Day 268 **A Tier 10-a-day: Model Solutions**

1 Time

(a) A coach leaves Leeds at 7:05 pm. The journey takes 3 hours 52 minutes. Work out the time it ends.
(b) Change 105 minutes into hours. Give your answer as a decimal.

(a) 7:05 pm + 3 hours 52 minutes = 10:57 pm
(b) 105 ÷ 60 = 1.75 hours
Answer: (a) 10:57 pm (b) 1.75 hours

2 Converting speeds

A car travels at 36 km/h.
Work out this speed in metres per second.

1 km = 1000 m and 1 hour = 3600 seconds
36 km/h = 36 × 1000 ÷ 3600 m/s
= 36 ÷ 3.6 = 10
Answer: 10 m/s

3 Describing transformations

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

The triangle and its image are the same distance from a vertical mirror line
Each point moves to the mirror line and the same distance beyond it
The mirror line is halfway between matching points, at $x = -1$
Answer: Reflection in the line $x = -1$

4 Factorising

Factorise $3x^2 - 5x - 12$

Multiply $3 \times -12 = -36$. Find two numbers that multiply to -36 and add to -5: -9 and 4
$3x^2 - 5x - 12 = 3x^2 - 9x + 4x - 12$
Factorise in pairs to get $(3x + 4)(x - 3)$
Answer: $(3x + 4)(x - 3)$

5 Density

A piece of wood has a mass of 276 g.
The density of the material is 1.2 g/cm^3.
Work out the volume of the piece of wood.

Volume = mass ÷ density
= 276 ÷ 1.2 = 230 cm^3
Answer: 230 cm^3

6 Similar shapes: area and volume

Two similar statues have heights 8 cm and 12 cm.
The smaller one has a volume of 48 cm^3.
Work out the volume of the larger one.

Length scale factor = $12 \div 8 = \frac{3}{2}$

Volume scale factor = $(\frac{3}{2})^3 = \frac{27}{8}$

Volume = $48 \times \frac{27}{8} = 162$

Answer: 162 cm^3

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7 Rationalising the denominator

Rationalise the denominator of $\frac{8}{\sqrt{8}}$

Give your answer in its simplest form.

Simplify the denominator: $\sqrt{8} = 2\sqrt{2}$

$\frac{8}{\sqrt{8}} = \frac{8}{2\sqrt{2}}$

Multiply top and bottom by $\sqrt{2}$: $\frac{8\sqrt{2}}{2 \times 2}$

$= 2\sqrt{2}$

Answer: $2\sqrt{2}$

8 Perpendicular bisector

A is the point $(-2, 8)$ and B is the point $(4, 2)$.

Find the equation of the perpendicular bisector of AB.

Midpoint of AB = $(\frac{(-2) + 4}{2}, \frac{8 + 2}{2}) = (1, 5)$

Gradient of AB = $\frac{-6}{6} = -1$

Perpendicular gradient = $-1 \div (-1) = 1$

$y = x + c$ through $(1, 5)$: $5 = 1 \times 1 + c$, so $c = 4$

$y = x + 4$

Answer: $y = x + 4$

9 Finding a rate of compound change

Aisha invests £2,500 in a savings account. (Calculator)

Compound interest is paid at a fixed rate each year.

After 2 years the investment is worth £2,652.25.

Work out the annual rate of interest.

Overall multiplier = £2,652.25 ÷ £2,500 = 1.0609

Take the square root: $\sqrt{1.0609} = 1.03$

Rate = $(1.03 - 1) \times 100 = 3\%$

Answer: 3%

10 Algebraic rearrangement and change of sign

$f(x) = x^3 - 2x^2 + 5x - 2$

Show that the equation $f(x) = 0$ has a solution between $x = 0$ and $x = 1$.

$f(0) = -2$

$f(1) = 2$

There is a change of sign and f is continuous, so there is a solution between $x = 0$ and $x = 1$

Answer: $f(0) = -2$ and $f(1) = 2$ (change of sign)