbf{9y^4}$ **(b)** $\mathbf{2y^3}$

3 Transformations of a point

(a) The point P(1, 3) is translated by the vector $\begin{pmatrix} 1 \\ 5 \end{pmatrix}$. Write down the coordinates of the image.

(b) The point P(1, 3) is rotated 180° about the origin. Write down the coordinates of the image.

(a) Add the vector: (1 + 1, 3 + 5) = (2, 8)

(b) A half turn takes (x, y) to (−x, −y): (−1, −3)

Answer: (a) (2, 8) (b) (−1, −3)

4 Expected outcomes

The probability that a spinner lands on blue is $\frac{1}{5}$.

Work out how many times you would expect this to happen in 120 spins.

Expected number = probability × number of trials

$\frac{1}{5} \times 120 = 24$

Answer: 24

5 Significant figures

Work out the value of this expression. (Calculator)

$\frac{4.1}{8.2} + \frac{9.8}{2.2}$

Give your answer correct to 3 significant figures.

Use a calculator: the full display is 4.954545...

Round to 3 significant figures: 4.95

Answer: 4.95

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6 Combining ratios

In a bag of counters, the ratio of yellow to black is 5 : 6.
The ratio of black to white is 5 : 1.
Write down the ratio yellow : black : white.

Make the black part the same in both ratios: lowest common multiple of 6 and 5 is 30
yellow : black = 25 : 30
black : white = 30 : 6
yellow : black : white = 25 : 30 : 6
Answer: 25 : 30 : 6

7 Substitution into formulae

$s = ut + \frac{1}{2}at^2$

Work out the value of s when u = 8, a = 6 and t = 6

$s = 8 \times 6 + \frac{1}{2} \times 6 \times 6^2$

$s = 48 + \frac{1}{2} \times 6 \times 36$

$s = 48 + 108 = 156$

Answer: s = 156

8 Reverse percentages

The price of a meal including VAT at 20% is £360. (Calculator)
Work out the price of the meal before VAT was added.

The price including VAT is 100% + 20% = 120% of the price before VAT.
120% = £360, so 1% = £360 ÷ 120 = £3
100% = £3 × 100 = £300
Answer: £300

9 Area of a triangle using sine

In triangle XYZ, XY = 13 cm, YZ = 12 cm and angle XYZ = 140°. (Calculator)
Work out the area of the triangle.
Give your answer correct to 1 decimal place.

Area = ½ab sin C
Area = ½ × 13 × 12 × sin 140°
= 50.137...
= 50.1 cm^2 (1 d.p.)
Answer: 50.1 cm^2

10 Repeated percentage change

The price of a laptop is £100.
The price is first reduced by 25%, then the new price is reduced by 25%.
(a) Work out the final price.
(b) Work out the overall percentage decrease in the price.

(a) Multipliers: 0.75 and 0.75
100 × 0.75 × 0.75 = £56.25
(b) Overall multiplier = 0.5625
Overall decrease = 43.75%
Answer: (a) £56.25 (b) 43.75% decrease