Day 176 **A Tier 10-a-day: Model Solutions**

1 Simultaneous equations in context

4 pens and 5 notebooks cost £84.
1 pen and 5 notebooks cost £51.
Work out the cost of one notebook.

Let p = cost of one pen in £ and n = cost of one notebook in £
4p + 5n = 84 (1)
p + 5n = 51 (2)
The n terms have the same sign, so subtract equation (2) from equation (1)
3p = 33, so p = 11
Substitute p = 11 into equation (1) to find n = 8
Answer: £8

2 Bearings

The bearing of Q from P is 305°.
Work out the bearing of P from Q.
The diagram is not drawn accurately.

The north lines at P and Q are parallel
Back bearing = 305° − 180° = 125°
Answer: 125°

3 Median and interquartile range

Here are the scores of 11 students in a test.
39 54 66 35 46 12 7 77 27 28 75
(a) Work out the median.
(b) Work out the interquartile range.

Put in order: 7, 12, 27, 28, 35, 39, 46, 54, 66, 75, 77
(a) The middle value is number 6, so the median is 39
(b) Lower half: 7, 12, 27, 28, 35, so LQ = 27
Upper half: 46, 54, 66, 75, 77, so UQ = 66
IQR = 66 − 27 = 39
Answer: (a) 39 (b) 39

4 Profit and loss

Isla buys a phone for £270 and sells it for £324.
Work out Isla's percentage profit.

Profit = £324 − £270 = £54

Percentage profit = $\frac{54}{270} \times 100 = 20\%$

Answer: 20%

5 Independent events

The probability that Noah hits the target is 0.6.
The probability that Ella hits the target is 0.7.
The two events are independent.
Work out the probability that neither Noah nor Ella will hit the target.

P(Noah does not) = 1 − 0.6 = 0.4 and P(Ella does not) = 1 − 0.7 = 0.3
0.4 × 0.3 = 0.12
Answer: 0.12

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6 Trigonometry: finding an angle

Work out the size of angle x. (Calculator)
Give your answer to 1 decimal place.
The diagram is not drawn accurately.

The sides given are the opposite (19) and the hypotenuse (20), so use sin

$\sin x = \frac{19}{20}$

$x = \sin^{-1}(\frac{19}{20})$

$x = 71.8°$

Answer: x = 71.8°

7 Simple and compound interest

Lena and Isla each invest £1000 for 2 years. (Calculator)
Lena's account pays 2% simple interest per year.
Isla's account pays 2% compound interest per year.
Work out how much more interest Isla earns than Lena.

Simple interest = £1000 × 2% × 2 = £40

Compound: £1000 × 1.02^2 = £1040.40, so interest = £40.40

Difference = 40.40 − 40 = £0.40 (to the nearest penny)

Answer: £0.40

8 Perpendicular bisector

A is the point (−2, 3) and B is the point (6, 1).
Find the equation of the perpendicular bisector of AB.

Midpoint of AB = $(\frac{(-2)+6}{2}, \frac{3+1}{2}) = (2, 2)$

Gradient of AB = $\frac{-2}{8} = -\frac{1}{4}$

Perpendicular gradient = $-1 \div (-\frac{1}{4}) = 4$

y = 4x + c through (2, 2): 2 = 4 × 2 + c, so c = −6

y = 4x − 6

Answer: y = 4x − 6

9 Expanding with surds

Expand and simplify $2\sqrt{10}(5 + 3\sqrt{10})$
Write your answer in the form $a + b\sqrt{c}$

$2\sqrt{10} \times 5 = 10\sqrt{10}$ and $2\sqrt{10} \times 3\sqrt{10} = 6 \times 10 = 60$

$= 60 + 10\sqrt{10}$

Answer: $60 + 10\sqrt{10}$

10 Circle theorems: tangents

PA and PB are tangents to a circle with centre O.
Angle APB = 98°.
Work out the size of angle x (angle AOB).
Give a reason for each step of your working.

A tangent is perpendicular to the radius, so angles OAP and OBP are both 90°

The angles in quadrilateral OAPB add up to 360°

x = 360 − 90 − 90 − 98 = 82

Answer: x = 82°