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

Monday 13 May 2013 – 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	
11	
Total	

Materials required for examination
Mathematical Formulae (Pink)

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, initials and signature.
Check that you have the correct question paper.
Answer ALL the questions.
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 11 questions in this question paper. The total mark for this paper is 75.
There are 28 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 should show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.

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1. Simplify

$$\frac{7+\sqrt{5}}{\sqrt{5}-1}$$

giving your answer in the form $a + b\sqrt{5}$, where a and b are integers.

(4)

Q1

(Total 4 marks)

Question Number	Scheme		Marks
1	$\frac{7+\sqrt{5}}{\sqrt{5}-1}\times\frac{(\sqrt{5}+1)}{(\sqrt{5}+1)}$	Multiplies top and bottom by a correct expression. This statement is sufficient.	M1
	(Allow to multiply top and bottom by $k(\sqrt{5}+1)$)		
	$=\frac{\dots}{4}$	Obtains a denominator of 4 or sight of $(\sqrt{5}-1)(\sqrt{5}+1)=4$	A1cso
	Note that M0A1 is not possible. The 4 must come from a correct method.		
	$(7+\sqrt{5})(\sqrt{5}+1)=7\sqrt{5}+5+7+\sqrt{5}$	An attempt to multiply the numerator by $(\pm\sqrt{5}\pm1)$ and get 4 terms with at least 2 correct for their $(\pm\sqrt{5}\pm1)$. (May be implied)	M1
	$3+2\sqrt{5}$	Answer as written or $a=3$ and $b=2$. (Allow $2\sqrt{5}+3$)	A1cso
	Correct answer with no working scores full marks		
			[4]
Way 2	$\frac{7+\sqrt{5}}{\sqrt{5}-1}\times\frac{(-\sqrt{5}-1)}{(-\sqrt{5}-1)}$	Multiplies top and bottom by a correct expression. This statement is sufficient.	M1
	(Allow to multiply top and bottom by $k(-\sqrt{5}-1)$)		
	$=\frac{\dots}{-4}$	Obtains a denominator of -4	A1cso
	$(7+\sqrt{5})(-\sqrt{5}-1)=-7\sqrt{5}-5-7-\sqrt{5}$	An attempt to multiply the numerator by $(\pm\sqrt{5}\pm1)$ and get 4 terms with at least 2 correct for their $(\pm\sqrt{5}\pm1)$. (May be implied)	M1
	$3+2\sqrt{5}$	Answer as written or $a=3$ and $b=2$	A1cso
	Correct answer with no working scores full marks		
			[4]
	Alternative using Simultaneous Equations: $\frac{(7+\sqrt{5})}{\sqrt{5}-1}=a+b\sqrt{5}\Rightarrow 7+\sqrt{5}=(a-b)\sqrt{5}+5b-a$ M1 Multiplies and collects rational and irrational parts $a-b=1,\ \ 5b-a=7$ A1 Correct equations $a=3,\ \ b=2$ M1 for attempt to solve simultaneous equations A1 both answers correct		`

Leave blank

2. Find

$$\int \left(10x^4 - 4x - \frac{3}{\sqrt{x}} \right) \mathrm{d}x$$

giving each term in its simplest form.

(4)

Q2

(Total 4 marks)

Question Number	Scheme		Marks
2	$(\int =)\dfrac{10x^5}{5} - \dfrac{4x^2}{2}, -\dfrac{3x^{\frac{1}{2}}}{\frac{1}{2}}$	M1: Some attempt to integrate: $x^n \to x^{n+1}$ on at least one term. (not for + c) (If they think $\dfrac{3}{\sqrt{x}}$ is $3x^{\frac{1}{2}}$ you can still award the method mark for $x^{\frac{1}{2}} \to x^{\frac{3}{2}}$	M1A1, A1
		A1: $\dfrac{10x^5}{5}$ **and** $\dfrac{-4x^2}{2}$ or better	
		A1: $-\dfrac{3x^{\frac{1}{2}}}{\frac{1}{2}}$ or better	
	$= \underline{2x^5 - 2x^2 - 6x^{\frac{1}{2}} + c}$	Each term correct and simplified and the + c all appearing together on the same line. Allow $\sqrt{x}$ for $x^{\frac{1}{2}}$. Ignore any spurious integral or signs and/or dy/dx's.	A1
	Do **not** apply isw. If they obtain the correct answer and then e.g. divide by 2 they lose the last mark.		
			[4]

Leave blank

3. (a) Find the value of $8^{\frac{5}{3}}$

(2)

(b) Simplify fully $\dfrac{\left(2x^{\frac{1}{2}}\right)^3}{4x^2}$

(3)

Question Number	Scheme		Marks
3(a)	$8^{\frac{1}{3}}=2$ or $8^5=32768$	A correct attempt to deal with the $\frac{1}{3}$ or the 5. $8^{\frac{1}{3}}=\sqrt[3]{8}$ or $8^5=8\times8\times8\times8\times8$	M1
	$\left(8^{\frac{5}{3}}=\right)$ 32	Cao	A1
	A correct answer with no working scores full marks		
	Alternative $8^{\frac{5}{3}}=8\times8^{\frac{2}{3}}=8\times2^2=$ M1 (Deals with the 1/3) = 32 A1		
			(2)
(b)	$\left(2x^{\frac{1}{2}}\right)^3=2^3x^{\frac{3}{2}}$	One correct power either 2^3 or $x^{\frac{3}{2}}$. $\left(2x^{\frac{1}{2}}\right)\times\left(2x^{\frac{1}{2}}\right)\times\left(2x^{\frac{1}{2}}\right)$ on its own is not sufficient for this mark.	M1
	$\frac{8x^{\frac{3}{2}}}{4x^2}=2x^{-\frac{1}{2}}$ or $\frac{2}{\sqrt{x}}$	M1: Divides coefficients of x **and** subtracts their powers of x. **Dependent on the previous M1**	dM1A1
		A1: Correct answer	
	Note that unless the power of x implies that they have subtracted their powers you would need to see evidence of subtraction. E.g. $\frac{8x^{\frac{3}{2}}}{4x^2}=2x^{\frac{1}{2}}$ would score dM0 unless you see some evidence that 3/2 – 2 was intended for the power of x.		
	Note that there is a misconception that $\frac{\left(2x^{\frac{1}{2}}\right)^3}{4x^2}=\left(\frac{2x^{\frac{1}{2}}}{4x^2}\right)^3$ - this scores 0/3		
			(3)
			[5]

Leave blank

4. A sequence $a_1, a_2, a_3, \ldots$ is defined by

$$a_1 = 4$$
$$a_{n+1} = k(a_n + 2), \qquad \text{for } n \geqslant 1$$

where k is a constant.

(a) Find an expression for a_2 in terms of k.

(1)

Given that $\sum_{i=1}^{3} a_i = 2$,

(b) find the two possible values of k.

(6)

Question Number	Scheme		Marks
	For this question, mark (a) and (b) together and ignore labelling.		
4(a)	$(a_2 =)\ k(4+2)\ \ (= 6k)$	Any correct (possibly un-simplified) expression	B1
			(1)
(b)	$a_3 = k(\text{their } a_2 + 2)\ \ (= 6k^2 + 2k)$	An attempt at a_3. Can follow through their answer to (a) but a_2 must be an expression in k.	M1
	$a_1 + a_2 + a_3 = 4 + (6k) + (6k^2 + 2k)$	An attempt to find their $a_1 + a_2 + a_3$	M1
	$4 + (6k) + (6k^2 + 2k) = 2$	A **correct** equation in any form.	A1
	Solves $6k^2 + 8k + 2 = 0$ to obtain k = $(6k^2 + 8k + 2 = 2(3k+1)(k+1))$	Solves their 3TQ as far as k = ... according to the general principles. (An independent mark for solving their three term quadratic)	M1
	$k = -1/3$	Any equivalent fraction	A1
	$k = -1$	Must be from a correct equation. (Do not accept un-simplified)	B1
	Note that it is quite common to think the sequence is an AP. Unless they find a_3, this is likely only to score the M1 for solving their quadratic.		
			(6)
			[7]

Leave blank

5. Find the set of values of x for which

(a) $2(3x + 4) > 1 - x$

(2)

(b) $3x^2 + 8x - 3 < 0$

(4)

Question Number	Scheme		Marks
5 (a)	$6x + x > 1 - 8$	Attempts to expand the bracket and collect *x* terms on one side and constant terms on the other. Condone sign errors and allow one error in expanding the bracket. Allow <, ≤, ≥, = instead of >.	M1
	$x > -1$	Cao	A1
	Do not isw here, mark their final answer.		
			(2)
(b)	$(x+3)(3x-1)[=0]$ $\Rightarrow x = -3$ and $\frac{1}{3}$	M1: Attempt to solve the quadratic to obtain two critical values A1: $x = -3$ **and** $\frac{1}{3}$ (may be implied by their inequality). Allow all equivalent fractions for -3 and 1/3. (Allow 0.333 for 1/3)	M1A1
	$-3 < x < \frac{1}{3}$	M1: Chooses "inside" region (The letter *x* does not need to be used here) A1ft: Allow $x < \frac{1}{3}$ **and** $x > -3$ or $\left(-3, \frac{1}{3}\right)$ or $x < \frac{1}{3} \cap x > -3$. Follow through their critical values. (must be in terms of *x* here) Allow all equivalent fractions for -3 and 1/3. Both ($x < \frac{1}{3}$ **or** $x > -3$) and ($x < \frac{1}{3}$**,** $x > -3$) as a final answer score A0.	M1A1ft
			(4)
			[6]
	Note that use of ≤ or ≥ appearing in an otherwise correct answer in (a) or (b) should only be penalised once, the first time it occurs.		

Leave blank

6. The straight line L_1 passes through the points $(-1, 3)$ and $(11, 12)$.

(a) Find an equation for L_1 in the form $ax + by + c = 0$,

where a, b and c are integers.

(4)

The line L_2 has equation $3y + 4x - 30 = 0$.

(b) Find the coordinates of the point of intersection of L_1 and L_2.

(3)

Question Number	Scheme		Marks
6	(-1, 3) , (11, 12)		
(a)	$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{12-3}{11-(-1)}, = \frac{3}{4}$	M1:Correct method for the gradient A1: Any correct fraction or decimal	M1,A1
	$y - 3 = ¾ (x+1)$ or $y - 12 = ¾ (x - 11)$ or $y = ¾ x + c$ with attempt at substitution to find c	Correct straight line method using either of the given points and a numerical gradient.	M1
	$4y - 3x - 15 = 0$	Or equivalent with integer coefficients (= 0 **is** required)	A1
	This A1 should only be awarded in (a)		
			(4)
(a) Way 2	$\frac{y-y_1}{y_2-y_1} = \frac{x-x_1}{x_2-x_1} \Rightarrow \frac{y-3}{12-3} = \frac{x+1}{11+1}$	M1: Use of a correct formula for the straight line A1: Correct equation	M1A1
	$12(y-3) = 9(x+1)$	Eliminates fractions	M1
	$4y - 3x - 15 = 0$	Or equivalent with integer coefficients (= 0 **is** required)	A1
			(4)
(b)	Solves their equation from part (a) and L_2 simultaneously to eliminate one variable	Must reach as far as an equation in x only or in y only. (Allow slips in the algebra)	M1
	$x = 3$ or $y = 6$	One of $x = 3$ or $y = 6$	A1
	Both $x = 3$ **and** $y = 6$	Values can be un-simplified fractions.	A1
	Fully correct answers with no working can score 3/3 in (b)		
			(3)
(b) Way 2	$(-1,3) \to -a + 3b + c = 0$ $(11,12) \to 11a + 12b + c = 0$	Substitutes the coordinates to obtain two equations	M1
	$\therefore a = -\frac{3}{4}b,\ b = -\frac{4}{15}c$	Obtains sufficient equations to establish values for a, b and c	A1
	e.g. $c = 1 \Rightarrow b = -\frac{4}{15},\ a = \frac{3}{15}$	Obtains values for a, b and c	M1
	$\frac{3}{15}x - \frac{4}{15}y + 1 = 0 \Rightarrow 4y - 3x - 15 = 0$	Correct equation	A1
			(4)
			[7]

Leave blank

7. A company, which is making 200 mobile phones each week, plans to increase its production.

The number of mobile phones produced is to be increased by 20 each week from 200 in week 1 to 220 in week 2, to 240 in week 3 and so on, until it is producing 600 in week N.

(a) Find the value of N.

(2)

The company then plans to continue to make 600 mobile phones each week.

(b) Find the total number of mobile phones that will be made in the first 52 weeks starting from and including week 1.

(5)

Question Number	Scheme		Marks
7(a)	$600 = 200 + (N-1)20 \Rightarrow N = ...$	Use of 600 with a **correct** formula in an attempt to find *N*. A correct formula could be implied by a correct answer.	M1
	$N = 21$	cso	A1
	Accept correct answer only.		
	$600 = 200 + 20N \Rightarrow N = 20$ is M0A0 (wrong formula) $\frac{600-200}{20} = 20 \therefore N = 21$ is M1A1 (correct formula implied)		
	Listing: All terms must be listed up to 600 and 21 correctly identified. A solution that scores 2 if fully correct and 0 otherwise.		
			(2)
(b)	**Look for an AP first:**		
	$S = \frac{21}{2}(2\times200+20\times20)$ or $\frac{21}{2}(200+600)$ or $S = \frac{20}{2}(2\times200+19\times20)$ or $\frac{20}{2}(200+580)$ (= 8400 or 7800)	M1: Use of correct sum formula with their **integer** *n* = *N* or *N* – 1 from part (a) where 3 < *N* < 52 and *a* = 200 and *d* = 20. A1: Any correct un-simplified numerical expression with *n* = 20 or *n* = 21 (No follow through here)	M1A1
	Then for the constant terms:		
	$600\times(52-"N")$ (= 18600)	M1: $600\times k$ where *k* is an integer and 3 < *k* < 52 A1: A correct un-simplified follow through expression with their *k* consistent with *n* so that *n* + *k* = 52	M1A1ft
	So total is 27000	Cao	A1
	Note that for the constant terms, they may correctly use an AP sum with *d* = 0.		
	There are no marks in (b) for just finding S_{52}		
			(5)
			[7]
	If they obtain *N* = 20 in (a) (0/2) and then in (b) proceed with, $S = \frac{20}{2}(2\times200+19\times20)+32\times600 = 7800+19\ 200 = 27\ 000$ allow them to 'recover' and score full marks in (b) Similarly If they obtain *N* = 22 in (a) (0/2) and then in (b) proceed with, $S = \frac{21}{2}(2\times200+20\times20)+31\times600 = 8400+18\ 600 = 27\ 000$ allow them to 'recover' and score full marks in (b)		

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8.

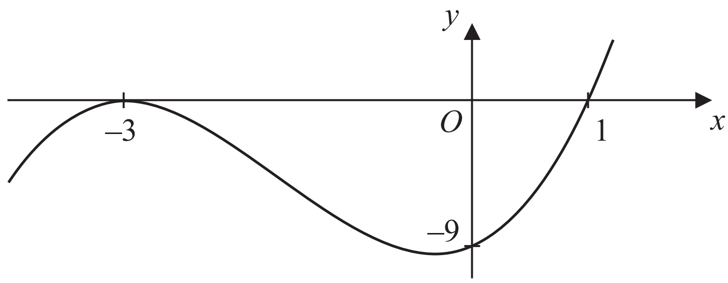


Figure 1

Figure 1 shows a sketch of the curve with equation $y = f(x)$ where

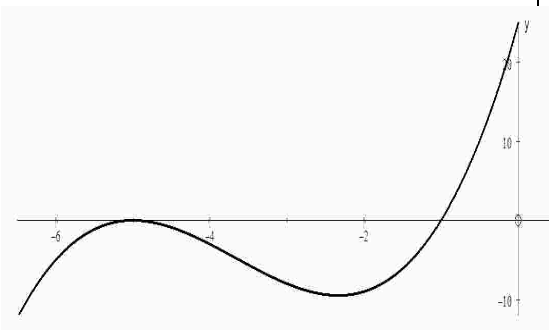
$$f(x) = (x + 3)^2 (x - 1), \qquad x \in \mathbb{R}.$$

The curve crosses the x-axis at (1, 0), touches it at (–3, 0) and crosses the y-axis at (0, –9)

(a) In the space below, sketch the curve C with equation $y = f(x + 2)$ and state the coordinates of the points where the curve C meets the x-axis.
(3)

(b) Write down an equation of the curve C.
(1)

(c) Use your answer to part (b) to find the coordinates of the point where the curve C meets the y-axis.
(2)

Question Number	Scheme		Marks
8 (a)		Horizontal translation – does **not** have to cross the *y*-axis on the right but must at least reach the *x*-axis.	B1
		Touching at (-5, 0). This could be stated anywhere or -5 could be marked on the *x*-axis. Or (0, -5) **marked in the correct place.** Be fairly generous with 'touching' if the intention is clear.	B1
		The right hand tail of their cubic shape crossing at (-1, 0). This could be stated anywhere or -1 could be marked on the *x*-axis. Or (0, -1) **marked in the correct place.** The curve must **cross** the *x*-axis and not stop at -1.	B1
			(3)
(b)	$(x+5)^2(x+1)$	Allow $(x+3+2)^2(x-1+2)$	B1
			(1)
(c)	When $x = 0$, $y = 25$	M1: Substitutes $x = 0$ into their expression in **part (b)** which is not f(x). This may be implied by their answer. Note that the question asks them to use part (b) but allow independent methods.	M1 A1
		A1: $y = 25$ (Coordinates not needed)	
	If they expand <u>incorrectly</u> prior to substituting $x = 0$, score M1 A0 **NB f(x + 2) =** $x^3+11x^2+35x+25$		
			(2)
			[6]

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9.

$$f'(x) = \frac{(3 - x^2)^2}{x^2}, \quad x \neq 0$$

(a) Show that $f'(x) = 9x^{-2} + A + Bx^2$,

where A and B are constants to be found.

(3)

(b) Find $f''(x)$.

(2)

Given that the point (–3, 10) lies on the curve with equation $y = f(x)$,

(c) find $f(x)$.

(5)

<table>
<tr><th>Question Number</th><th colspan="2">Scheme</th><th>Marks</th></tr>
<tr><td>9 (a)</td><td>$(3-x^2)^2 = 9-6x^2+x^4$</td><td>An attempt to expand the numerator obtaining an expression of the form $9 \pm px^2 \pm qx^4, \quad p,q \neq 0$</td><td>M1</td></tr>
<tr><td></td><td>$9x^{-2}+x^2$</td><td>Must come from $\frac{9+x^4}{x^2}$</td><td>A1</td></tr>
<tr><td></td><td>-6</td><td>Must come from $\frac{-6x^2}{x^2}$</td><td>A1</td></tr>
<tr><td></td><td colspan="2">Alternative 1: Writes $\frac{(3-x^2)^2}{x^2}$ as $(3x^{-1}-x)^2$ and attempts to expand = M1 then A1A1 as in the scheme.</td><td></td></tr>
<tr><td></td><td colspan="2">Alternative 2: Sets $(3-x^2)^2 = 9+Ax^2+Bx^4$, expands $(3-x^2)^2$ and compares coefficients = M1 then A1A1 as in the scheme.</td><td></td></tr>
<tr><td></td><td></td><td></td><td>(3)</td></tr>
<tr><td></td><td colspan="2">$(\text{f}'(x) = 9x^{-2}-6+x^2)$</td><td></td></tr>
<tr><td>(b)</td><td>$-18x^{-3}+2x$</td><td>M1: $x^n \to x^{n-1}$ on separate terms at least once. Do not award for $A \to 0$ (Integrating is M0)
A1ft: $-18x^{-3}+2"B"x$ with a numerical B and no extra terms. (A may have been incorrect or even zero)</td><td>M1 A1ft</td></tr>
<tr><td></td><td></td><td></td><td>(2)</td></tr>
<tr><td>(c)</td><td>$\text{f}(x) = -9x^{-1}-6x+\frac{x^3}{3}(+c)$</td><td>M1: $x^n \to x^{n+1}$ on separate terms at least once. (Differentiating is M0)
A1ft: $-9x^{-1}+Ax+\frac{Bx^3}{3}(+c)$ with numerical A and B, $A, B \neq 0$</td><td>M1A1ft</td></tr>
<tr><td></td><td>$10 = \frac{-9}{-3}-6(-3)+\frac{(-3)^3}{3}+c$ so c = ...</td><td>Uses x = -3 and y =10 in what they think is f(x) (They may have differentiated here) but it must be a changed function i.e. not the original $\text{f}'(x)$, to form a linear equation in c and attempts to find c. No + c gets M0 and A0 unless their method implies that they are correctly finding a constant.</td><td>M1</td></tr>
<tr><td></td><td>c = -2</td><td>cso</td><td>A1</td></tr>
<tr><td></td><td>$(\text{f}(x) =) -9x^{-1}-6x+\frac{x^3}{3}$ + their c</td><td>Follow through their c in an otherwise (possibly un-simplified) correct expression.
Allow $-\frac{9}{x}$ for $-9x^{-1}$ or even $\frac{9x^{-1}}{-1}$.</td><td>A1ft</td></tr>
<tr><td></td><td colspan="2">Note that if they integrate in (b), no marks there but if they then go on to use their integration in (c), the marks for integration are available.</td><td></td></tr>
<tr><td></td><td></td><td></td><td>(5)</td></tr>
<tr><td></td><td></td><td></td><td>[10]</td></tr>
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10. Given the simultaneous equations

$$2x + y = 1$$
$$x^2 - 4ky + 5k = 0$$

where k is a non zero constant,

(a) show that

$$x^2 + 8kx + k = 0$$

(2)

Given that $x^2 + 8kx + k = 0$ has equal roots,

(b) find the value of k.

(3)

(c) For this value of k, find the solution of the simultaneous equations.

(3)

Question Number	Scheme	Marks	
10(a)	$x^2 - 4k(1-2x) + 5k(=0)$	Makes *y* the subject from the first equation and substitutes into the second equation (= 0 not needed here) or eliminates *y* by a correct method.	M1
	So $x^2 + 8kx + k = 0$ *	Correct completion to printed answer. There must be no incorrect statements.	A1cso
			(2)
(b)	$(8k)^2 - 4k$	M1: Use of $b^2 - 4ac$ (Could be in the quadratic formula or an inequality, = 0 not needed yet). There must be some correct substitution but there must be no *x*'s. No formula quoted followed by e.g. $8k^2 - 4k = 0$ is M0. A1: Correct expression. Do not condone missing brackets unless they are implied by later work but can be implied by $(8k)^2 > 4k$ etc.	M1 A1
	$k = \frac{1}{16}$ (oe)	Cso (Ignore any reference to *k* = 0) but there must be no contradictory earlier statements. A fully correct solution with no errors.	A1
			(3)
(b) Way 2 Equal roots	$\Rightarrow x^2 + 8kx + k = (x + \sqrt{k})^2$ $\Rightarrow 8k = 2\sqrt{k}$	M1: Correct strategy for equal roots A1: Correct equation	M1A1
	$k = \frac{1}{16}$ (oe)	Cso (Ignore any reference to *k* = 0)	A1
(b) Way 3	Completes the Square $x^2 + 8kx + k = (x+4k)^2 - 16k^2 + k$ $\Rightarrow 16k^2 - k = 0$	M1: $(x \pm 4k)^2 \pm p \pm k,\ p \neq 0$ A1: Correct equation	M1A1
	$k = \frac{1}{16}$ (oe)	Cso (Ignore any reference to *k* = 0)	A1
			(3)
(c)	$x^2 + \frac{1}{2}x + \frac{1}{16} = 0$ so $(x + \frac{1}{4})^2 = 0 \Rightarrow x =$	Substitutes their value of *k* into the given quadratic and attempt to solve their 2 or 3 term quadratic as far as *x* = (may be implied by substitution into the quadratic formula) or starts again and substitutes their value of *k* into the second equation and solves simultaneously to obtain a value for *x*.	M1
	$x = -\frac{1}{4}, y = 1\frac{1}{2}$	First A1 one answer correct, second A1 both answers correct.	A1A1
	Special Case: $x^2 + \frac{1}{2}x + \frac{1}{16} = 0 \Rightarrow x = -\frac{1}{4}, \frac{1}{4} \Rightarrow y = 1\frac{1}{2}, \frac{1}{2}$ allow M1A1A0		
			(3)
			[8]

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11.

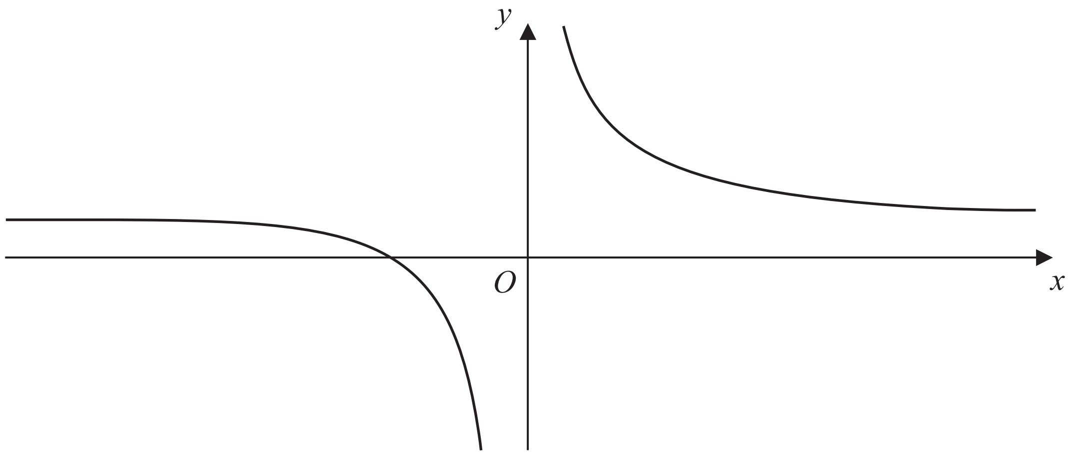

Figure 2

Figure 2 shows a sketch of the curve H with equation $y = \frac{3}{x} + 4,\ x \neq 0$.

(a) Give the coordinates of the point where H crosses the x-axis.
(1)

(b) Give the equations of the asymptotes to H.
(2)

(c) Find an equation for the normal to H at the point $P(-3, 3)$.
(5)

This normal crosses the x-axis at A and the y-axis at B.

(d) Find the length of the line segment AB. Give your answer as a surd.
(3)

Question Number	Scheme		Marks
11 (a)	$\left(-\frac{3}{4}, 0\right)$. Accept $x = -\frac{3}{4}$		B1
			(1)
(b)	$y = 4$	B1: One correct asymptote	B1B1
	$x = 0$ or 'y-axis'	B1: Both correct asymptotes and no extra ones.	
	Special case $x \neq 0$ **and** $y \neq 4$ scores B1B0		
			(2)
(c)	$\frac{dy}{dx} = -3x^{-2}$	$\frac{dy}{dx} = kx^{-2}$ (Allow $\frac{dy}{dx} = kx^{-2} + 4$)	M1
	At $x = -3$, gradient of curve = $-\frac{1}{3}$	Cao (may be un-simplified but must be a fraction with no powers) e.g. $-3(-3)^{-2}$ scores A0 unless evaluated as e.g. $\frac{-3}{9}$ or is implied by their normal gradient.	A1
	Gradient of normal = -1/*m*	Correct perpendicular gradient rule applied to a numerical gradient that must have come from substituting x = -3 into their derivative. **Dependent on the previous M1.**	dM1
	Normal at *P* is $(y-3) = 3(x+3)$	M1: Correct straight line method using (-3, 3) and a "changed" gradient. A wrong equation with no formula quoted is M0. **Also dependent on the first M1.**	dM1A1
		A1: Any correct equation	
			(5)
(d)	(-4, 0) and (0, 12).	Both correct (May be seen on a sketch)	B1
	So *AB* has length $\sqrt{160}$ or AB^2 has length 160	M1: Correct use of Pythagoras for their *A* and *B* one of which lies on the x-axis and the other on the y-axis, obtained from their equation in (c). A correct method for AB^2 or *AB*.	M1 A1cso
		A1: $\sqrt{160}$ or better e.g. $4\sqrt{10}$ **with no errors seen**	
			(3)
			[11]