Day 122 **A Tier 10-a-day: Model Solutions**

1 Expanding and simplifying

Expand and simplify

$(x + 1)^2 - (x - 4)(x - 3)$

$(x + 1)^2 = x^2 + 2x + 1$

$(x - 4)(x - 3) = x^2 - 7x + 12$

Subtract (take care with the signs): $(x^2 + 2x + 1) - (x^2 - 7x + 12)$

$= 9x - 11$

Answer: $9x - 11$

2 Standard form notation

(a) Write 0.000011 in standard form.

(b) Write 1.25×10^4 as an ordinary number.

(a) Move the decimal point 5 places to get 1.1: 1.1×10^{-5}

(b) Move the decimal point 4 places to the right: 12,500

Answer: (a) 1.1×10^{-5} (b) 12,500

3 Factorising

Factorise $6x^2 - 11x + 3$

Multiply $6 \times 3 = 18$. Find two numbers that multiply to 18 and add to -11: -2 and -9

$6x^2 - 11x + 3 = 6x^2 - 2x - 9x + 3$

Factorise in pairs to get $(2x - 3)(3x - 1)$

Answer: $(2x - 3)(3x - 1)$

4 Density

A metal block has a mass of 198 g.

The density of the material is 0.9 g/cm^3.

Work out the volume of the metal block.

Volume = mass ÷ density

$= 198 \div 0.9 = 220$ cm^3

Answer: 220 cm^3

5 Expanding with surds

Expand and simplify $(7 - 2\sqrt{5})^2$

Give your answer in the form $a + b\sqrt{c}$

$(7 - 2\sqrt{5})(7 - 2\sqrt{5}) = 49 - 14\sqrt{5} - 14\sqrt{5} + 20$

Collect: $69 - 28\sqrt{5}$

Answer: $69 - 28\sqrt{5}$

6 Tree diagrams

The tree diagram shows probabilities for two events.

(a) Work out the values of x and y.

(b) Work out the probability that Omar walks to work.

(a) Probabilities on pairs of branches add up to 1.

$x = 1 - 0.3 = 0.7$ and $y = 1 - 0.3 = 0.7$

(b) P(walks) = $0.3 \times 0.3 + 0.7 \times 0.6$

$= 0.09 + 0.42 = 0.51$

Answer: (a) x = 0.7, y = 0.7 (b) 0.51

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7 Forming quadratic equations

A rectangle has width x cm and length (x + 7) cm.
The area of the rectangle is 120 cm^2.
(a) Show that $x^2 + 7x - 120 = 0$
(b) Work out the value of x.

(a) Area = length × width, so $x(x + 7) = 120$
$x^2 + 7x = 120$
$x^2 + 7x - 120 = 0$
(b) Factorise: $(x - 8)(x + 15) = 0$
$x = 8$ or $x = -15$
A length cannot be negative, so $x = 8$
Answer: (a) Shown (b) x = 8

8 Area of a segment

The diagram shows a circle with centre O and radius 15 cm.
Angle AOB = 100°. (Calculator)
Work out the area of the shaded segment.
Give your answer to 3 significant figures.

Area of sector = $\frac{100}{360} \times \pi \times 15^2 = 196.35$

Area of triangle OAB = $\frac{1}{2} \times 15 \times 15 \times \sin 100° = 110.79$

Segment = 196.35 − 110.79 = 85.6
Answer: 85.6 cm^2

9 Bearings and distances

A boat leaves a port and travels 24 km on a bearing of 125°. (Calculator)
It then travels 7 km on a bearing of 215°.
(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$^2 = 24^2 + 7^2 = 625$, so distance = 25 km

(b) The angle at the port between the first leg and the line to the end: $\tan^{-1}(\frac{7}{24}) = 16.3°$

Bearing = 125° + 16.3° = 141.3°
Bearing = 141°
Answer: (a) 25 km (b) 141°

10 Bounds of a speed or density

A runner travels 350 m in 18 s. The distance is measured to the nearest 10 metres and the time to the nearest 0.1 second. (Calculator)
Work out the upper bound for the runner's speed in m/s.
Give your answer correct to 3 significant figures.

speed = distance ÷ time
For the upper bound of speed use the upper bound of distance and the lower bound of time.
355 ÷ 17.95 = 19.77716
= 19.8 m/s (3 s.f.)
Answer: 19.8 m/s