Day 276 **A Tier 10-a-day: Model Solutions**

1 Distance-time graphs

A cyclist makes a journey. The distance-time graph shows the journey.
(a) For how many minutes did the cyclist stop?
(b) Work out the speed during the first part of the journey. Give your answer in km/h.

(a) The graph is horizontal from 20 to 40 minutes, so the stop is 40 − 20 = 20 minutes
(b) First part: distance 8 km in 20 minutes

Speed = distance ÷ time = $8 \div \frac{20}{60}$ = 24 km/h

Answer: (a) 20 minutes (b) 24 km/h

2 Equations with brackets

Solve 6(x − 1) = 4(x + 1) − 12

Expand the brackets: 6x − 6 = 4x + 4 − 12
Simplify: 6x − 6 = 4x − 8
Collect x terms on one side and numbers on the other: 2x = −2
x = −1
Answer: x = −1

3 Surface area of a cuboid

A closed gift box is a cuboid measuring 13 cm by 4 cm by 6 cm.
Work out the total surface area.

Faces: 13 × 4, 13 × 6 and 4 × 6 each appear twice
2 × (52 + 78 + 24)
= 2 × 154 = 308
Answer: 308 cm^2

4 Pressure

A machine rests on an area of 0.5 m^2 of the floor.
The pressure on the floor is 150 N/m^2.
Work out the force exerted by the machine.

Force = pressure × area
= 150 × 0.5 = 75
Answer: 75 N

5 Percentages of percentages

30% of a number is 9. (Calculator)
Work out 50% of the same number.

30% = 9, so 1% = 9 ÷ 30 = 0.3
50% = 0.3 × 50 = 15
Answer: 15

6 Simultaneous equations in context

5 sandwiches and 2 drinks cost £25.
5 sandwiches and 3 drinks cost £30.
Work out the cost of one drink.

Let s = cost of one sandwich in £ and d = cost of one drink in £
5s + 2d = 25 (1)
5s + 3d = 30 (2)
Multiply (1) by 3 and (2) by 2 to make the d coefficients match
15s + 6d = 75 (1)
10s + 6d = 60 (2)
The d terms have the same sign, so subtract equation (2) from equation (1)
5s = 15, so s = 3
Substitute s = 3 into equation (1) to find d = 5
Answer: £5

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7 Volume of a hollow cylinder

The diagram shows the cross-section of a metal pipe.
The outer radius is 7 cm and the inner radius is 5 cm.
The pipe is 15 cm long.
Work out the volume of metal used. Give your answer in terms of π.

Area of the ring = $\pi \times 7^2 - \pi \times 5^2 = \pi(49 - 25) = 24\pi$
Volume = area × length = $24\pi \times 15$
$= 360\pi$
Answer: 360π cm^3

8 Bounds of a speed or density

A metal block has mass 330 g and volume 180 cm^3. The mass is measured to the nearest 10 grams and the volume to the nearest cm^3. (Calculator)
Work out the upper bound for the density of the metal in g/cm^3.
Give your answer correct to 3 significant figures.

density = mass ÷ volume
For the upper bound of density use the upper bound of mass and the lower bound of volume.
335 ÷ 179.5 = 1.86630
= 1.87 g/cm^3 (3 s.f.)
Answer: 1.87 g/cm^3

9 Perpendicular bisector

A is the point (5, 2) and B is the point (−3, 0).
Find the equation of the perpendicular bisector of AB.

Midpoint of AB = $(\frac{5 + (-3)}{2}, \frac{2 + 0}{2}) = (1, 1)$

Gradient of AB = $\frac{-2}{-8} = \frac{1}{4}$

Perpendicular gradient = $-1 \div \frac{1}{4} = -4$

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

10 Bearings with the cosine rule

Boat P sails 18 km from a harbour on a bearing of 195°.
Boat Q sails 13 km from the same harbour on a bearing of 075°. (Calculator)
Work out the distance between the two boats.
Give your answer to 3 significant figures.

The angle between the two paths = $|195° - 75°| = 120°$
$d^2 = 18^2 + 13^2 - 2 \times 18 \times 13 \times \cos 120°$
$d^2 = 727.00$
$d = 27.0$
Answer: 27.0 km