Day 216 **A Tier 10-a-day: Model Solutions**

1 Completing the square

Solve $x^2 + 8x - 3 = 0$ by completing the square.
Give your answers in surd form.

$x^2 + 8x - 3 = (x + 4)^2 - 19$
$(x + 4)^2 = 19$
$x + 4 = \pm\sqrt{19}$
$x = -4 \pm \sqrt{19}$
Answer: $x = -4 \pm \sqrt{19}$

2 Finding a percentage change

The number of students in a school was 200 and is now 140.
Work out the percentage decrease.

Change = $200 - 140 = 60$
Percentage decrease = $\frac{60}{200} \times 100 = 30\%$
Answer: 30% decrease

3 Area of a sector

The diagram shows a sector of a circle of radius 9 cm.
Work out the area of the sector.
Give your answer in terms of π.
The diagram is not drawn accurately.

Area = $\frac{30}{360} \times \pi \times 9^2$
$= \frac{1}{12} \times 81\,\pi$
$= \frac{27}{4}\pi$
Answer: $\frac{27}{4}\pi$ cm^2

4 Direct and inverse proportion

y is directly proportional to the cube of x.
When x = 3, y = 189.
(a) Find a formula for y in terms of x.
(b) Work out the value of y when x = 8.

(a) $y = kx^3$. Substitute x = 3 and y = 189: $189 = k \times 27$, so $k = 7$
$y = 7x^3$
(b) $y = 7 \times 8^3 = 7 \times 512 = 3584$
Answer: (a) $y = 7x^3$ (b) 3584

5 Converting area and volume units

A swimming pool holds 6 m^3 of water.
How many litres is this?

1 m^3 = 1000 litres
$6 \times 1000 = 6000$
Answer: 6000 litres

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6 Trigonometry: finding a side

Work out the value of x. (Calculator)
Give your answer to 3 significant figures.
The diagram is not drawn accurately.

x is the hypotenuse and 6 cm is the adjacent, so use cos

$\cos 63° = \frac{6}{x}$

$x = 6 \div \cos 63°$

$x = 13.2$

Answer: x = 13.2 cm

7 Recurring decimals (mixed)

Write $0.40\dot{2}\dot{2}$ as a fraction in its simplest form.

Let x = 0.40202...
Multiply by 10: 10x = 4.0202...
Multiply by 1000: 1000x = 402.0202...
Subtract: 990x = 402 − 4 = 398

$x = \frac{398}{990} = \frac{199}{495}$

Answer: $\frac{199}{495}$

8 Venn diagrams from information

There are 30 students in a class.
16 students do tennis and 11 students do badminton.
5 students do neither.
(a) Work out how many students do both.
(b) One student is chosen at random. Find the probability that they do tennis only.

(a) Students doing at least one = 30 − 5 = 25
Both = 16 + 11 − 25 = 2
(b) tennis only = 16 − 2 = 14

Probability $= \frac{14}{30} = \frac{7}{15}$

Answer: (a) 2 (b) $\frac{7}{15}$

9 Rearranging formulae (subject twice)

Make x the subject of $y = \frac{3x + 2}{x + 6}$

Multiply both sides by (x + 6): y(x + 6) = 3x + 2
Expand the bracket: xy + 6y = 3x + 2
Collect the x terms on one side: xy − 3x = −6y + 2
Factorise: x(y − 3) = −6y + 2

Divide by (y − 3): $x = \frac{-6y + 2}{y - 3}$

Answer: $x = \frac{-6y + 2}{y - 3}$

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10 Rationalising the denominator

Rationalise the denominator of $\frac{16}{4\sqrt{3}}$

Give your answer in its simplest form.

Multiply top and bottom by $\sqrt{3}$: $\frac{16\sqrt{3}}{4 \times 3}$

$= \frac{16\sqrt{3}}{12} = \frac{4\sqrt{3}}{3}$

Answer: $\mathbf{\frac{4\sqrt{3}}{3}}$