Year 9 Quadratics and Parabolas - Practice Test 2

14 questions | 50 marks

Award the shown method marks for equivalent correct working.

1. Expand and simplify. [2 marks]

(a) $(x+3)(x+5)$

Multiply each term and collect like terms: $x^2+5x+3x+15=x^2+8x+15$. (1 mark)

Answer: $x^2+8x+15$

(b) $(x-4)(x+2)$

Multiply each term and collect like terms: $x^2+2x-4x-8=x^2-2x-8$. (1 mark)

Answer: x^2-2x-8

2. Factorise. [3 marks]

(a) $x^2+9x+20$

$4+5=9$ and $4\times5=20$, so $(x+4)(x+5)$. (1 mark)

Answer: $(x+4)(x+5)$

(b) $x^2-7x+10$

$-5+(-2)=-7$ and $(-5)(-2)=10$, so $(x-5)(x-2)$. (1 mark)

Answer: $(x-5)(x-2)$

(c) x^2+x-12

$4+(-3)=1$ and $4(-3)=-12$, so $(x+4)(x-3)$. (1 mark)

Answer: $(x+4)(x-3)$

3. Factorise fully. [3 marks]

(a) $x^2 - 36$

Use the difference of two squares: $x^2 - 6^2 = (x - 6)(x + 6)$. (1 mark)

Answer: $(x - 6)(x + 6)$

(b) $x^2 - 10x + 25$

$(-5) + (-5) = -10$ and $(-5)(-5) = 25$, so $(x - 5)^2$. (1 mark)

Answer: $(x - 5)^2$

(c) $x^2 + 8x$

Take out the common factor x: $x(x + 8)$. (1 mark)

Answer: $x(x + 8)$

4. Solve each equation. [3 marks]

(a) $(x - 3)(x + 5) = 0$

At least one factor is zero: $x - 3 = 0$ or $x + 5 = 0$, giving $x = 3$ or $x = -5$. (1 mark)

Answer: $x = 3$ or $x = -5$

(b) $x(x + 7) = 0$

$x = 0$ or $x + 7 = 0$, giving $x = 0$ or $x = -7$. (1 mark)

Answer: $x = 0$ or $x = -7$

(c) $(x + 4)^2 = 0$

The repeated factor is zero when $x + 4 = 0$, so the single distinct solution is $x = -4$. (1 mark)

Answer: $x = -4$

5. Solve $x^2 - 6x + 8 = 0$ by factorising. Check one of your solutions in the original equation. [3 marks]

Factorise: $(x - 2)(x - 4) = 0$. (1 mark)

Set each factor equal to zero: $x = 2$ or $x = 4$. (1 mark)

For example, check $x = 2$: $2^2 - 6(2) + 8 = 4 - 12 + 8 = 0$. A correct check with $x = 4$ is also accepted. (1 mark)

Answer: $x = 2$ or $x = 4$

6. Solve $x^2 + 5x = 14$ by factorising. Check one solution in the original equation. [4 marks]

Subtract 14 from both sides: $x^2 + 5x - 14 = 0$. (1 mark)

Factorise: $(x + 7)(x - 2) = 0$. (1 mark)

Set each factor equal to zero: $x = -7$ or $x = 2$. (1 mark)

For example, $(-7)^2 + 5(-7) = 49 - 35 = 14$. A correct check with $x = 2$ is also accepted. (1 mark)

Answer: $x = -7$ or $x = 2$

7. Use the rule $y = x^2 - 2x - 3$. [6 marks]

Values for Question 7

x	-2	-1	0	1	2	3	4
y							

(a) Complete the table.

Substitute the given x-values. Award 2 marks for all seven correct values; award 1 mark for four to six correct values. (2 marks)

Answer: $y = 5, 0, -3, -4, -3, 0, 5$ in table order.

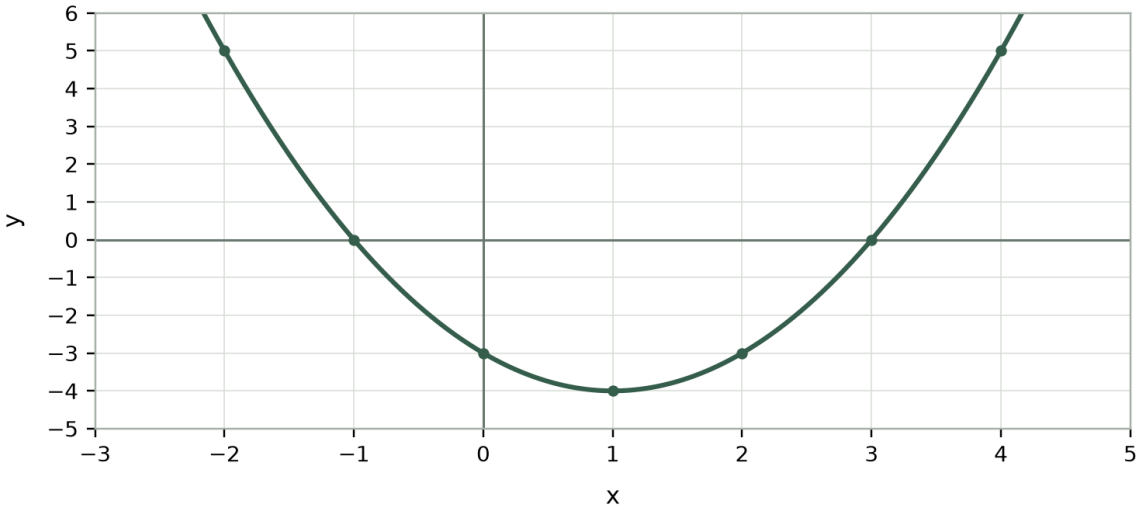
(b) Plot the points on the grid. Join them with a smooth curve.

Plot the seven points accurately. Award 2 marks for all points; award 1 mark for four to six correct points. Allow follow-through for correctly plotting the student's values from part (a), using the axes consistently. (2 marks)

Draw one smooth upward-opening curve through the points. The curve must turn at $(1, -4)$; do not use straight line segments between the points. (1 mark)

Answer: A smooth upward-opening parabola through the seven points, with turning point $(1, -4)$.

Grid for Question 7

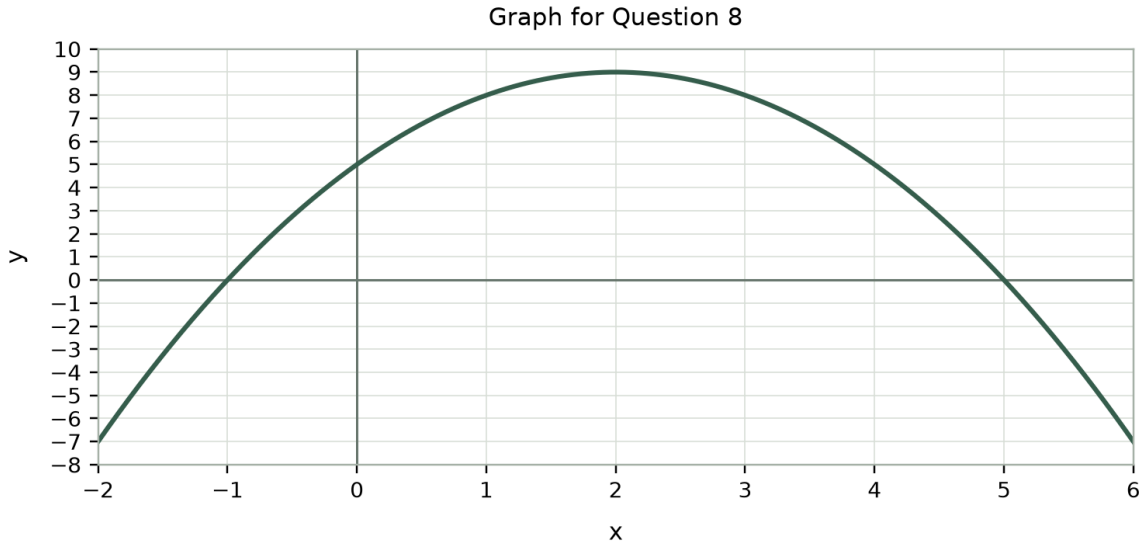


(c) Write the equation of the axis of symmetry.

The matching pairs of points lie the same distance from $x = 1$, so the axis is $x = 1$. (1 mark)

Answer: $x = 1$.

8. Use the graph shown. [5 marks]



(a) Write the coordinates of the turning point.

The highest point is $(2, 9)$. (1 mark)

Answer: $(2, 9)$

(b) Write the equation of the axis of symmetry.

The vertical line through the turning point is $x = 2$. (1 mark)

Answer: $x = 2$

(c) Write both x-intercepts as coordinates.

The curve crosses the horizontal axis at $(-1, 0)$ and $(5, 0)$. Award 1 mark for each correct intercept. (2 marks)

Answer: $(-1, 0)$ and $(5, 0)$

(d) Write the y-intercept as a coordinate.

The curve crosses the vertical axis at $(0, 5)$. (1 mark)

Answer: $(0, 5)$

9. A parabola has rule $y = -2(x+1)^2 + 6$. [3 marks]

(a) Write its turning point.

The squared term is zero at $x = -1$, giving the turning point $(-1, 6)$. (1 mark)

Answer: $(-1, 6)$

(b) Does it open upwards or downwards?

The negative coefficient -2 makes the parabola open downwards. (1 mark)

Answer: Downwards

(c) Find y when $x = 0$.

Substitute $x = 0$: $y = -2(0+1)^2 + 6 = -2 + 6 = 4$. (1 mark)

Answer: $y = 4$

10. Two rules are $A : y = x^2 + 4x - 5$ and $B : y = (x+5)(x-1)$. [3 marks]

(a) Expand and simplify rule B.

Multiply to obtain $y = x^2 - x + 5x - 5$. (1 mark)

Collect like terms: $y = x^2 + 4x - 5$. (1 mark)

Answer: $y = x^2 + 4x - 5$

(b) Do the two rules produce the same graph? Explain.

Yes. The expanded rules are identical, so the graph is the same for every x. Accept an equivalent explanation. (1 mark)

Answer: Yes. The rules are equivalent, so they give the same y for every x.

11. A rectangular sign is x metres wide and $(x+3)$ metres long. Its area is 54 m^2. [5 marks]

Rectangular sign (not to scale)



(a) Write an equation for x. Rearrange it so one side is zero.

Area is length times width: $x(x+3)=54$. (1 mark)

Expand and rearrange: $x^2+3x-54=0$. (1 mark)

Answer: $x(x+3)=54$, so $x^2+3x-54=0$.

(b) Solve your equation by factorising.

Factorise: $(x+9)(x-6)=0$. (1 mark)

The solutions are $x=-9$ or $x=6$. (1 mark)

Answer: $x=6$ or $x=-9$.

(c) Give the sign's dimensions.

Reject $x=-9$ because a width cannot be negative. Width is 6 m and length is $6+3=9$ m. (1 mark)

Answer: Width 6 m, length 9 m.

12. An arch is modelled by $h=-x^2+6x$, where h is the height in metres and x is the horizontal distance in metres from its left base. [4 marks]

(a) Find the height when $x=1$.

Substitute $x=1$: $h=-1+6=5$ m. (1 mark)

Answer: 5 m

(b) Find the distance between the two bases by setting $h=0$.

Set $h=0$ and factorise: $x(6-x)=0$. (1 mark)

The bases are at $x=0$ and $x=6$, so they are 6 m apart. (1 mark)

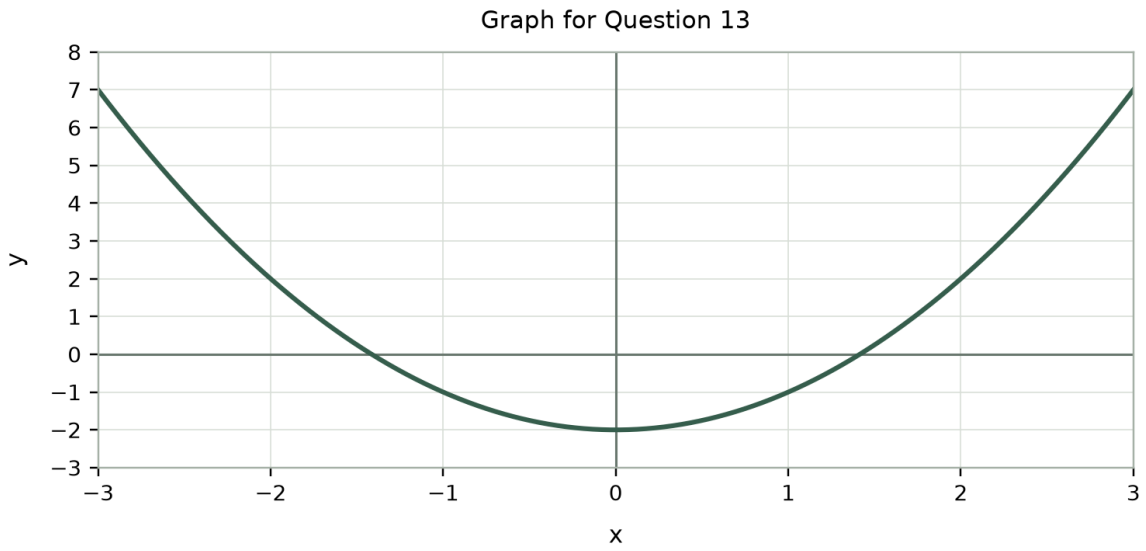
Answer: 6 m

(c) The arch is symmetric. Find its greatest height.

The highest point is halfway between the bases, at $x=3$. Then $h=-3^2+6(3)=-9+18=9$ m. (1 mark)

Answer: 9 m

13. The graph shows $y = x^2 - 2$. [3 marks]



(a) Use the graph to estimate both solutions of $x^2 - 2 = 0$. Give each estimate to one decimal place.

Read the negative x-intercept as about -1.4. Accept a reading within 0.1 of this value from the supplied graph. (1 mark)

Read the positive x-intercept as about 1.4. Accept a reading within 0.1 of this value from the supplied graph. (1 mark)

Answer: $x \approx -1.4$ and $x \approx 1.4$.

(b) Explain why a graph reading gives an estimate.

The thickness of the curve and the scale of the graph limit how precisely the intercept can be read. Accept an equivalent explanation. (1 mark)

Answer: A graph is drawn and read at a limited scale, so the intercepts cannot be read exactly.

14. Luca solves $x^2 = 5x$ by dividing both sides by x. He writes $x = 5$. [3 marks]

(a) Rearrange and factorise the original equation to find all solutions.

Rearrange and factorise: $x^2 - 5x = x(x - 5) = 0$. (1 mark)

Set each factor to zero: $x = 0$ or $x = 5$. (1 mark)

Answer: $x = 0$ or $x = 5$.

(b) Explain what Luca missed.

Luca divided by a quantity that could be zero. This removed the valid solution $x = 0$; division by zero is not allowed. (1 mark)

Answer: Dividing by x loses the solution $x = 0$, because division by zero is not allowed.