

Quadratic and other graphs

Foundation and Higher tiers

Total marks: 83

Marks

- M** Method mark, for a correct method. It can be implied by a correct answer.
- A** Accuracy mark, for a correct answer. It needs the method mark before it.
- B** A mark for a correct value or statement, with or without working.
- ft** Follow through: the mark is given for using an earlier wrong answer correctly.
- oe** Or equivalent.
- [a, b]** Any value from a to b inclusive.

Questions

Q	Skill	Spec	Tier	Grade	Calculator	Marks
1	Reading from a quadratic graph	A12	Foundation	3	No	3
2	Drawing a quadratic graph	A12	Foundation	4	No	4
3	Recognising graphs	A12	Common	5	No	3
4	Roots and turning points from a graph	A11 A18	Common	5	No	4
5	Symmetry of a quadratic graph	A11	Common	5	No	3
6	Intercepts of a cubic graph	A12	Common	5	No	3
7	Sketching a quadratic from completed square form	A11 A12	Higher	7	No	3
8	Exponential graphs	A12	Higher	7	No	3
9	Drawing a translated graph	A13	Higher	7	No	3
10	Transformations of a turning point	A13	Higher	8	No	3
11	Translating a trigonometric graph	A13 A12	Higher	8	No	3
12	Solving an equation with a graph and a line	A11 A18	Higher	8	No	3
13	Drawing a cubic graph	A12	Common	5	Yes	6
14	The sine graph	A12	Higher	6	Yes	4
15	An exponential graph in context	A12 R16 A14	Higher	6	Yes	5
16	A reciprocal graph in context	A12 A14	Common	6	Yes	6

Q	Skill	Spec	Tier	Grade	Calculator	Marks
17	Gradient of a curve as a rate	A15 A14	Higher	7	Yes	5
18	Area under a speed-time graph	A15 A14	Higher	7	Yes	4
19	Completing the square with decimals	A11 A18	Higher	7	Yes	5
20	Solving trigonometric equations with a calculator and a graph	A12	Higher	7	Yes	5
21	A quadratic model: the formula and the greatest value	A18 A11 A14	Higher	7	Yes	5
	Total					83

Question 1 A12 · Foundation · Grade 3 · 3 marks

Q	Answer	Mark	Comments
1(a)	3.25	B1	accept [3, 3.5]
1(b)	1	B1	
	3	B1	

Question 2 A12 · Foundation · Grade 4 · 4 marks

Q	Answer	Mark	Comments
2(a)	0, -3, 0	B2	in the right places. B1 for two correct
2(b)	all 7 points from their table plotted correctly	B1ft	within half a square
	a smooth curve through all their points	B1	lowest point at (1, -4) within half a square, not flat-bottomed

Question 3 A12 · Common · Grade 5 · 3 marks

Q	Answer	Mark	Comments
3	$y = x^3$: C; $y = 4 - x^2$: A; $y = \frac{1}{x}$: B; $y = x^2 - 4$: D	B3	B2 for two correct. B1 for one correct

Question 4 A11 A18 · Common · Grade 5 · 4 marks

Q	Answer	Mark	Comments
4(a)	-2 and 4	B1	
4(b)	(1, 9)	B1	
4(c)	one of [-0.9, -0.6] or [2.6, 2.9]	B1	or a line drawn at $y = 6$
	both [-0.9, -0.6] and [2.6, 2.9]	B1	

Question 5 A11 · Common · Grade 5 · 3 marks

Q	Answer	Mark	Comments
5(a)	$x = 4$	M1	or $(x - 2)(x - 6)$
	(4, -4)	A1	
5(b)	(0, 12)	B1	

Question 6 A12 · Common · Grade 5 · 3 marks

Q	Answer	Mark	Comments
6	A(-2, 0), B(1, 0) and C(3, 0)	B2	B1 for two correct, or -2, 1 and 3 in the wrong order
	D(0, 6)	B1	

Question 7 A11 A12 · Higher · Grade 7 · 3 marks

Q	Answer	Mark	Comments
7	a U-shaped curve with its turning point (3, -4) labelled	B1	turning point below the x-axis and to the right of the y-axis
	(1, 0) and (5, 0) labelled	B1	oe
	(0, 5) labelled	B1	oe

Question 8 A12 · Higher · Grade 7 · 3 marks

Q	Answer	Mark	Comments
8	$a = 3$	B1	
	$48 = 3 \times b^2$ or $b^2 = 16$	M1	ft their a
	$b = 4$	A1	

Question 9 A13 · Higher · Grade 7 · 3 marks

Q	Answer	Mark	Comments
9(a)	a correct graph through (1, -1), (3, 1), (5, 1) and (6, -2)	B2	B1 for a translation of the correct shape by 3 in any one direction, or three points correct
9(b)	$y = f(-x)$	B1	

Question 10 A13 · Higher · Grade 8 · 3 marks

Q	Answer	Mark	Comments
10(a)	(5, -5)	B1	
10(b)	(3, 5)	B1	
10(c)	(-3, -4)	B1	

Question 11 A13 A12 · Higher · Grade 8 · 3 marks

Q	Answer	Mark	Comments
11(a)	the maximum at $x = 300$, or the graph of $y = \cos x$ moved 60 to the left	M1	oe
	60	A1	
11(b)	(120, -1)	B1	

Question 12 A11 A18 · Higher · Grade 8 · 3 marks

Q	Answer	Mark	Comments
12	the line $y = x - 2$ drawn	M1	oe, or states $y = x - 2$
	one of $[-1.9, -1.7]$ or $[2.7, 2.9]$	A1	
	both $[-1.9, -1.7]$ and $[2.7, 2.9]$	A1	

Question 13 A12 · Common · Grade 5 · 6 marks

Q	Answer	Mark	Comments
13(a)	2.125, 2.375, -0.375, -0.125	B2	B1 for two or three correct
13(b)	all 9 points from their table plotted correctly	B1ft	within half a square
	a smooth curve through all their points	B1	
13(c)	$[-1.95, -1.8]$, $[0.25, 0.45]$ and $[1.45, 1.6]$	B2	B1 for one or two correct. ft their curve

Question 14 A12 · Higher · Grade 6 · 4 marks

Q	Answer	Mark	Comments
14(a)	(90, 1)	B1	
14(b)	150	B1	
14(c)	210 and 330	B2	with no extra values in the range. B1 for one correct

Question 15 A12 R16 A14 · Higher · Grade 6 · 5 marks

Q	Answer	Mark	Comments
15(a)	18%	B1	
15(b)	2450×0.82^3	M1	oe
	£1350.85	A1	
15(c)	a reading at $V = 1225$	M1	oe, such as a line drawn across at 1225
	3.5	A1	accept $[3.3, 3.7]$

Question 16 A12 A14 · Common · Grade 6 · 6 marks

Q	Answer	Mark	Comments
16(a)	5.27, 3.52, 2.64	B2	B1 for one or two correct
16(b)	all 6 points from their table plotted correctly	B1ft	within half a square
	a smooth curve through all their points	B1	
16(c)	a reading from the graph at $t = 3.75$	M1	oe, 3 hours 45 minutes changed to 3.75 hours
	11.3	A1	accept [11, 11.5]

Question 17 A15 A14 · Higher · Grade 7 · 5 marks

Q	Answer	Mark	Comments
17(a)	a tangent drawn to the curve at $t = 6$	M1	
	$\frac{\text{change in } d}{\text{change in } t}$ for their tangent	M1	oe, using two points on their tangent at least 2 seconds apart
	5.4	A1	accept [4.8, 6.0]
17(b)	$\frac{28.8 - 1.8}{8 - 2}$	M1	oe, readings from the graph
	4.5	A1	accept [4.3, 4.7]

Question 18 A15 A14 · Higher · Grade 7 · 4 marks

Q	Answer	Mark	Comments
18(a)	$\frac{1}{2} \times 4 \times (0 + 5.2)$ or $\frac{1}{2} \times 4 \times (5.2 + 8.2)$	M1	oe, the area of one trapezium
	$\frac{1}{2} \times 4 \times (0 + 2 \times (5.2 + 8.2 + 9.8) + 10.8)$	M1	oe, all four strips added
	114.4	A1	
18(b)	Underestimate, as the curve is above the tops of the trapezia	B1	oe, such as 'the trapezia miss some of the area under the curve'

Question 19 A11 A18 · Higher · Grade 7 · 5 marks

Q	Answer	Mark	Comments
19(a)	$(x - 2.3)^2$	M1	oe, or $a = 2.3$
	$(x - 2.3)^2 - 2$	A1	
19(b)	(2.3, -2)	B1ft	ft their part (a)
19(c)	$x - 2.3 = \pm\sqrt{2}$	M1	oe, ft their part (a), or a correct use of the formula
	0.89 and 3.71	A1	accept 0.89 or [0.885, 0.886] and accept 3.71 or [3.714, 3.715]

Question 20 A12 · Higher · Grade 7 · 5 marks

Q	Answer	Mark	Comments
20(a)	110.5	B1	accept 110.5 or [110.48, 110.49]
	249.5	B1ft	ft 360 – their first value, accept 249.5 or [249.51, 249.52]. B0 for any extra values in the range
20(b)	the greatest value of $\cos x$ is 1, and $1.2 > 1$	B1	oe, such as ‘the graph never goes above 1’
20(c)	one of 119.1 or 299.1	B1	accept 119.1 or [119.05, 119.06] or accept 299.1 or [299.05, 299.06], or –60.9 seen
	119.1 and 299.1	B1	and no extra values in the range

Question 21 A18 A11 A14 · Higher · Grade 7 · 5 marks

Q	Answer	Mark	Comments
21(a)	$4.9t^2 - 6.2t - 3 = 0$	M1	oe, the height put equal to 0
	$\frac{6.2 \pm \sqrt{(6.2^2 - 4 \times 4.9 \times -3)}}{2 \times 4.9}$	M1	oe, a correct substitution into the formula
	1.64	A1	accept 1.64 or [1.638, 1.639], and the negative value rejected
21(b)	$t = \frac{6.2}{9.8}$ (= 0.633...) or $-4.9(t - 0.633\ldots)^2 + 4.961\ldots$	M1	oe, the time of the greatest height, or halfway between their two solutions
	4.96	A1	accept 4.96 or [4.961, 4.962]