Day 202 **A Tier 10-a-day: Model Solutions**

1 Expanding and simplifying

Expand and simplify

$(x - 4)^2 - (x - 5)(x - 5)$

$(x - 4)^2 = x^2 - 8x + 16$

$(x - 5)(x - 5) = x^2 - 10x + 25$

Subtract (take care with the signs): $(x^2 - 8x + 16) - (x^2 - 10x + 25)$

$= 2x - 9$

Answer: $2x - 9$

2 Bearings and distances

A ship leaves a port and travels 30 km on a bearing of 165°. (Calculator)
It then travels 16 km on a bearing of 075°.
(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$^2 = 30^2 + 16^2 = 1156$, so distance = 34 km

(b) The angle at the port between the first leg and the line to the end: $\tan^{-1}(\frac{16}{30}) = 28.1°$

Bearing = $165° - 28.1° = 136.9°$

Bearing = 137°

Answer: (a) 34 km (b) 137°

3 Simplifying algebraic fractions

Simplify fully

$$\frac{x^2 + x - 12}{x^2 + 6x + 8}$$

Factorise the top: $(x + 4)(x - 3)$

Factorise the bottom: $(x + 4)(x + 2)$

Cancel the common factor $(x + 4)$

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

4 Mixed number addition and subtraction

Work out $2\frac{1}{2} + 3\frac{1}{3}$

Give your answer as a mixed number in its simplest form.

Write as improper fractions: $2\frac{1}{2} = \frac{5}{2}$ and $3\frac{1}{3} = \frac{10}{3}$

Common denominator 6: $\frac{15}{6} + \frac{20}{6}$

$= \frac{35}{6}$

$= 5\frac{5}{6}$

Answer: $5\frac{5}{6}$

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5 Simultaneous equations in context

5 muffins and 3 coffees cost £47.
2 muffins and 2 coffees cost £26.
Work out the cost of one coffee.

Let m = cost of one muffin in £ and c = cost of one coffee in £
5m + 3c = 47 (1)
2m + 2c = 26 (2)
Multiply (1) by 2 and (2) by 3 to make the c coefficients match
10m + 6c = 94 (1)
6m + 6c = 78 (2)
The c terms have the same sign, so subtract equation (2) from equation (1)
4m = 16, so m = 4
Substitute m = 4 into equation (1) to find c = 9
Answer: £9

6 Probabilities adding to 1

The table shows the probabilities of the outcomes of a biased spinner.
(a) Work out the value of p.
(b) The spinner is spun 300 times. Estimate the number of times it lands on 2.

(a) Probabilities add to 1: 0.05 + p + p + 0.25 = 1
0.3 + 2p = 1, so 2p = 0.7
p = 0.35
(b) P(2) = 0.35, so expected number = 0.35 × 300 = 105
Answer: (a) p = 0.35 (b) 105

7 Surd fractions

Show that $\frac{\sqrt{125}+\sqrt{180}}{\sqrt{5}}$ is an integer, and find its value.

$\sqrt{125} = 5\sqrt{5}$ and $\sqrt{180} = 6\sqrt{5}$
Numerator = $5\sqrt{5} + 6\sqrt{5} = 11\sqrt{5}$
$\frac{11\sqrt{5}}{\sqrt{5}} = 11$
Answer: 11

8 Bounds in measurement

A circle has a radius of 10 cm, correct to the nearest cm. (Calculator)
Work out the lower bound for the area of the circle.
Give your answer to 3 significant figures.

Lower bound of radius = 9.5 cm
Area = $\pi \times 9.5^2 = 284$
Answer: 284 cm^2

9 Inverse proportion formulae

y is inversely proportional to x.
When x = 5, y = 10.
(a) Find a formula for y in terms of x.
(b) Work out the positive value of x when y = 25.

(a) $y = \frac{k}{x}$. Substitute: $10 = \frac{k}{5}$, so k = 10 × 5 = 50
$y = \frac{50}{x}$
(b) $25 = \frac{50}{x}$, so x = 50 ÷ 25 = 2
Answer: (a) $y = \frac{50}{x}$ (b) x = 2

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10 Error intervals

y = 1.04 has been truncated to 2 decimal places.
Write down the error interval for y.

Truncating means cutting off the digits after the second decimal place.
The original value is at least 1.04 and less than 1.04 + 0.01 = 1.05
Answer: $1.04 \leq y < 1.05$