Day 73 **A Tier 10-a-day: Model Solutions**

1 Difference of two squares

(a) Factorise $36x^2 - 1$

(b) Use the same idea to work out $42^2 - 8^2$ without a calculator.

(a) $36x^2 - 1 = (6x)^2 - 1^2$

$(6x - 1)(6x + 1)$

(b) $a^2 - b^2 = (a + b)(a - b)$, so $42^2 - 8^2 = (42 + 8)(42 - 8)$

$= 50 \times 34 = 1700$

Answer: (a) $(6x - 1)(6x + 1)$ (b) 1700

2 Loci and constructions

MN is a straight line of length 7 cm.

A point T moves so that it is always less than 7 cm from the point M.

Describe the region where T can be.

Less than 7 cm from M means inside the circle

Centre M, radius 7 cm

Answer: Inside a circle with centre M and radius 7 cm

3 Inequalities

Solve $-2x - 9 \leq 3x - 9$

Collect the x terms on the left: $-5x - 9 \leq -9$

Add 9: $-5x \leq 0$

Divide by -5. Dividing by a negative number reverses the inequality sign

$x \geq 0$

Answer: $x \geq 0$

4 Adding and subtracting in standard form

Work out $(2.5 \times 10^6) - (2.4 \times 10^4)$

Give your answer in standard form.

Write both numbers using 10^4: $2.5 \times 10^6 = 250 \times 10^4$

$(250 - 2.4) \times 10^4 = 247.6 \times 10^4$

In standard form: 2.476×10^6

Answer: 2.476×10^6

5 Mixing in a ratio

Jug A contains 8 litres of a mixture of red paint and white paint in the ratio 7 : 1.

Jug B contains 25 litres of a mixture of red paint and white paint in the ratio 1 : 4.

The contents of both jugs are mixed together.

Work out the ratio of red paint to white paint in the mixture. Give your answer in its simplest form.

Jug A: red paint = $7 \times 8 \div 8 = 7$ litres, white paint = 1 litres

Jug B: red paint = 5 litres, white paint = 20 litres

Total: red paint = 12 litres, white paint = 21 litres

Ratio = 12 : 21 = 4 : 7

Answer: 4 : 7

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6 Forming and solving equations

Maya is x years old.
Her mum is 4 times as old as Maya, plus 2 years.
The sum of their ages is 32 years.
Work out how old her mum is.

Let Maya's age be x, so her mum's age is 4x + 2
x + (4x + 2) = 32
5x = 30
x = 6
Her mum's age = 4 × 6 + 2 = 26
Answer: 26 years

7 Bearings and distances

A boat leaves a port and travels 10 km on a bearing of 140°. (Calculator)
It then travels 24 km on a bearing of 230°.
(a) Work out how far it is now from the port.
(b) Work out the bearing of its final position from the port. Give your answer to the nearest degree.

The two bearings differ by 90°, so the path makes a right angle
(a) Distance^2 = 10^2 + 24^2 = 676, so distance = 26 km

(b) The angle at the port between the first leg and the line to the end: $\tan^{-1}(\frac{24}{10})$ = 67.4°

Bearing = 140° + 67.4° = 207.4°
Bearing = 207°
Answer: (a) 26 km (b) 207°

8 Simple and compound interest

Kai and Tara each invest £1000 for 3 years. (Calculator)
Kai's account pays 6% simple interest per year.
Tara's account pays 6% compound interest per year.
Work out how much more interest Tara earns than Kai.

Simple interest = £1000 × 6% × 3 = £180
Compound: £1000 × 1.06^3 = £1191.016, so interest = £191.016
Difference = 191.016 − 180 = £11.02 (to the nearest penny)
Answer: £11.02

9 Area of a segment

The diagram shows a circle with centre O and radius 11 cm.
Angle AOB = 90°. (Calculator)
Work out the area of the shaded segment.
Give your answer to 3 significant figures.

Area of sector = $\frac{90}{360}$ × π × 11^2 = 95.033

Area of triangle OAB = $\frac{1}{2}$ × 11 × 11 × sin 90° = 60.500

Segment = 95.033 − 60.500 = 34.5
Answer: 34.5 cm^2

10 Finding a rate of compound change

Nadia invests £6,000 in a savings account. (Calculator)
Compound interest is paid at a fixed rate each year.
After 2 years the investment is worth £7,260.
Work out the annual rate of interest.

Overall multiplier = £7,260 ÷ £6,000 = 1.21
Take the square root: $\sqrt{1.21}$ = 1.1
Rate = (1.1 − 1) × 100 = 10%
Answer: 10%