Day 123 **A Tier 10-a-day: Model Solutions**

1 Equations with fractions

Solve $\frac{x-1}{2} - \frac{x+3}{5} = -2$

Multiply every term by 10 (the lowest common multiple of 2 and 5)
$5(x - 1) - 2(x + 3) = 10 \times (-2)$
$3x - 11 = -20$
$3x = -9$
$x = -3$
Answer: $x = -3$

2 Ordering numbers

Write these numbers in order of size, starting with the smallest.
$\frac{3}{20}$ 0.59 $\frac{1}{20}$ 22%

Change each to a decimal: $\frac{3}{20} = 0.15$, $0.59 = 0.59$, $\frac{1}{20} = 0.05$, $22\% = 0.22$
Order the decimals: $0.05 < 0.15 < 0.22 < 0.59$
Answer: $\frac{1}{20}$, $\frac{3}{20}$, 22%, 0.59

3 Converting speeds

A car travels at 72 km/h.
Work out this speed in metres per second.

1 km = 1000 m and 1 hour = 3600 seconds
72 km/h = $72 \times 1000 \div 3600$ m/s
$= 72 \div 3.6 = 20$
Answer: 20 m/s

4 Profit and loss

Isla buys a phone for £200 and sells it for £224.
Work out Isla's percentage profit.

Profit = £224 − £200 = £24
Percentage profit = $\frac{24}{200} \times 100 = 12\%$
Answer: 12%

5 Rearranging to solve quadratics

Solve $2x^2 + 5x = -2$

Move everything to one side: $2x^2 + 5x + 2 = 0$
Factorise: $(x + 2)(2x + 1) = 0$
$x = -2$ or $x = -\frac{1}{2}$
Answer: $x = -2$ or $x = -\frac{1}{2}$

6 Circle theorems: tangents

PA and PB are tangents to a circle with centre O.
Angle APB = 42°.
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°
$x = 360 - 90 - 90 - 42 = 138$
Answer: $x = 138°$

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7 The quadratic formula

Solve $x^2 - 4x - 7 = 0$
Give your solutions correct to 2 decimal places. (Calculator)

Use $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ with $a = 1$, $b = -4$, $c = -7$

$x = \frac{4 \pm \sqrt{(-4)^2 - 4 \times 1 \times (-7)}}{2}$

$x = \frac{4 \pm \sqrt{44}}{2}$

$x = 5.32$ or $x = -1.32$

Answer: $x = 5.32$ or $x = -1.32$

8 Frequency density

The table gives information about 121 measurements.
A histogram is drawn using this information.
(a) Work out the missing frequency.
(b) Work out the height of the bar for the class $10 < l \leq 40$.

(a) Missing frequency = $121 - (78 + 16 + 18) = 9$
(b) Class width = $40 - 10 = 30$
Frequency density = $78 \div 30 = 2.6$
Answer: (a) 9 (b) 2.6

9 Bearings with the cosine rule

Boat P sails 18 km from a harbour on a bearing of 205°.
Boat Q sails 17 km from the same harbour on a bearing of 170°. (Calculator)
Work out the distance between the two boats.
Give your answer to 3 significant figures.

The angle between the two paths = $|205° - 170°| = 35°$
$d^2 = 18^2 + 17^2 - 2 \times 18 \times 17 \times \cos 35°$
$d^2 = 111.68$
$d = 10.6$
Answer: 10.6 km

10 Probability with three selections

A bag contains 3 red counters and 4 blue counters.
Three counters are taken at random without replacement.
Work out the probability that all three counters are red.

P(all red) = $\frac{3}{7} \times \frac{2}{6} \times \frac{1}{5}$

$= \frac{6}{210} = \frac{1}{35}$

Answer: $\frac{1}{35}$