Day 353 **A Tier 10-a-day: Model Solutions**

1 Completing the square

Solve $x^2 - 10x + 4 = 0$ by completing the square.
Give your answers in surd form.

$x^2 - 10x + 4 = (x - 5)^2 - 21$
$(x - 5)^2 = 21$
$x - 5 = \pm\sqrt{21}$
$x = 5 \pm \sqrt{21}$
Answer: $x = 5 \pm \sqrt{21}$

2 Growth and decay

The population of a town is 25000. (Calculator)
It increases by 10% each year.
Work out the population after 2 years.
Give your answer to the nearest whole number.

Multiplier = 100% + 10% = 1.1
$25000 \times 1.1^2 = 30250.00$
= 30250 to the nearest whole number
Answer: 30250

3 Bearings

The bearing of M from L is 245°.
Work out the bearing of L from M.
The diagram is not drawn accurately.

The north lines at L and M are parallel
Back bearing = 245° − 180° = 65°
Answer: 065°

4 Converting units

(a) Change 12,000 cm^3 to litres.
(b) Change 1,250 mm^2 to cm^2.

(a) 12,000 $cm^3 \div 1000$ = 12 litres
(b) 1,250 $mm^2 \div 100$ = 12.5 cm^2
Answer: (a) 12 litres (b) 12.5 cm^2

5 Angles in regular polygons around a point

A square and an equilateral triangle share the side AB and are on opposite sides of it.
The two shapes meet at the point A.
Work out the size of the angle at A that is not inside either shape.

Interior angle of the square = 180 − 360 ÷ 4 = 90°
Interior angle of the equilateral triangle = 180 − 360 ÷ 3 = 60°
Angles round a point add up to 360°
360 − 90 − 60 = 210
Answer: 210°

6 Income tax

No tax is paid on the first £12,000 of income. Tax of 25% is paid on the next £35,000. Tax of 35% is paid on all income above £47,000. (Calculator)
Aisha earns £61,500 a year.
Work out the income tax paid.

Next £35,000 at 25%: £35,000 × 0.25 = £8,750
Above £47,000: £61,500 − £47,000 = £14,500, taxed at 35%: £14,500 × 0.35 = £5,075
Total tax = £8,750 + £5,075 = £13,825
Answer: £13,825

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7 Adding algebraic fractions

Write as a single fraction in its simplest form

$\frac{x-1}{4} - \frac{x-1}{3}$

Common denominator is 12

$= \frac{3(x-1) - 4(x-1)}{12}$

$= \frac{-x+1}{12}$

Answer: $\mathbf{\frac{-x+1}{12}}$

8 Recurring decimals (mixed)

Write $0.9\dot{2}$ as a fraction in its simplest form.

Let x = 0.922...
Multiply by 10: 10x = 9.22...
Multiply by 100: 100x = 92.22...
Subtract: 90x = 92 − 9 = 83

$x = \frac{83}{90}$

Answer: $\mathbf{\frac{83}{90}}$

9 Circle theorems: angles in the same segment

A, B, C and D are points on a circle. AC and BD meet at E.
Angle BAC = 45° and angle ACD = 47°.
Work out the size of angle x (angle AEB).
Give reasons for your working.

Angles in the same segment are equal, so angle ABD = angle ACD = 47°
In triangle ABE: angle BAE = 45° and angle ABE = 47°
x = 180 − 45 − 47 = 88
Answer: x = 88°

10 Mixing in a ratio

Jug A contains 25 litres of a mixture of concentrate and water in the ratio 4 : 1.
Jug B contains 11 litres of a mixture of concentrate and water in the ratio 5 : 6.
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 = 4 × 25 ÷ 5 = 20 litres, water = 5 litres
Jug B: concentrate = 5 litres, water = 6 litres
Total: concentrate = 25 litres, water = 11 litres
Ratio = 25 : 11 = 25 : 11
Answer: 25 : 11