Day 47 **A Tier 10-a-day: Model Solutions**

1 Equations with brackets

Solve $6(x + 7) = 2(x + 8) + 10$

Expand the brackets: $6x + 42 = 2x + 16 + 10$
Simplify: $6x + 42 = 2x + 26$
Collect x terms on one side and numbers on the other: $4x = -16$
$x = -4$
Answer: $x = -4$

2 Map scales

The scale of a map is 1 : 10000.
A road is 0.3 km long.
Work out the length of the road on the map, in centimetres.

0.3 km = 30000 cm
Length on map = 30000 ÷ 10000 = 3 cm
Answer: 3 cm

3 Inequalities

Solve $-5x - 9 \geq -x - 25$

Collect the x terms on the left: $-4x - 9 \geq -25$
Add 9: $-4x \geq -16$
Divide by -4. Dividing by a negative number reverses the inequality sign
$x \leq 4$
Answer: $x \leq 4$

4 Density

A bar of soap has a volume of 290 cm^3.
The density of the material is 7.8 g/cm^3.
Work out the mass of the bar of soap.

Mass = density × volume
= 7.8 × 290 = 2262 g
Answer: 2262 g

5 Standard form in context

Light travels at 3×10^5 kilometres per second.
The Sun is 9.3×10^7 kilometres from Earth.
Work out how many seconds light takes to travel from the Sun to Earth.
Give your answer in standard form.

time = distance ÷ speed = $(9.3 \times 10^7) \div (3 \times 10^5)$
$9.3 \div 3 = 3.1$ and $10^7 \div 10^5 = 10^2$
$= 3.1 \times 10^2$ seconds
Answer: 3.1×10^2 seconds

6 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 = 60° and angle ACD = 36°.
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 = 36°
In triangle ABE: angle BAE = 60° and angle ABE = 36°
$x = 180 - 60 - 36 = 84$
Answer: $x = 84°$

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7 Composite functions

f(x) = 4x + 7

g(x) = x^2 + 3

Solve gf(x) = 28

gf(x) = $(4x + 7)^2 + 3$

$(4x + 7)^2 + 3 = 28$, so $(4x + 7)^2 = 25$

$4x + 7 = \pm 5$

$4x + 7 = 5$ or $4x + 7 = -5$

$x = -\frac{1}{2}$ or $x = -3$

Answer: $x = -\frac{1}{2}$ or $x = -3$

8 The cosine rule: finding an angle

Work out the size of angle x. (Calculator)

Give your answer to 1 decimal place.

The diagram is not drawn accurately.

$$\cos x = \frac{7^2 + 11^2 - 8^2}{2 \times 7 \times 11}$$

$$\cos x = \frac{106}{154}$$

$x = \cos^{-1}(0.6883)$

$x = 46.5°$

Answer: x = 46.5°

9 Rationalising with conjugates

Rationalise the denominator of $\frac{57}{5 + \sqrt{6}}$

Give your answer in the form $a + b\sqrt{c}$ where a and b are integers.

Multiply top and bottom by the conjugate $5 - \sqrt{6}$: $\frac{57(5 - \sqrt{6})}{(5 + \sqrt{6})(5 - \sqrt{6})}$

Denominator: $25 - 6 = 19$

$\frac{57(5 - \sqrt{6})}{19} = 3(5 - \sqrt{6})$

$= 15 - 3\sqrt{6}$

Answer: $15 - 3\sqrt{6}$

10 Simple and compound interest

Dev and Owen each invest £1000 for 2 years. (Calculator)

Dev's account pays 5% simple interest per year.

Owen's account pays 5% compound interest per year.

Work out how much more interest Owen earns than Dev.

Simple interest = £1000 × 5% × 2 = £100

Compound: £1000 × 1.05^2 = £1102.50, so interest = £102.50

Difference = 102.50 − 100 = £2.50 (to the nearest penny)

Answer: £2.50