Day 229 **A Tier 10-a-day: Model Solutions**

1 Substitution

Work out the value of $5x^2 + 4x - 7$ when $x = -4$

Substitute $x = -4$: $5 \times (-4)^2 + 4 \times (-4) - 7$
$= 80 - 16 - 7$
$= 57$
Answer: 57

2 Surface area of a cuboid

A cuboid has length 13 cm and width 8 cm.
Its total surface area is 418 cm^2.
Work out the height of the cuboid.

$2 \times (13 \times 8 + 13\,h + 8\,h) = 418$
$104 + 21h = 209$
$21h = 105$
$h = 105 \div 21 = 5$
Answer: 5 cm

3 Time

(a) A train leaves London at 5:40 pm. The journey takes 4 hours 52 minutes. Work out the time it ends.
(b) Change 225 minutes into hours. Give your answer as a decimal.

(a) 5:40 pm + 4 hours 52 minutes = 10:32 pm
(b) $225 \div 60 = 3.75$ hours
Answer: (a) 10:32 pm (b) 3.75 hours

4 Solving quadratic equations

Solve $2x^2 + 3x - 2 = 0$

Factorise: $(2x - 1)(x + 2) = 0$
$2x - 1 = 0$ or $x + 2 = 0$
$x = \frac{1}{2}$ or $x = -2$

Answer: $x = \frac{1}{2}$ or $x = -2$

5 Independent events

The probability that Priya hits the target is 0.8.
The probability that Harry hits the target is 0.3.
The two events are independent.
Work out the probability that at least one of them will hit the target.

P(neither) = $0.2 \times 0.7 = 0.14$
P(at least one) = $1 - 0.14 = 0.86$
Answer: 0.86

6 Recurring decimals to fractions

Write the recurring decimal $0.\dot{1}2\dot{9}$ as a fraction in its simplest form.

Let $x = 0.129129129...$
Multiply by 1000: $1000x = 129.129129...$
Subtract: $999x = 129$
$x = \frac{129}{999} = \frac{43}{333}$

Answer: $\frac{43}{333}$

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7 Bearings and distances

A ship leaves a port and travels 12 miles on a bearing of 095°. (Calculator)
It then travels 9 miles on a bearing of 005°.
(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 = $12^2 + 9^2$ = 225, so distance = 15 miles

(b) The angle at the port between the first leg and the line to the end: $\tan^{-1}(\frac{9}{12})$ = 36.9°

Bearing = 95° − 36.9° = 58.1°
Bearing = 058°
Answer: (a) 15 miles (b) 058°

8 Box plots

The box plot shows the masses, in kg, of the parcels in delivery A.
(a) Write down the median and the interquartile range.
For delivery B the median is 40 and the interquartile range is 45.
(b) Compare the distributions of the two deliveries.

(a) Median = 45
Interquartile range = 65 − 30 = 35
(b) The median for Delivery A is higher (45 compared with 40), so it has the higher values on average
The IQR for Delivery A is smaller (35 compared with 45), so its values are more consistent
Answer: (a) Median 45, IQR 35 (b) Delivery A has the higher median; Delivery A has the smaller IQR so is more consistent

9 Rationalising with conjugates

Rationalise the denominator of $\frac{29}{6 + \sqrt{7}}$

Give your answer in the form $a + b\sqrt{c}$ where a and b are integers.

Multiply top and bottom by the conjugate $6 - \sqrt{7}$: $\frac{29(6 - \sqrt{7})}{(6 + \sqrt{7})(6 - \sqrt{7})}$

Denominator: 36 − 7 = 29

$\frac{29(6 - \sqrt{7})}{29} = 1(6 - \sqrt{7})$

$= 6 - \sqrt{7}$

Answer: $6 - \sqrt{7}$

10 The cosine rule: finding a side

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

$x^2 = 18^2 + 16^2 - 2 \times 18 \times 16 \times \cos 31°$

$x^2 = 324 + 256 - 576 \cos 31°$

$x^2 = 86.272$

$x = 9.29$

Answer: x = 9.29 cm