Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	6	6	3	/	0	1	Signature	

Paper Reference(s)

6663/01

Edexcel GCE

Core Mathematics C1

Advanced Subsidiary

Tuesday 10 January 2006 – Afternoon

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total	

Materials required for examination
Mathematical Formulae (Green)

Items included with question papers
Nil

Calculators may NOT be used in this examination.

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.
Check that you have the correct question paper.
You must write your answer for each question in the space following the question.

Information for Candidates

A booklet 'Mathematical Formulae and Statistical Tables' is provided.
Full marks may be obtained for answers to ALL questions.
The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 10 questions in this question paper. The total mark for this paper is 75.
There are 20 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You must show sufficient working to make your methods clear to the Examiner. Answers without working may gain no credit.

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1. Factorise completely

$$x^3 - 4x^2 + 3x.$$

(3)

Q1

(Total 3 marks)

Question number	Scheme		Marks
1.	$x(x^2-4x+3)$	Factor of x. (Allow $(x-0)$)	M1
	$= x(x-3)(x-1)$	Factorise 3 term quadratic	M1 A1
			(3)
			Total 3 marks

2.	(a) $u_2 = (-2)^2 = 4$		B1
	$u_3 = 1,\ u_4 = 4$	For u_3, ft $(u_2-3)^2$	B1ft, B1
			(3)
	(b) $u_{20} = 4$		B1ft
			(1)
			Total 4 marks

3.	(a) $y = 5-(2\times 3) = -1$	(or equivalent verification) (*)	B1
			(1)
	(b) Gradient of L is $\frac{1}{2}$		B1
	$y-(-1) = \frac{1}{2}(x-3)$	(ft from a <u>changed</u> gradient)	M1 A1ft
	$x-2y-5=0$	(or equiv. with integer coefficients)	A1
			(4)
			Total 5 marks

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2. The sequence of positive numbers $u_1, u_2, u_3, \ldots$ is given by:

$$u_{n+1} = (u_n - 3)^2, \qquad u_1 = 1.$$

(a) Find u_2, u_3 and u_4.

(3)

(b) Write down the value of u_{20}.

(1)

Q2

(Total 4 marks)

Question number	Scheme		Marks
1.	$x(x^2-4x+3)$	Factor of x. (Allow $(x-0)$)	M1
	$=x(x-3)(x-1)$	Factorise 3 term quadratic	M1 A1
			(3)
			Total 3 marks

2.	(a) $u_2=(-2)^2=4$		B1
	$u_3=1,\ u_4=4$	For u_3, ft $(u_2-3)^2$	B1ft, B1
			(3)
	(b) $u_{20}=4$		B1ft
			(1)
			Total 4 marks

3.	(a) $y=5-(2\times 3)=-1$	(or equivalent verification) (*)	B1
			(1)
	(b) Gradient of L is $\frac{1}{2}$		B1
	$y-(-1)=\frac{1}{2}(x-3)$	(ft from a <u>changed</u> gradient)	M1 A1ft
	$x-2y-5=0$	(or equiv. with integer coefficients)	A1
			(4)
			Total 5 marks

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3. The line L has equation $y = 5 - 2x$.

(a) Show that the point P (3, –1) lies on L.

(1)

(b) Find an equation of the line perpendicular to L, which passes through P. Give your answer in the form $ax + by + c = 0$, where a, b and c are integers.

(4)

Q3

(Total 5 marks)

Question number	Scheme		Marks
1.	$x(x^2-4x+3)$	Factor of x. (Allow $(x-0)$)	M1
	$= x(x-3)(x-1)$	Factorise 3 term quadratic	M1 A1
			(3)
			Total 3 marks

2.	(a) $u_2 = (-2)^2 = 4$		B1
	$u_3 = 1,\ u_4 = 4$	For u_3, ft $(u_2-3)^2$	B1ft, B1
			(3)
	(b) $u_{20} = 4$		B1ft
			(1)
			Total 4 marks

3.	(a) $y = 5-(2\times 3) = -1$	(or equivalent verification) (*)	B1
			(1)
	(b) Gradient of L is $\frac{1}{2}$		B1
	$y-(-1) = \frac{1}{2}(x-3)$	(ft from a <u>changed</u> gradient)	M1 A1ft
	$x-2y-5=0$	(or equiv. with integer coefficients)	A1
			(4)
			Total 5 marks

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4. Given that $y = 2x^2 - \frac{6}{x^3}$, $x \neq 0$,

(a) find $\frac{dy}{dx}$,

(2)

(b) find $\int y \, dx$.

(3)

Q4

(Total 5 marks)

Question number	Scheme	Marks
4.	(a) $\frac{dy}{dx} = 4x + 18x^{-4}$ M1: $x^2 \to x$ or $x^{-3} \to x^{-4}$	M1 A1
		(2)
	(b) $\frac{2x^3}{3} - \frac{6x^{-2}}{-2} + C$ M1: $x^2 \to x^3$ or $x^{-3} \to x^{-2}$ or $+C$	M1 A1 A1
		(3)
	$\left(= \frac{2x^3}{3} + 3x^{-2} + C\right)$ First A1: $\frac{2x^3}{3} + C$	
	Second A1: $-\frac{6x^{-2}}{-2}$	
		Total 5 marks

5.	(a) $3\sqrt{5}$ (or $a = 3$)	B1
		(1)
	(b) $\frac{2(3+\sqrt{5})}{(3-\sqrt{5})} \times \frac{(3+\sqrt{5})}{(3+\sqrt{5})}$	M1
	$(3-\sqrt{5})(3+\sqrt{5}) = 9-5$ (= 4) (Used as or intended as denominator)	B1
	$(3+\sqrt{5})(p \pm q\sqrt{5}) = \ldots$ 4 terms ($p \neq 0, q \neq 0$) (Independent)	M1
	or $(6+2\sqrt{5})(p \pm q\sqrt{5}) = \ldots$ 4 terms ($p \neq 0, q \neq 0$)	
	[Correct version: $(3+\sqrt{5})(3+\sqrt{5}) = 9 + 3\sqrt{5} + 3\sqrt{5} + 5$, or double this.]	
	$\frac{2(14+6\sqrt{5})}{4} = 7 + 3\sqrt{5}$ 1st A1: $b = 7$, 2nd A1: $c = 3$	A1 A1
		(5)
		Total 6 marks

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5. (a) Write $\sqrt{45}$ in the form $a\sqrt{5}$, where a is an integer.
(1)

(b) Express $\dfrac{2(3+\sqrt{5})}{(3-\sqrt{5})}$ in the form $b + c\sqrt{5}$, where b and c are integers.
(5)

Question number	Scheme	Marks
4.	(a) $\frac{dy}{dx} = 4x + 18x^{-4}$ M1: $x^2 \to x$ or $x^{-3} \to x^{-4}$	M1 A1
		(2)
	(b) $\frac{2x^3}{3} - \frac{6x^{-2}}{-2} + C$ M1: $x^2 \to x^3$ or $x^{-3} \to x^{-2}$ or $+C$	M1 A1 A1
		(3)
	$\left(= \frac{2x^3}{3} + 3x^{-2} + C \right)$ First A1: $\frac{2x^3}{3} + C$	
	Second A1: $-\frac{6x^{-2}}{-2}$	
		Total 5 marks

5.	(a) $3\sqrt{5}$ (or $a = 3$)	B1
		(1)
	(b) $\frac{2(3+\sqrt{5})}{(3-\sqrt{5})} \times \frac{(3+\sqrt{5})}{(3+\sqrt{5})}$	M1
	$(3-\sqrt{5})(3+\sqrt{5}) = 9 - 5$ (= 4) (Used as or intended as denominator)	B1
	$(3+\sqrt{5})(p \pm q\sqrt{5}) = ...$ 4 terms $(p \neq 0, q \neq 0)$ (Independent)	M1
	or $(6+2\sqrt{5})(p \pm q\sqrt{5}) = ...$ 4 terms $(p \neq 0, q \neq 0)$	
	[Correct version: $(3+\sqrt{5})(3+\sqrt{5}) = 9 + 3\sqrt{5} + 3\sqrt{5} + 5$, or double this.]	
	$\frac{2(14+6\sqrt{5})}{4} = 7 + 3\sqrt{5}$ 1st A1: $b = 7$, 2nd A1: $c = 3$	A1 A1
		(5)
		Total 6 marks

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6.

Figure 1

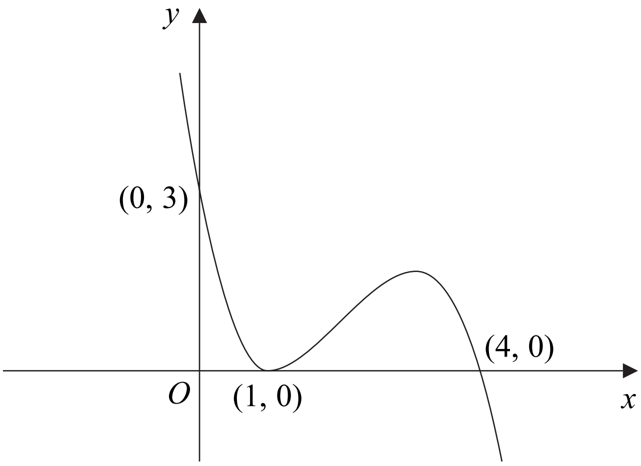


Figure 1 shows a sketch of the curve with equation $y = \mathrm{f}(x)$. The curve passes through the points (0, 3) and (4, 0) and touches the x-axis at the point (1, 0).

On separate diagrams sketch the curve with equation

(a) $y = \mathrm{f}(x + 1)$,

(3)

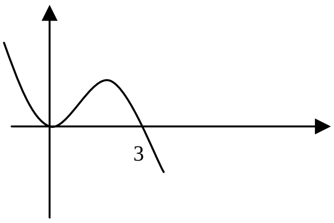
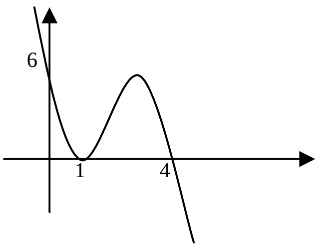
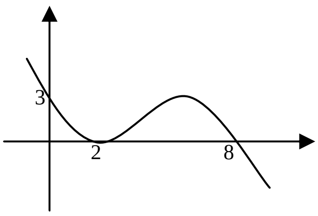
(b) $y = 2\,\mathrm{f}(x)$,

(3)

(c) $y = \mathrm{f}\left(\frac{1}{2}x\right)$.

(3)

On each diagram show clearly the coordinates of all the points where the curve meets the axes.

Question number	Scheme		Marks	
6.	(a) 	(See below)	M1	
		Clearly through origin (or (0, 0) seen)	A1	
		3 labelled (or (3, 0) seen)	A1	
				(3)
	(b) 	Stretch parallel to y-axis	M1	
		1 and 4 labelled (or (1, 0) and (4, 0) seen)	A1	
		6 labelled (or (0, 6) seen)	A1	
				(3)
	(c) 	Stretch parallel to x-axis	M1	
		2 and 8 labelled (or (2, 0) and (8, 0) seen)	A1	
		3 labelled (or (0, 3) seen)	A1	
				(3)
			Total 9 marks	

7.	(a) 500 + (500 + 200) = 1200 or $S_2 = \frac{1}{2}2\{1000 + 200\} = 1200$	(*)	B1	(1)
	(b) Using a = 500, d = 200 with n = 7, 8 or 9	$a + (n-1)d$ or "listing"	M1	
	$500 + (7 \times 200) =$ (£)1900		A1	(2)
	(c) Using $\frac{1}{2}n\{2a + (n-1)d\}$ or $\frac{1}{2}n\{a + l\}$, or listing and "summing" terms		M1	
	$S_8 = \frac{1}{2}8\{2 \times 500 + 7 \times 200\}$ or $S_8 = \frac{1}{2}8\{500 + 1900\}$, or all terms in list correct		A1	
	= (£) 9600		A1	(3)
	(d) $\frac{1}{2}n\{2 \times 500 + (n-1) \times 200\} = 32000$	M1: General S_n, equated to 32000	M1 A1	
	$n^2 + 4n - 320 = 0$ (or equiv.)	M1: Simplify to 3 term quadratic	M1 A1	
	$(n+20)(n-16) = 0 \quad n = ...$	M1: Attempt to solve 3 t.q.	M1	
	n = 16, Age is 26		A1cso,A1cso	
				(7)
			Total 13 marks	

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7. On Alice's 11th birthday she started to receive an annual allowance. The first annual allowance was £500 and on each following birthday the allowance was increased by £200.

(a) Show that, immediately after her 12th birthday, the total of the allowances that Alice had received was £1200.

(1)

(b) Find the amount of Alice's annual allowance on her 18th birthday.

(2)

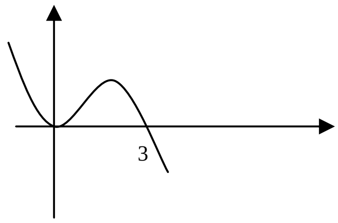
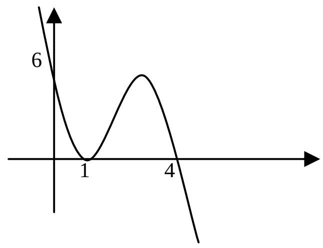
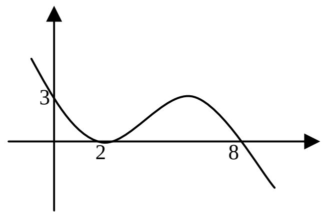
(c) Find the total of the allowances that Alice had received up to and including her 18th birthday.

(3)

When the total of the allowances that Alice had received reached £32 000 the allowance stopped.

(d) Find how old Alice was when she received her last allowance.

(7)

Question number	Scheme	Marks
6.	(a) 	
	(See below)	M1
	Clearly through origin (or (0, 0) seen)	A1
	3 labelled (or (3, 0) seen)	A1 (3)
	(b) 	
	Stretch parallel to *y*-axis	M1
	1 and 4 labelled (or (1, 0) and (4, 0) seen)	A1
	6 labelled (or (0, 6) seen)	A1 (3)
	(c) 	
	Stretch parallel to *x*-axis	M1
	2 and 8 labelled (or (2, 0) and (8, 0) seen)	A1
	3 labelled (or (0, 3) seen)	A1 (3)
		Total 9 marks

7.	(a) 500 + (500 + 200) = 1200 or $S_2 = \frac{1}{2}2\{1000+200\} = 1200$ (*)	B1 (1)
	(b) Using a = 500, d = 200 with n = 7, 8 or 9 $a+(n-1)d$ or "listing"	M1
	$500+(7\times 200) = (£)1900$	A1 (2)
	(c) Using $\frac{1}{2}n\{2a+(n-1)d\}$ or $\frac{1}{2}n\{a+l\}$, or listing and "summing" terms	M1
	$S_8 = \frac{1}{2}8\{2\times 500+7\times 200\}$ or $S_8 = \frac{1}{2}8\{500+1900\}$, or all terms in list correct	A1
	= (£) 9600	A1 (3)
	(d) $\frac{1}{2}n\{2\times 500+(n-1)\times 200\} = 32000$ M1: General S_n, equated to 32000	M1 A1
	$n^2+4n-320=0$ (or equiv.) M1: Simplify to 3 term quadratic	M1 A1
	$(n+20)(n-16)=0$ $n = ...$ M1: Attempt to solve 3 t.q.	M1
	n = 16, Age is 26	A1cso,A1cso
		(7)
		Total 13 marks

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8. The curve with equation $y = \mathrm{f}(x)$ passes through the point (1, 6). Given that

$$\mathrm{f}'(x) = 3 + \frac{5x^2 + 2}{x^{\frac{1}{2}}}, \quad x > 0,$$

find $\mathrm{f}(x)$ and simplify your answer.

(7)

Question number	Scheme		Marks
8.	$\dfrac{5x^2+2}{x^{\frac{1}{2}}} = 5x^{\frac{3}{2}} + 2x^{-\frac{1}{2}}$	M1: One term correct.	M1 A1
		A1: Both terms correct, and no extra terms.	
	$\mathrm{f}(x) = 3x + \dfrac{5x^{\frac{5}{2}}}{\left(\frac{5}{2}\right)} + \dfrac{2x^{\frac{1}{2}}}{\left(\frac{1}{2}\right)}\ (+C)$	(+ C not required here)	M1 A1ft
	$6 = 3 + 2 + 4 + C$	Use of $x = 1$ and $y = 6$ to form eqn. in C	M1
	$C = -3$		A1cso
	$3x + 2x^{\frac{5}{2}} + 4x^{\frac{1}{2}} - 3$	(simplified version required)	A1 (ft C)
			(7)
	[or: $3x + 2\sqrt{x^5} + 4\sqrt{x} - 3$ or equiv.]		
			Total 7 marks

9.	(a) -2 (P), 2 (Q)	($\pm$ 2 scores B1 B1)	B1, B1
			(2)
	(b) $y = x^3 - x^2 - 4x + 4$ (May be seen earlier)	Multiply out, giving 4 terms	M1
	$\dfrac{dy}{dx} = 3x^2 - 2x - 4$	(*)	M1 A1cso
			(3)
	(c) At $x = -1$: $\dfrac{dy}{dx} = 3(-1)^2 - 2(-1) - 4 = 1$		
	Eqn. of tangent: $y - 6 = 1(x - (-1))$, $y = x + 7$	(*)	M1 A1cso
			(2)
	(d) $3x^2 - 2x - 4 = 1$ (Equating to "gradient of tangent")		M1
	$3x^2 - 2x - 5 = 0$ $(3x-5)(x+1) = 0$ $x = \ldots$		M1
	$x = \dfrac{5}{3}$ or equiv.		A1
	$y = \left(\dfrac{5}{3} - 1\right)\left(\dfrac{25}{9} - 4\right)$, $= \dfrac{2}{3} \times \left(-\dfrac{11}{9}\right) = -\dfrac{22}{27}$ or equiv.		M1, A1
			(5)
			Total 12 marks

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9.

Figure 2

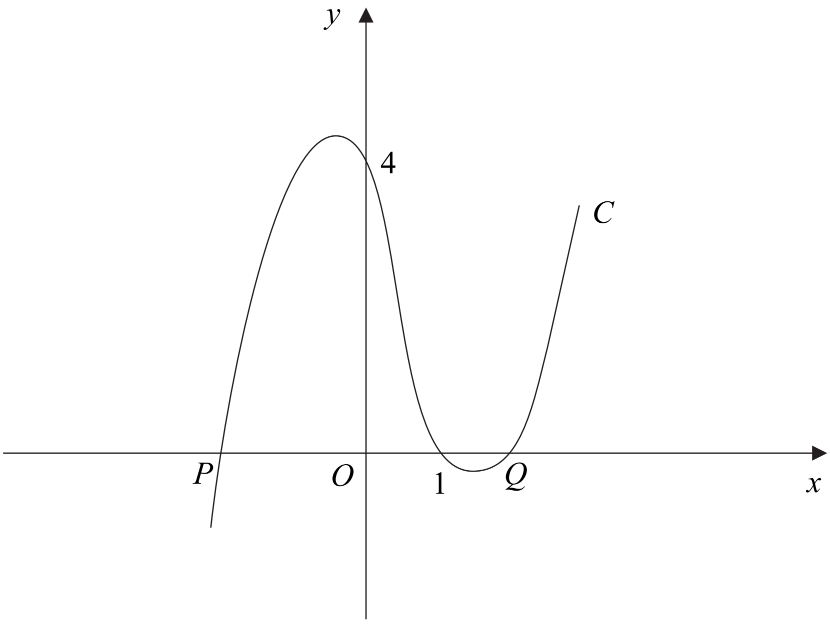

Figure 2 shows part of the curve C with equation

$$y = (x - 1)(x^2 - 4).$$

The curve cuts the x-axis at the points P, (1, 0) and Q, as shown in Figure 2.

(a) Write down the x-coordinate of P, and the x-coordinate of Q.

(2)

(b) Show that $\dfrac{\mathrm{d}y}{\mathrm{d}x} = 3x^2 - 2x - 4$.

(3)

(c) Show that $y = x + 7$ is an equation of the tangent to C at the point (–1, 6).

(2)

The tangent to C at the point R is parallel to the tangent at the point (–1, 6).

(d) Find the exact coordinates of R.

(5)

Question number	Scheme	Marks
8.	$\dfrac{5x^2+2}{x^{\frac{1}{2}}}=5x^{\frac{3}{2}}+2x^{-\frac{1}{2}}$ M1: One term correct.	M1 A1
	A1: Both terms correct, and no extra terms.	
	$f(x)=3x+\dfrac{5x^{\frac{5}{2}}}{\left(\frac{5}{2}\right)}+\dfrac{2x^{\frac{1}{2}}}{\left(\frac{1}{2}\right)}\ (+C)$ (+ C not required here)	M1 A1ft
	$6 = 3 + 2 + 4 + C$ Use of $x = 1$ and $y = 6$ to form eqn. in C	M1
	$C = -3$	A1cso
	$3x+2x^{\frac{5}{2}}+4x^{\frac{1}{2}}-3$ (simplified version required)	A1 (ft C)
		(7)
	[or: $3x+2\sqrt{x^5}+4\sqrt{x}-3$ or equiv.]	
		Total 7 marks

9.	(a) -2 (P), 2 (Q) (± 2 scores B1 B1)	B1, B1
		(2)
	(b) $y=x^3-x^2-4x+4$ (May be seen earlier) Multiply out, giving 4 terms	M1
	$\dfrac{dy}{dx}=3x^2-2x-4$ (*)	M1 A1cso
		(3)
	(c) At $x=-1$: $\dfrac{dy}{dx}=3(-1)^2-2(-1)-4=1$	
	Eqn. of tangent: $y-6=1(x-(-1))$, $y=x+7$ (*)	M1 A1cso
		(2)
	(d) $3x^2-2x-4=1$ (Equating to "gradient of tangent")	M1
	$3x^2-2x-5=0$ $(3x-5)(x+1)=0$ $x=\dots$	M1
	$x=\dfrac{5}{3}$ or equiv.	A1
	$y=\left(\dfrac{5}{3}-1\right)\left(\dfrac{25}{9}-4\right)$, $=\dfrac{2}{3}\times\left(-\dfrac{11}{9}\right)=-\dfrac{22}{27}$ or equiv.	M1, A1
		(5)
		Total 12 marks

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10. $$x^2 + 2x + 3 \equiv (x + a)^2 + b.$$

(a) Find the values of the constants a and b.

(2)

(b) In the space provided below, sketch the graph of $y = x^2 + 2x + 3$, indicating clearly the coordinates of any intersections with the coordinate axes.

(3)

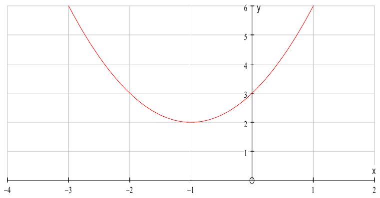
(c) Find the value of the discriminant of $x^2 + 2x + 3$. Explain how the sign of the discriminant relates to your sketch in part (b).

(2)

The equation $x^2 + kx + 3 = 0$, where k is a constant, has no real roots.

(d) Find the set of possible values of k, giving your answer in surd form.

(4)

Question number	Scheme		Marks	
10.	(a) $x^2 + 2x + 3 = (x+1)^2, \ +2$	(a = 1, b = 2)	B1, B1	(2)
	(b) 	"U"-shaped parabola	M1	
		Vertex in correct quadrant (ft from (–a, b)	A1ft	
		(0, 3) (or 3 on y-axis)	B1	(3)
	(c) $b^2 - 4ac = 4 - 12 = -8$		B1	
	Negative, so curve does not cross x-axis		B1	(2)
	(d) $b^2 - 4ac = k^2 - 12$	(May be within the quadratic formula)	M1	
	$k^2 - 12 < 0$	(Correct inequality expression in any form)	A1	
	$-\sqrt{12} < k < \sqrt{12}$	(or $-2\sqrt{3} < k < 2\sqrt{3}$)	M1 A1	(4)
			Total 11 marks	