Day 301 **A Tier 10-a-day: Model Solutions**

1 Simultaneous equations

Solve the simultaneous equations
$-3x + 2y = -18$
$2x + 4y = -4$

Multiply (1) by 2 to make the y coefficients match
$-6x + 4y = -36$ (1)
$2x + 4y = -4$ (2)
The y terms have the same sign, so subtract equation (1) from equation (2)
$8x = 32$, so $x = 4$
Substitute $x = 4$ into equation (1) to find $y = -3$
Answer: $x = 4$, $y = -3$

2 Income tax

No tax is paid on the first £11,000 of income. Tax of 25% is paid on the next £35,000. Tax of 35% is paid on all income above £46,000. (Calculator)
Aisha earns £54,500 a year.
Work out the income tax paid.

Next £35,000 at 25%: £35,000 × 0.25 = £8,750
Above £46,000: £54,500 − £46,000 = £8,500, taxed at 35%: £8,500 × 0.35 = £2,975
Total tax = £8,750 + £2,975 = £11,725
Answer: £11,725

3 Circle theorems: angle in a semicircle

PQ is a diameter of the circle.
Angle QPR = 40°.
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 PRQ = 90°
Angles in a triangle add up to 180°
$x = 180 - 90 - 40 = 50$
Answer: $x = 50°$

4 Solving quadratic equations

Solve $6x^2 + 7x - 3 = 0$

Factorise: $(3x - 1)(2x + 3) = 0$
$3x - 1 = 0$ or $2x + 3 = 0$
$x = \frac{1}{3}$ or $x = -\frac{3}{2}$
Answer: $x = \frac{1}{3}$ or $x = -\frac{3}{2}$

5 Error intervals

t = 870 is rounded to the nearest 10.
Write down the error interval for t.

The rounding unit is 10, so the value could be up to half of this, 5, either side.
Lower bound = 870 − 5 = 865, upper bound = 870 + 5 = 875
Answer: $865 \leq t < 875$

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6 Quadratic graphs

The curve C has equation $y = x^2 + 2x - 8$
(a) Find the coordinates of the points where C crosses the x-axis.
(b) Find the coordinates of the turning point of C.

(a) Set $y = 0$: $x^2 + 2x - 8 = 0$
$(x - 2)(x + 4) = 0$
$x = -4$ or $x = 2$, so the graph crosses the x-axis at $(-4, 0)$ and $(2, 0)$
(b) The turning point is halfway between the roots: $x = (-4 + 2) \div 2 = -1$
$y = -9$, so the minimum point is $(-1, -9)$
Answer: (a) (−4, 0) and (2, 0) (b) (−1, −9)

7 Simple and compound interest

Harry and Dev each invest £5000 for 2 years. (Calculator)
Harry's account pays 4% simple interest per year.
Dev's account pays 4% compound interest per year.
Work out how much more interest Dev earns than Harry.

Simple interest = £5000 × 4% × 2 = £400
Compound: £5000 × 1.04^2 = £5408.00, so interest = £408.00
Difference = 408.00 − 400 = £8.00 (to the nearest penny)
Answer: £8.00

8 Area of a segment

The diagram shows a circle with centre O and radius 9 cm.
Angle AOB = 130°. (Calculator)
Work out the area of the shaded segment.
Give your answer to 3 significant figures.

Area of sector = $\frac{130}{360} \times \pi \times 9^2 = 91.892$

Area of triangle OAB = $\frac{1}{2} \times 9 \times 9 \times \sin 130° = 31.025$

Segment = 91.892 − 31.025 = 60.9
Answer: 60.9 cm^2

9 Converting area and volume units

Change 2400 cm^3 to litres.

1 litre = 1000 cm^3
2400 ÷ 1000 = 2.4
Answer: 2.4 litres

10 The sine rule

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

$\frac{\sin x}{16} = \frac{\sin 90°}{22}$

$\sin x = \frac{16 \times \sin 90°}{22}$

$x = \sin^{-1}(0.7273)$
$x = 46.7°$
Answer: x = 46.7°