Test answers - Graphs: linear and quadratic

Year: Year 9 · Duration: 45 minutes · /20

Answer to Question 1 (4 marks)

a. Substitute each value of x into $3x - 2$: $x = -1$ gives $-3 - 2 = -5$; $x = 0$ gives -2; $x = 1$ gives 1; $x = 2$ gives 4; $x = 3$ gives 7. The values are $-5, -2, 1, 4, 7$ (2 marks for all five, 1 mark for at least three).
b. In $y = mx + c$ the gradient is the coefficient of x and the intercept is the constant term. Gradient **3** (1 mark), y-intercept -2 (1 mark).

The table confirms the gradient: each y value is 3 more than the one before as x increases by 1. It also confirms the intercept: when $x = 0$, $y = -2$, so the line crosses the y-axis at $(0, -2)$. Plot the points and join them with a ruler.

Answer to Question 2 (4 marks)

a. Substitute carefully, using brackets for negatives. $x = -2$: $(-2)^2 - 2(-2) - 3 = 4 + 4 - 3 =$**5**. $x = 1$: $1 - 2 - 3 =$$-4$. $x = 4$: $16 - 8 - 3 =$**5**. (2 marks for all three, 1 mark for two)
b. The roots are the x-values where the curve crosses the x-axis, so where $y = 0$ in the table: $x = -1$ **and** $x = 3$. (1 mark)
c. A parabola is symmetrical, so the turning point is halfway between the roots, at $x = \dfrac{-1 + 3}{2} = 1$, where $y = -4$. The turning point is $(1, -4)$, a minimum. (1 mark)

Check (b) by factorising: $x^2 - 2x - 3 = (x + 1)(x - 3)$.

Answer to Question 3 (4 marks)

a. Gradient = change in y ÷ change in x. The y-values change by $4 - (-2) = 6$ and the x-values by $3 - 0 = 3$, so the gradient is $6 \div 3 =$**2**. (1 mark)
b. The line passes through $(0, -2)$, so the y-intercept is -2. The equation is $y = 2x - 2$. (1 mark)
c. Substitute $x = 5$: $2 \times 5 - 2 = 10 - 2 = 8$. This gives $y = 8$, matching the point, so $(5, 8)$ lies on the line. (1 mark)
d. Parallel lines have equal gradients, so keep the gradient 2 and use the new intercept 5: $y = 2x + 5$. (1 mark)

Check (b) with the second point: $2 \times 3 - 2 = 4$. The two parallel lines are always 7 units apart vertically and never meet.

Answer to Question 4 (4 marks)

a. In each equation the monthly charge is the gradient and the joining fee is the intercept. Gym A: $y = 12x + 20$ (1 mark). Gym B: $y = 10x + 30$ (1 mark).
b. The costs are equal when $12x + 20 = 10x + 30$ (1 mark for setting them equal). Subtract $10x$: $2x + 20 = 30$. Subtract 20: $2x = 10$, so $x =$**5 months**. The cost is $12 \times 5 + 20 =$**£80** (1 mark).

Check with Gym B: $10 \times 5 + 30 = 80$. On a graph the two lines cross at $(5, 80)$. Before 5 months Gym A is cheaper because of its lower joining fee; after 5 months Gym B is cheaper because each month costs £2 less. For a one-year membership Gym B saves £14.

Answer to Question 5 (4 marks)

a. Substitute into $h = x(8 - x)$. For $x = 2$: $2 \times (8 - 2) = 2 \times 6 =$**12** (1 mark). For $x = 6$: $6 \times (8 - 6) = 6 \times 2 =$**12** (1 mark).
b. The table is symmetrical about $x = 4$, and the largest value sits in the middle. The maximum height is **16 m** at a distance of **4 m**. (1 mark)
c. The ball lands when its height returns to 0, which happens at $x = 8$. It travels **8 m** before landing. (1 mark)

Expanding gives $h = 8x - x^2$; the negative x^2 term makes the curve an upside-down parabola, which has a maximum rather than a minimum. The roots $x = 0$ and $x = 8$ are the throw and the landing, and the maximum is halfway between them.