Day 224 **A Tier 10-a-day: Model Solutions**

1 Midpoints and length of a line segment

M is the midpoint of AB.
A is the point (−3, −2) and M is the point (−4, −5).
Work out the coordinates of B.

From A to M: x changes by −1 and y changes by −3
Do the same again from M to get B
B = (−4 + (−1), −5 + (−3)) = (−5, −8)
Answer: (−5, −8)

2 Direct proportion

Here are the ingredients for 10 muffins.
Butter: 250 g
Water: 250 ml
Sugar: 300 g
(a) Work out how much butter is needed for 18 muffins.
(b) Hannah has 771 ml of water. What is the greatest number of muffins she can make?

(a) butter for one: 250 ÷ 10 = 25 g
For 18: 25 × 18 = 450 g
(b) water for one: 250 ÷ 10 = 25 ml
771 ÷ 25 = 30 remainder 21, so she can make 30
Answer: (a) 450 g (b) 30

3 Quadratic graph from its roots

The diagram shows the graph of $y = x^2 + bx + c$.
Find the value of b and the value of c.

The curve crosses the x-axis at x = −5 and x = −2
So y = (x + 5)(x + 2)
Expand: $y = x^2 + 7x + 10$
b = 7 and c = 10
Answer: b = 7, c = 10

4 Fractions of an amount

Tom spends $\frac{1}{5}$ of the money on a book and $\frac{1}{3}$ of the money that is left on a game.
Tom has £64 left.
How much money did Tom have to begin with?

After the second purchase $\frac{2}{3}$ of what was left after the first purchase remains.
£64 = $\frac{2}{3}$ of the amount left, so $\frac{1}{3}$ of it is £64 ÷ 2 = £32
So the amount left after the first purchase is £32 × 3 = £96
This is $\frac{4}{5}$ of the original amount, so the original amount is £96 ÷ 4 × 5 = £120
Answer: £120

5 Arc length and perimeter of a sector

The diagram shows a sector of a circle of radius 14 cm.
Work out the length of the arc of the sector.
Give your answer in terms of π.
The diagram is not drawn accurately.

Arc length = $\frac{90}{360} \times 2 \times \pi \times 14$
$= 7\pi$
Answer: 7π cm

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6 Expanding and simplifying

Expand and simplify
$3(x - 2)(x + 6) - (x + 5)(x - 5)$

$3(x - 2)(x + 6) = 3(x^2 + 4x - 12) = 3x^2 + 12x - 36$
$(x + 5)(x - 5) = x^2 - 25$
Subtract: $2x^2 + 12x - 11$
Answer: $2x^2 + 12x - 11$

7 Simple and compound interest

Hugo and Tara each invest £2000 for 3 years. (Calculator)
Hugo's account pays 3% simple interest per year.
Tara's account pays 3% compound interest per year.
Work out how much more interest Tara earns than Hugo.

Simple interest = £2000 × 3% × 3 = £180
Compound: £2000 × 1.03^3 = £2185.454, so interest = £185.454
Difference = 185.454 − 180 = £5.45 (to the nearest penny)
Answer: £5.45

8 Index equations

Solve $2^{x+4} = 8^x$

$8 = 2^3$, so $8^x = (2^3)^x = 2^{3x}$
$x + 4 = 3x$
$4 = 3x - x = 2x$
$x = 2$
Answer: $x = 2$

9 Pie charts

The pie chart shows how some students chose a drink.
19 students chose juice.
(a) Work out the angle for water.
(b) How many students chose water?

(a) 360 − 155 − 40 − 95 = 70°
(b) 19 students is 95°, so 1 student is 95 ÷ 19 = 5°
Water: 70 ÷ 5 = 14
Answer: (a) 70° (b) 14

10 Transformations of graphs

The graph of $y = f(x)$ has a minimum point at (5, 5).
Write down the coordinates of the turning point of the graph of
(a) $y = f(x) - 4$
(b) $y = -f(x)$

(a) Subtracting 4 from f(x) moves the graph 4 units down
The minimum point is (5, 1)
(b) The graph is reflected in the x-axis, so the y-coordinate changes sign
The minimum point becomes a maximum point at (5, −5)
Answer: (a) (5, 1) (b) (5, −5)