Day 250 **A Tier 10-a-day: Model Solutions**

1 Substitution

Work out the value of $2x^2 - 4x + 9$ when $x = -3$

Substitute $x = -3$: $2 \times (-3)^2 - 4 \times (-3) + 9$
$= 18 + 12 + 9$
$= 39$
Answer: 39

2 Stratified sampling

A company has 220 employees in Sales, 140 in Admin and 280 in Production.
A stratified sample of 32 employees is to be taken.
Work out how many employees should be chosen from Admin.

Total = 220 + 140 + 280 = 640

Number from Admin = $\frac{140}{640} \times 32$

= 7
Answer: 7

3 Dividing fractions in context

A jug holds $21\frac{3}{4}$ litres of juice. Glasses hold $\frac{3}{4}$ litre each.

How many glasses can be filled completely?

Divide: $21\frac{3}{4} \div \frac{3}{4}$

As improper fractions and multiplying by the reciprocal: $\frac{87}{4} \times \frac{4}{3}$

= 29
Answer: 29

4 Midpoints and length of a line segment

M is the midpoint of AB.
A is the point (6, 3) and M is the point (5, 4).
Work out the coordinates of B.

From A to M: x changes by -1 and y changes by 1
Do the same again from M to get B
B = (5 + (−1), 4 + 1) = (4, 5)
Answer: (4, 5)

5 Percentage change

Ali buys a painting for £800.
He sells it for £768.
Work out his percentage loss.

Loss = £800.00 − £768.00 = £32.00

Percentage loss = $\frac{£32.00}{£800.00} \times 100 = 4\%$

Answer: 4%

6 Similar shapes: area and volume

Two similar model boats have heights 15 cm and 25 cm.
The surface area of the smaller one is 45 cm^2.
Work out the surface area of the larger one.

Length scale factor = $25 \div 15 = \frac{5}{3}$

Area scale factor = $(\frac{5}{3})^2 = \frac{25}{9}$

Area = $45 \times \frac{25}{9} = 125$

Answer: 125 cm^2

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7 Surd fractions

Show that $\frac{\sqrt{216}-\sqrt{96}}{\sqrt{6}}$ is an integer, and find its value.

$\sqrt{216} = 6\sqrt{6}$ and $\sqrt{96} = 4\sqrt{6}$

Numerator $= 6\sqrt{6} - 4\sqrt{6} = 2\sqrt{6}$

$\frac{2\sqrt{6}}{\sqrt{6}} = 2$

Answer: 2

8 The quadratic formula

Solve $2x^2 + 2x - 2 = 0$

Give your solutions correct to 2 decimal places. (Calculator)

Use $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ with $a = 2$, $b = 2$, $c = -2$

$x = \frac{-2 \pm \sqrt{2^2 - 4 \times 2 \times (-2)}}{4}$

$x = \frac{-2 \pm \sqrt{20}}{4}$

$x = 0.62$ or $x = -1.62$

Answer: $x = 0.62$ or $x = -1.62$

9 Loci and constructions

PQ is a straight line of length 8 cm.

A point S moves so that it is always 8 cm from the line PQ.

Describe the locus of S.

Along the line, the locus is two parallel lines 8 cm away

Near each end, the locus is a semicircle of radius 8 cm centred on P and on Q

Answer: A 'racetrack' shape: two straight lines 8 cm either side of PQ joined by a semicircle of radius 8 cm at each end

10 Rationalising the denominator

Rationalise the denominator of $\frac{17}{\sqrt{27}}$

Give your answer in its simplest form.

Simplify the denominator: $\sqrt{27} = 3\sqrt{3}$

$\frac{17}{\sqrt{27}} = \frac{17}{3\sqrt{3}}$

Multiply top and bottom by $\sqrt{3}$: $\frac{17\sqrt{3}}{3 \times 3}$

$= \frac{17\sqrt{3}}{9}$

Answer: $\frac{17\sqrt{3}}{9}$