Day 113 **A Tier 10-a-day: Model Solutions**

1 Substitution

Work out the value of $3x^2 + 2x + 4$ when $x = -6$

Substitute $x = -6$: $3 \times (-6)^2 + 2 \times (-6) + 4$
$= 108 - 12 + 4$
$= 100$
Answer: 100

2 Converting speeds

A train travels at 4 m/s.
Work out this speed in kilometres per hour.

In 1 hour there are 3600 seconds, so 4 m/s = 4×3600 m/h
$= 14400$ m/h $= 14400 \div 1000$ km/h
$= 14.4$
Answer: 14.4 km/h

3 Prime factors

Express 242 as a product of prime factors. Give your answer in index form.

Divide by prime numbers in turn: $242 \div 2 = 121$, $121 \div 11 = 11$, $11 \div 11 = 1$
$242 = 2 \times 11 \times 11$
In index form: $242 = 2 \times 11^2$
Answer: $242 = 2 \times 11^2$

4 Laws of indices

Simplify fully
(a) $\frac{16x^4y^6}{3xy^2}$
(b) $(3x^3y^2)^4$

(a) Divide the numbers: $16 \div 3 = \frac{16}{3}$
Subtract the powers: $x^4 \div x = x^3$ and $y^6 \div y^2 = y^4$
$= \frac{16x^3y^4}{3}$
(b) Raise every part to the power 4: $3^4 = 81$, $(x^3)^4 = x^{12}$, $(y^2)^4 = y^8$
$= 81x^{12}y^8$
Answer: (a) $\frac{16x^3y^4}{3}$ (b) $81x^{12}y^8$

5 Venn diagram probability

The Venn diagram shows information about 23 people.
One person is chosen at random.
(a) The person is in set Netball. Find the probability that they are also in set Hockey.
(b) The person is not in set Hockey. Find the probability that they are in set Netball.

(a) In Netball: $6 + 2 = 8$ people, of whom 2 are also in Hockey: $\frac{1}{4}$
(b) Not in Hockey: $6 + 4 = 10$ people, of whom 6 are in Netball: $\frac{3}{5}$
Answer: (a) $\frac{1}{4}$ (b) $\frac{3}{5}$

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6 Trigonometry in context

A flagpole stands on horizontal ground. (Calculator)
From a point 25 m from the base of the flagpole, the angle of elevation of the top is 25°.
Work out the height of the flagpole. Give your answer to 3 significant figures.

$\tan 25° = \frac{\text{height}}{25}$

height = 25 × tan 25°
= 11.7
Answer: 11.7 m

7 Converting area and volume units

A swimming pool holds 17.5 m^3 of water.
How many litres is this?

1 m^3 = 1000 litres
17.5 × 1000 = 17500
Answer: 17500 litres

8 Roots and powers

(a) Work out $\sqrt{900}$
(b) Work out $\sqrt[3]{27000}$

(a) $\sqrt{900} = \sqrt{9 \times 100} = 3 \times 10 = 30$
(b) $\sqrt[3]{27000} = 3 \times 10 = 30$
Answer: (a) 30 (b) 30

9 Error intervals

x = 30 is rounded to 1 significant figure.
Write down the error interval for x.

The rounding unit is 10, so the value could be up to half of this, 5, either side.
Lower bound = 30 − 5 = 25, upper bound = 30 + 5 = 35
Answer: $25 \leq x < 35$

10 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 = 47° and angle ACD = 33°.
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 = 33°
In triangle ABE: angle BAE = 47° and angle ABE = 33°
x = 180 − 47 − 33 = 100
Answer: x = 100°