Day 235 **A Tier 10-a-day: Model Solutions**

1 Rounding

(a) Write 8840.2 correct to 2 significant figures.
(b) Write 89.538 correct to 1 decimal place.

(a) Count 2 significant figures and look at the next digit: 8840.2 rounds to 8800
(b) Look at the digit after decimal place 1: 89.538 rounds to 89.5
Answer: (a) 8800 (b) 89.5

2 Equations with brackets

Solve $6(x + 1) = 3(x + 7) - 9$

Expand the brackets: $6x + 6 = 3x + 21 - 9$
Simplify: $6x + 6 = 3x + 12$
Collect x terms on one side and numbers on the other: $3x = 6$
$x = 2$
Answer: x = 2

3 Angles in parallel lines

The diagram shows two parallel lines crossed by a straight line.
(a) Work out the value of x.
(b) Work out the size of the angle marked $(4x + 5)°$.
The diagram is not drawn accurately.

(a) Co-interior angles add up to 180°
$4x + 5 + 3x - 28 = 180$
$7x - 23 = 180$
$7x = 203$
$x = 29$
(b) $4 \times 29 + 5 = 121$
Answer: (a) x = 29 (b) 121°

4 Square and cube numbers

n is the smallest positive integer such that $90 \times n$ is a square number.
Find the value of n.

Write 90 as a product of prime factors: $90 = 2 \times 3^2 \times 5$
For a square number every prime must have a power that is a multiple of 2.
Extra primes needed: 2 (needs 1 more), 5 (needs 1 more)
$n = 10$
Answer: n = 10

5 Forming quadratic equations

A rectangle has width x cm and length $(x + 5)$ cm.
The area of the rectangle is 104 cm^2.
(a) Show that $x^2 + 5x - 104 = 0$
(b) Work out the value of x.

(a) Area = length × width, so $x(x + 5) = 104$
$x^2 + 5x = 104$
$x^2 + 5x - 104 = 0$
(b) Factorise: $(x - 8)(x + 13) = 0$
$x = 8$ or $x = -13$
A length cannot be negative, so $x = 8$
Answer: (a) Shown (b) x = 8

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6 Estimating the mean from grouped data

The table shows the times, in minutes, taken by 20 people to finish a race.
(a) Write down the class that contains the median.
(b) Work out an estimate for the mean.

(a) The median is in position (20 + 1) ÷ 2 = 10.5. Cumulative frequencies: 2, 4, 8, 12, 20
The median is in the class $80 < t \leq 90$
(b) Midpoints: 55, 65, 75, 85, 95
55 × 2 + 65 × 2 + 75 × 4 + 85 × 4 + 95 × 8 = 1640
Estimate = 1640 ÷ 20 = 82
Answer: (a) $80 < t \leq 90$ (b) 82

7 The sine rule

Work out the size of angle x. (Calculator)
Give your answer to 1 decimal place.
The diagram is not drawn accurately.

$$\frac{\sin x}{6} = \frac{\sin 71°}{9}$$

$$\sin x = \frac{6 \times \sin 71°}{9}$$

$x = \sin^{-1}(0.6303)$
$x = 39.1°$
Answer: $x = 39.1°$

8 Stratified sampling

A club has 250 members in junior, 250 in intermediate and 175 in senior.
A stratified sample of 27 members is to be taken.
Work out how many members should be chosen from intermediate.

Total = 250 + 250 + 175 = 675

$$\text{Number from intermediate} = \frac{250}{675} \times 27$$

= 10
Answer: 10

9 Volume of composite solids

A solid is made from a cylinder of radius 3 cm and a hemisphere on top, with the same radius.
The total volume of the solid is 72π cm^3.
Work out the height of the cylinder.

$$\text{Hemisphere} = \frac{2}{3} \times \pi \times 3^3 = 18\pi$$

Cylinder volume = $72\pi - 18\pi = 54\pi$
$\pi \times 3^2 \times h = 54\pi$
$h = 54 \div 9 = 6$
Answer: 6 cm

10 Simultaneous equations (one quadratic)

Solve the simultaneous equations
$y = x^2 + 7x - 2$
$y = 4x + 8$

Set the y values equal: $x^2 + 7x - 2 = 4x + 8$
$x^2 + 3x - 10 = 0$
$(x + 5)(x - 2) = 0$
$x = -5$ or $x = 2$
Substitute into $y = 4x + 8$: $y = -12$ and $y = 16$
Answer: $x = -5$, $y = -12$ and $x = 2$, $y = 16$