Day 273 **A Tier 10-a-day: Model Solutions**

1 Converting speeds

A lorry travels at 108 km/h.
Work out this speed in metres per minute.

In 1 hour: 108 km = 108000 m
1 hour = 60 minutes, so 108000 ÷ 60 = 1800 m per minute
Answer: 1800 m/min

2 Circle theorems: angle in a semicircle

XY is a diameter of the circle.
Angle YXZ = 33°.
Work out the size of angle x.
Give a reason for each step of your working.

The angle in a semicircle is 90°, so angle XZY = 90°
Angles in a triangle add up to 180°
x = 180 − 90 − 33 = 57
Answer: x = 57°

3 Wages and overtime

Chloe is paid £13.80 per hour for a basic week of 38 hours. (Calculator)
Overtime is paid at time and a half.
Last week Chloe worked 3 hours of overtime.
Work out Chloe's total pay for the week.

Basic pay = 38 × £13.80 = £524.40
Overtime rate = £13.80 × 1.5 = £20.70 per hour
Overtime pay = 3 × £20.70 = £62.10
Total = £524.40 + £62.10 = £586.50
Answer: £586.50

4 Congruent triangles

Triangle UVW: UV = 9 cm, VW = 5 cm, UW = 7 cm.
Triangle STU: ST = 9 cm, TU = 5 cm, SU = 8 cm.
Are the two triangles congruent?
Give a reason for your answer.

The sides of triangle UVW are 9, 5 and 7
The sides of triangle STU are 9, 5 and 8
The side lengths are not the same, so the triangles are not congruent
Answer: No, not congruent

5 Simultaneous equations in context

3 muffins and 3 coffees cost £30.
1 muffin and 2 coffees cost £12.
Work out the cost of one coffee.

Let m = cost of one muffin in £ and c = cost of one coffee in £
3m + 3c = 30 (1)
m + 2c = 12 (2)
Multiply (1) by 2 and (2) by 3 to make the c coefficients match
6m + 6c = 60 (1)
3m + 6c = 36 (2)
The c terms have the same sign, so subtract equation (2) from equation (1)
3m = 24, so m = 8
Substitute m = 8 into equation (1) to find c = 2
Answer: £2

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6 Average speed

Priya drives 60 km at 60 km/h and then a further 60 km at 30 km/h.
Work out the average speed for the whole journey.

Time for first part = 60 ÷ 60 = 1 hours
Time for second part = 60 ÷ 30 = 2 hours
Total distance = 120 km, total time = 3 hours
Average speed = 120 ÷ 3 = 40 km/h
Answer: 40 km/h

7 Bounds of a speed or density

A metal block has mass 360 g and volume 90 cm^3. The mass is measured to the nearest 10 grams and the volume to the nearest cm^3. (Calculator)
Work out the lower bound for the density of the metal in g/cm^3.
Give your answer correct to 3 significant figures.

density = mass ÷ volume
For the lower bound of density use the lower bound of mass and the upper bound of volume.
355 ÷ 90.5 = 3.92265
= 3.92 g/cm^3 (3 s.f.)
Answer: 3.92 g/cm^3

8 Circle theorems: isosceles triangles with radii

A, B and C are points on a circle with centre O.
Angle OAB = 38°.
(a) Work out angle AOB.
(b) Work out the size of angle x.
Give reasons for your answers.

(a) OA = OB (radii), so triangle OAB is isosceles and angle OBA = 38°
Angle AOB = 180 − 38 − 38 = 104°
(b) The angle at the centre is twice the angle at the circumference
x = 104 ÷ 2 = 52
Answer: (a) 104° (b) x = 52°

9 Expanding with surds

Expand and simplify $(4 + \sqrt{3})(4 - \sqrt{3})$

The middle terms cancel: $(4 + \sqrt{3})(4 - \sqrt{3}) = 16 - 3$
= 13
Answer: 13

10 Rearranging formulae (subject twice)

Make x the subject of $y = \frac{4x - 3}{x - 6}$

Multiply both sides by (x − 6): y(x − 6) = 4x − 3
Expand the bracket: xy − 6y = 4x − 3
Collect the x terms on one side: xy − 4x = 6y − 3
Factorise: x(y − 4) = 6y − 3
Divide by (y − 4): $x = \frac{6y - 3}{y - 4}$
Answer: $x = \frac{6y - 3}{y - 4}$