Day 45 **A Tier 10-a-day: Model Solutions**

1 Converting units of area and volume

Convert 0.25 m^3 into cm^3.

1 m = 100 cm, so 1 m^3 = 100 × 100 × 100 = 1 000 000 cm^3
0.25 × 1 000 000 = 250000
Answer: 250000 cm^3

2 Functions

f(x) = 3x − 6
g(x) = x^2 − 3
(a) Find f(−2)
(b) Find fg(x). Give your answer in its simplest form.

(a) f(−2) = 3 × (−2) − 6 = −12
(b) fg(x) means f(g(x)), so replace x in f with x^2 − 3
fg(x) = 3(x^2 − 3) − 6
= 3x^2 − 15
Answer: (a) −12 (b) 3x^2 − 15

3 HCF and LCM in index form

A = $2^2 \times 5^3 \times 7^2$
B = $2^4 \times 5^4 \times 7^3$
Find the highest common factor (HCF) and the lowest common multiple (LCM) of A and B.
Give your answers as products of prime factors.

HCF: for each prime take the lower power (a missing prime has power 0): $2^2 \times 5^3 \times 7^2$
LCM: for each prime take the higher power: $2^4 \times 5^4 \times 7^3$
Answer: HCF = $2^2 \times 5^3 \times 7^2$, LCM = $2^4 \times 5^4 \times 7^3$

4 Reverse percentages

The price of a season ticket increases by 12%.
The new price is £89.60.
Work out the price before the increase.

112% represents £89.60
1% = £89.60 ÷ 112 = £0.8
100% = £0.8 × 100 = £80.00
Answer: £80.00

5 Solving quadratic equations

Solve 3x^2 + 4x − 4 = 0

Factorise: (x + 2)(3x − 2) = 0
x + 2 = 0 or 3x − 2 = 0
x = −2 or x = $\frac{2}{3}$
Answer: x = −2 or x = $\frac{2}{3}$

6 Error intervals

m = 8,400 is rounded to the nearest 100.
Write down the error interval for m.

The rounding unit is 100, so the value could be up to half of this, 50, either side.
Lower bound = 8,400 − 50 = 8,350, upper bound = 8,400 + 50 = 8,450
Answer: 8,350 ≤ m < 8,450

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7 Perpendicular bisector

A is the point (−4, −2) and B is the point (2, 0).
Find the equation of the perpendicular bisector of AB.

Midpoint of AB = $(\frac{(-4)+2}{2}, \frac{(-2)+0}{2}) = (-1, -1)$

Gradient of AB = $\frac{2}{6} = \frac{1}{3}$

Perpendicular gradient = $-1 \div \frac{1}{3} = -3$

$y = -3x + c$ through $(-1, -1)$: $-1 = -3 \times (-1) + c$, so $c = -4$
$y = -3x - 4$
Answer: $y = -3x - 4$

8 Similar shapes: area and volume

Two similar shapes have areas 18 cm^2 and 162 cm^2.
The length of one side of the smaller shape is 2 cm.
Work out the length of the matching side on the larger shape.

Area scale factor = 162 ÷ 18 = 9
Length scale factor = $\sqrt{9} = 3$
Length = 2 × 3 = 6
Answer: 6 cm

9 Mixing in a ratio

Jug A contains 12 litres of a mixture of concentrate and water in the ratio 3 : 1.
Jug B contains 18 litres of a mixture of concentrate and water in the ratio 1 : 2.
The contents of both jugs are mixed together.
Work out the ratio of concentrate to water in the mixture. Give your answer in its simplest form.

Jug A: concentrate = 3 × 12 ÷ 4 = 9 litres, water = 3 litres
Jug B: concentrate = 6 litres, water = 12 litres
Total: concentrate = 15 litres, water = 15 litres
Ratio = 15 : 15 = 1 : 1
Answer: 1 : 1

10 Converting units

(a) Change 4,800 cm^3 to litres.
(b) Change 1,250 mm^2 to cm^2.

(a) 4,800 cm^3 ÷ 1000 = 4.8 litres
(b) 1,250 mm^2 ÷ 100 = 12.5 cm^2
Answer: (a) 4.8 litres (b) 12.5 cm^2