Day 75 **A Tier 10-a-day: Model Solutions**

1 Quadratic graphs

The curve C has equation $y = x^2 + 4x + 3$
(a) Find the coordinates of the points where C crosses the x-axis.
(b) Find the coordinates of the turning point of C.

(a) Set $y = 0$: $x^2 + 4x + 3 = 0$
$(x + 1)(x + 3) = 0$
$x = -3$ or $x = -1$, so the graph crosses the x-axis at $(-3, 0)$ and $(-1, 0)$
(b) The turning point is halfway between the roots: $x = (-3 + (-1)) \div 2 = -2$
$y = -1$, so the minimum point is $(-2, -1)$
Answer: (a) $(-3, 0)$ and $(-1, 0)$ (b) $(-2, -1)$

2 Median from a frequency table

The frequency table shows data for 33 students.
(a) Find the median.
(b) Work out the range.

(a) The median is the 17th value $(33 + 1) \div 2 = 17$
Cumulative frequencies: 8, 14, 17, 26, 33
The 17th value is 7
(b) Range $= 9 - 5 = 4$
Answer: (a) 7 (b) 4

3 Angles in parallel lines

The diagram shows two parallel lines crossed by a straight line.
(a) Work out the value of x.
(b) Work out the size of the angle marked $(3x + 20)°$.
The diagram is not drawn accurately.

(a) Corresponding angles are equal
$3x + 20 = 2x + 49$
$x = 29$
$x = 29$
(b) $3 \times 29 + 20 = 107$
Answer: (a) $x = 29$ (b) 107°

4 Factorising

Factorise $2x^2 + 3x - 20$

Multiply $2 \times -20 = -40$. Find two numbers that multiply to -40 and add to 3: 8 and -5
$2x^2 + 3x - 20 = 2x^2 + 8x - 5x - 20$
Factorise in pairs to get $(2x - 5)(x + 4)$
Answer: $(2x - 5)(x + 4)$

5 Median and interquartile range

Here are the times, in seconds, taken by 11 runners.
62 22 20 65 76 25 6 23 57 35 9
(a) Work out the median.
(b) Work out the interquartile range.

Put in order: 6, 9, 20, 22, 23, 25, 35, 57, 62, 65, 76
(a) The middle value is number 6, so the median is 25
(b) Lower half: 6, 9, 20, 22, 23, so LQ = 20
Upper half: 35, 57, 62, 65, 76, so UQ = 62
IQR $= 62 - 20 = 42$
Answer: (a) 25 (b) 42

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6 Recurring decimals, show that

(a) Show that $0.\dot{1}\dot{9} = \frac{19}{99}$

(b) Hence write $5.\dot{1}\dot{9}$ as a mixed number in its simplest form.

(a) Let x = 0.191919..., so 100x = 19.1919...

$100x - x = 19$, so $99x = 19$ and $x = \frac{19}{99}$

(b) $5.\dot{1}\dot{9} = 5 + \frac{19}{99} = 5\frac{19}{99}$

Answer: (b) $5\frac{19}{99}$

7 Bounds in measurement

A rectangle measures 6 cm by 12 cm, each correct to the nearest cm. (Calculator)
Work out the upper bound for the length of a diagonal of the rectangle.
Give your answer to 3 significant figures.

Upper bounds of the sides are 6.5 cm and 12.5 cm

Diagonal $= \sqrt{6.5^2 + 12.5^2} = \sqrt{198.5}$
$= 14.1$

Answer: 14.1 cm

8 Simultaneous equations (one quadratic)

Solve the simultaneous equations

$x^2 + y^2 = 289$

$y = x + 23$

Substitute $y = x + 23$ into $x^2 + y^2 = 289$

$x^2 + (x + 23)^2 = 289$

$2x^2 + 46x + 240 = 0$

Divide by 2: $x^2 + 23x + 120 = 0$

$(x + 15)(x + 8) = 0$

$x = -15$ or $x = -8$

Use $y = x + 23$ to find y: when $x = -15$, $y = 8$; when $x = -8$, $y = 15$

Answer: $x = -15$, $y = 8$ and $x = -8$, $y = 15$

9 Inverse proportion formulae

y is inversely proportional to x.
When x = 1, y = 12.
(a) Find a formula for y in terms of x.
(b) Work out the value of y when x = 2.

(a) $y = \frac{k}{x}$. Substitute: $12 = \frac{k}{1}$, so $k = 12 \times 1 = 12$

$y = \frac{12}{x}$

(b) $y = \frac{12}{2} = 6$

Answer: (a) $y = \frac{12}{x}$ (b) 6

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10 Bounds and accuracy

A cyclist travels 350 metres in 16.7 seconds. The distance is correct to the nearest 10 metres and the time to the nearest 0.1 second.

(a) Work out the upper bound and the lower bound of the speed in m/s.

(b) Write the speed to a suitable degree of accuracy. Give a reason for your answer.

(a) Upper bound = 355 ÷ 16.65 = 21.3213

Lower bound = 345 ÷ 16.75 = 20.5970

(b) Both bounds round to 21 to 2 s.f. but not to the same value to 3 s.f.

So the speed is 21 m/s to 2 significant figures.

Answer: (a) 21.3213, 20.5970 (b) 21 m/s (2 s.f.)