Day 31 **A Tier 10-a-day: Model Solutions**

1 Circle theorems: angle in a semicircle

PQ is a diameter of the circle.
Angle QPR = 69°.
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 − 69 = 21
Answer: x = 21°

2 Equations with algebraic fractions

Solve $\frac{2}{(x-2)} + \frac{6}{(x+1)} = 1$

Multiply every term by $(x-2)(x+1)$
$2(x+1) + 6(x-2) = (x-2)(x+1)$
$8x - 10 = x^2 - x - 2$
$x^2 - 9x + 8 = 0$
$(x-1)(x-8) = 0$
x = 1 or x = 8
Answer: x = 1 or x = 8

3 Speed, distance and time

A train travels at 84 km/h for 2 hours 45 minutes.
Work out the distance travelled.

45 minutes = 0.75 hour, so time = 2.75 hours
Distance = speed × time = 84 × 2.75 = 231 km
Answer: 231 km

4 Finding a percentage change

The number of visitors to a museum was 80 and is now 32.
Work out the percentage decrease.

Change = 80 − 32 = 48
Percentage decrease = $\frac{48}{80} \times 100 = 60\%$
Answer: 60% decrease

5 Converting area and volume units

A swimming pool holds 2.4 m^3 of water.
How many litres is this?

1 m^3 = 1000 litres
2.4 × 1000 = 2400
Answer: 2400 litres

6 Sectors: finding an angle or radius

A sector has angle 72° at the centre and arc length 6π cm.
Work out the radius of the sector.

Arc length = $\frac{72}{360} \times 2 \times \pi \times r$
$6\pi = \frac{2}{5} \times r \times \pi$
$r = 6 \div \frac{2}{5}$
r = 15
Answer: 15 cm

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7 Successive percentage changes

The price of a product increases by 50% each year for 2 years.
Work out the overall percentage increase over the 2 years.

Multiplier for each year = 1.5

Overall multiplier = $1.5^2 = 2.25$

Percentage increase = 125%

Answer: 125%

8 Functions

$f(x) = -3x + 6$

$g(x) = x^2 + 3$

(a) Find g(2)

(b) Find gf(x). Expand and simplify your answer.

(a) $g(2) = 2^2 + 3 = 7$

(b) gf(x) means g(f(x)), so replace x in g with $-3x + 6$

$gf(x) = (-3x + 6)^2 + 3$

$= 9x^2 - 36x + 39$

Answer: (a) 7 (b) $9x^2 - 36x + 39$

9 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.

$$\cos x = \frac{20^2 + 19^2 - 7^2}{2 \times 20 \times 19}$$

$$\cos x = \frac{712}{760}$$

$x = \cos^{-1}(0.9368)$

$x = 20.5°$

Answer: x = 20.5°

10 Finding a rate of compound change

Ryan invests £18,500 in a savings account. (Calculator)
Compound interest is paid at a fixed rate each year.
After 2 years the investment is worth £22,385.
Work out the annual rate of interest.

Overall multiplier = £22,385 ÷ £18,500 = 1.21

Take the square root: $\sqrt{1.21} = 1.1$

Rate = $(1.1 - 1) \times 100 = 10\%$

Answer: 10%