5.9 Drawing Quadratic Graphs: Test Pack

EDEXCEL 1MA1 · Calculator allowed · about 70 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Work out the value of y when x = 0 for the quadratic function $y = x^2 + 3x + 2$.

(Total for Question 1 is 1 mark)

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2 Complete the table of values for $y = x^2 - 1$, for $-2 \leq x \leq 2$.

x	-2	-1	0	1	2
y	_	_	_	_	_

(Total for Question 2 is 2 marks)

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3 Draw a simple sketch of the graph $y = x^2$. On the sketch, mark and label the points when x = -2, -1, 0, 1, 2.

(a) Find the y values for x = -2, -1, 0, 1, 2. **(2)**

(b) Mark and label these five points on the sketch and draw the curve shape. **(1)**

(Total for Question 3 is 3 marks)

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4 Three students each drew a table of values for $y = x^2 - 3x$, for $-3 \leq x \leq 3$. Only one table is correct.

(a) Which table is correct? **(1)**

- ☐ A) x: -3,-2,-1,0,1,2,3 -> y: 18,10,4,0,-2,-2,0
- ☐ B) x: -3,-2,-1,0,1,2,3 -> y: -18,-10,-4,0,2,2,0
- ☐ C) x: -3,-2,-1,0,1,2,3 -> y: 0,-2,-2,0,4,10,18
- ☐ D) x: -3,-2,-1,0,1,2,3 -> y: 36,25,16,9,4,1,0

(b) Give a reason for your answer. **(1)**

(Total for Question 4 is 2 marks)

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5 For each equation, state whether its graph is u-shaped or n-shaped.

(i) $y = 4 - 7x^2$ **(1)**

(ii) $y = 6x^2 - x - 1$ **(1)**

(iii) $y = -x^2 + 3x - 2$ **(1)**

(Total for Question 5 is 3 marks)

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6 The graph of $y = x^2 - 4x + 3$ is a parabola. On graph paper, sketch this parabola. On your sketch, clearly mark the vertex and the x- and y-intercepts.

(Total for Question 6 is 3 marks)

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7 A quadratic graph has the equation $y = (x - 1)(x - 5)$.

(a) Write down the coordinates of the two points where the graph crosses the x-axis. **(2)**

.....

(b) Find the coordinates of the point where the graph crosses the y-axis. **(2)**

.....

(c) Using the symmetry of the graph, find the coordinates of the turning point. **(2)**

.....

(Total for Question 7 is 6 marks)

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8 The graph of $y = x^2 + 6x + 5$ crosses the x-axis at two points.

(a) Find the coordinates of the two points where the graph crosses the x-axis. **(2)**

.....

(b) Using the symmetry of the graph, write down the coordinates of the turning point. **(2)**

.....

(c) Write down the coordinates of the y-intercept of the graph. **(1)**

.....

(Total for Question 8 is 5 marks)

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9 The parabola $y = -2(x - 1)^2 + 5$ is drawn. State the coordinates of the vertex and write down the equation of the axis of symmetry. Then sketch the graph, labelling the vertex and axis.

(Total for Question 9 is 3 marks)

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10 A rectangular lawn has width x metres and length $(x + 5)$ metres. The area of the lawn, A m^2, is given by $A = x(x + 5)$.

(a) Complete the table of values for $A = x(x + 5)$, for $1 \leq x \leq 3$. **(2)**

x	1	2	3
A	_	_	_

(b) Explain why, in this context, x cannot take a negative value. **(1)**

(Total for Question 10 is 3 marks)

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11 Consider the two graphs $y = x^2 - 4$ and $y = 2 - x^2/2$.

(a) Algebraically find the points of intersection. **(3)**

(b) State how many points of intersection there are and explain briefly why the number of intersections matches the algebraic result. **(2)**

(Total for Question 11 is 5 marks)

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12 A market trader models her weekly profit, P pounds, using $P = -2x^2 + 40x$, where x is the price increase in pounds applied to each item, for $0 \leq x \leq 20$.

(a) Complete the table of values for $P = -2x^2 + 40x$. **(2)**

x	0	5	10	15	20
P	0	_	200	_	0

(b) Using the symmetry of the table, find the maximum weekly profit and the value of x at which it occurs. **(2)**

.....

(c) Interpret what the value P = 0 represents at both x = 0 and x = 20. **(1)**

(Total for Question 12 is 5 marks)

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13 $y = x^2 - 6x + 11$

(a) Show that $y = (x - 3)^2 + 2$. **(2)**

(b) Hence explain why the equation $x^2 - 6x + 11 = 0$ has no real solutions. **(2)**

(Total for Question 13 is 4 marks)

14 The graph of $y = x^2 + kx + 9$, where k is a non-zero constant, touches the x-axis at exactly one point. Find the possible values of k and the corresponding points where the graph touches the x-axis.

(Total for Question 14 is 5 marks)

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Mark scheme · 5.9 Drawing Quadratic Graphs: Test Pack

A correct answer earns full marks unless the question asks for working, a method, proof or explanation.

Question 1

y = 2 cao **B1**

Answer: 2 [$y = 0^2 + 3(0) + 2 = 2$]

Question 2

at least 3 of the 5 y-values correct **B1**

all 5 y-values correct **B1**

Answer: 3, 0, -1, 0, 3

Question 3

(a) correct method to square the x values shown or listed **M1**

(a) y values 4, 1, 0, 1, 4 cao **A1**

(a) Answer: y = 4, 1, 0, 1, 4

(b) curve sketched through the five labelled points with correct U shape **A1**

(b) Answer: Sketch with points plotted at (-2,4), (-1,1), (0,0), (1,1), (2,4) and a U-shaped curve through them.

Question 4

(a) A **B1**

(a) Answer: A

(b) correct substitution check shown for at least one value, e.g. at x=-3, $(-3)^2$-3(-3)=9+9=18 oe **B1**

(b) Answer: At x = -3: $(-3)^2 - 3(-3) = 9 + 9 = 18$, which only matches table A

Question 5

(i) n-shaped **B1**

(i) Answer: n-shaped

(ii) u-shaped **B1**

(ii) Answer: u-shaped

(iii) n-shaped **B1**

(iii) Answer: n-shaped

Question 6

complete sketch showing a parabola with correct shape and axis of symmetry x = 2 (vertex visible) ft **M1**

vertex marked at (2, -1) cao **A1**

x-intercepts at x = 1 and x = 3 and y-intercept at (0, 3) all marked cao **A1**

Answer: Vertex (2, -1); x-intercepts (1, 0) and (3, 0); y-intercept (0, 3).

Question 7

(a) (1, 0) **B1**

(a) (5, 0) **B1**

(a) Answer: (1, 0) and (5, 0)

(b) substitutes x = 0 into y = (x-1)(x-5) **M1**

(b) (0, 5) cao **A1**

(b) Answer: (0, 5)

(c) x = 3 (midpoint of the roots x=1 and x=5) **M1**

(c) (3, -4) cao **A1**

(c) Answer: (3, -4)

Question 8

(a) correct factorisation (x + 1)(x + 5) = 0 oe **M1**

(a) (-1, 0) and (-5, 0) both cao **A1**

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

(b) finds the midpoint of the roots, x = (-1 + -5)/2 = -3, ft from part (a) **M1**

(b) (-3, -4) cao **A1**

(b) Answer: (-3, -4)

(c) (0, 5) **B1**

(c) Answer: (0, 5)

Question 9

state vertex from vertex form or identify axis x = 1 ft **M1**

vertex (1, 5) cao **A1**

axis of symmetry x = 1 cao **A1**

Answer: Vertex (1, 5); axis of symmetry x = 1.

Question 10

(a) at least 2 of the 3 A-values correct **B1**

(a) all 3 A-values correct **B1**

(a) Answer: 6, 14, 24

(b) x represents a width/length, and a physical length cannot be negative oe **B1**

(b) Answer: x is a width (a length), and a length cannot be negative

Question 11

(a) equate $x^2 - 4 = 2 - x^2/2$ and rearrange correctly to form $3x^2 = 12$ or equivalent **M1**

(a) solve $x^2 = 4$ to get x = ±2 **M1**

(a) give intersection points (2, 0) and (-2, 0) cao **A1**

(a) Answer: (2, 0) and (-2, 0)

(b) state there are 2 points of intersection cao **B1**

(b) explain because the rearranged equation $3x^2 - 12 = 0$ gives two distinct real solutions x = ±2 oe **B1**

(b) Answer: There are 2 intersections because the algebraic equation gives two distinct real solutions x = ±2, leading to two distinct points.

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Question 12

(a) P = 150 at x = 5 **B1**

(a) P = 150 at x = 15 **B1**

(a) Answer: x=5: P=150, x=15: P=150

(b) identifies that the maximum lies midway between x = 0 and x = 20 (or between the two equal P-values), x = 10 **M1**

(b) maximum profit = £200 at x = 10 **A1**

(b) Answer: Maximum profit = £200, at x = 10

(c) a sensible interpretation, e.g. the price increase is either too small or too large to generate any profit oe **B1**

(c) Answer: At x = 0 there is no price increase, and at x = 20 the price increase is so large that no profit is made; both give zero profit in this model

Question 13

(a) $(x - 3)^2$ seen **M1**

(a) correctly shows $(x - 3)^2 + 2 = x^2 - 6x + 9 + 2 = x^2 - 6x + 11$ (cso) **A1**

(a) Answer: $y = (x - 3)^2 + 2$

(b) states or uses that $(x - 3)^2 \geq 0$ for all real x **M1**

(b) correct conclusion: since $(x - 3)^2 \geq 0$, $y = (x - 3)^2 + 2 \geq 2$, so y is never 0, so the graph never crosses the x-axis and there are no real solutions (cso) **A1**

(b) Answer: Since $(x - 3)^2 \geq 0$ for all real x, $y = (x - 3)^2 + 2 \geq 2$ always, so y can never equal 0, meaning the graph never crosses the x-axis and the equation has no real solutions

Question 14

uses the condition for equal roots, $b^2 - 4ac = 0$, with a = 1, b = k, c = 9 **M1**

forms $k^2 - 36 = 0$ and rearranges to $k^2 = 36$, dependent on the previous M1 **M1**

k = 6 **A1**

k = -6 **A1**

touch points ft: (-3, 0) when k = 6, and (3, 0) when k = -6 **B1**

Answer: k = 6, touching at (-3, 0); or k = -6, touching at (3, 0)

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