Paper Reference(s)

6663/01

Edexcel GCE

Core Mathematics C1
Gold Level G3

Time: 1 hour 30 minutes

Materials required for examination papers	**Items included with question papers**
Mathematical Formulae (Green)	Nil

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulas stored in them.

Instructions to Candidates

Write the name of the examining body (Edexcel), your centre number, candidate number, the unit title (Core Mathematics C1), the paper reference (6663), your surname, initials and signature.

Information for Candidates

A booklet ‘Mathematical Formulae and Statistical Tables’ is provided.
Full marks may be obtained for answers to ALL questions.
There are 10 questions in this question paper. The total mark for this paper is 75.

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.

Suggested grade boundaries for this paper:

A*	A	B	C	D	E
61	53	45	36	28	19

1. Factorise completely $x - 4x^3$.

(3)

January 2013

---

2. Express 8^{2x+3} in the form 2^y, stating y in terms of x.

(2)

January 2013

---

3. (*a*) Show that $x^2 + 6x + 11$ can be written as

$$(x + p)^2 + q,$$

where p and q are integers to be found.

(2)

(*b*) Sketch the curve with equation $y = x^2 + 6x + 11$, showing clearly any intersections with the coordinate axes.

(2)

(*c*) Find the value of the discriminant of $x^2 + 6x + 11$.

(2)

May 2010

---

4. The curve C has equation $y = x(5 - x)$ and the line L has equation $2y = 5x + 4$.

(*a*) Use algebra to show that C and L do not intersect.

(4)

(*b*) Sketch C and L on the same diagram, showing the coordinates of the points at which C and L meet the axes.

(4)

January 2012

5.

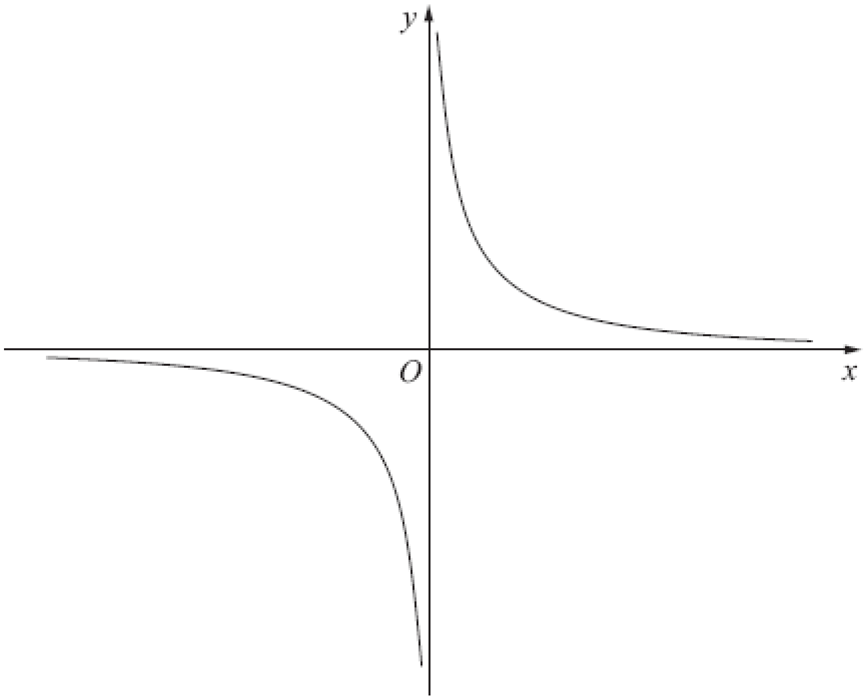


Figure 1

Figure 1 shows a sketch of the curve with equation $y = \dfrac{2}{x}$, $x \neq 0$.

The curve C has equation $y = \dfrac{2}{x} - 5$, $x \neq 0$, and the line l has equation $y = 4x + 2$.

(*a*) Sketch and clearly label the graphs of C and l on a single diagram.

On your diagram, show clearly the coordinates of the points where C and l cross the coordinate axes.

(5)

(*b*) Write down the equations of the asymptotes of the curve C.

(2)

(*c*) Find the coordinates of the points of intersection of $y = \dfrac{2}{x} - 5$ and $y = 4x + 2$.

(5)

January 2013

6. 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)

May 2013

---

7. The equation

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

has no real solutions for x.

(*a*) Show that k satisfies $k^2 + 4k - 32 < 0$.

(3)

(*b*) Hence find the set of possible values of k.

(4)

January 2008

---

8. (*a*) Calculate the sum of all the even numbers from 2 to 100 inclusive,

$$2 + 4 + 6 + ... + 100.$$

(3)

(*b*) In the arithmetic series

$$k + 2k + 3k + ... + 100,$$

k is a positive integer and k is a factor of 100.

(i) Find, in terms of k, an expression for the number of terms in this series.

(ii) Show that the sum of this series is

$$50 + \frac{5000}{k}.$$

(4)

(*c*) Find, in terms of k, the 50th term of the arithmetic sequence

$$(2k + 1), \quad (4k + 4), \quad (6k + 7), \; \ldots \; ,$$

giving your answer in its simplest form.

(2)

May 2011

---

9. $$\mathrm{f}(x) = x^2 + 4kx + (3 + 11k), \quad \text{where } k \text{ is a constant.}$$

(*a*) Express $\mathrm{f}(x)$ in the form $(x + p)^2 + q$, where p and q are constants to be found in terms of k.

(3)

Given that the equation $\mathrm{f}(x) = 0$ has no real roots,

(*b*) find the set of possible values of k.

(4)

Given that $k = 1$,

(*c*) sketch the graph of $y = \mathrm{f}(x)$, showing the coordinates of any point at which the graph crosses a coordinate axis.

(3)

January 2010

10.

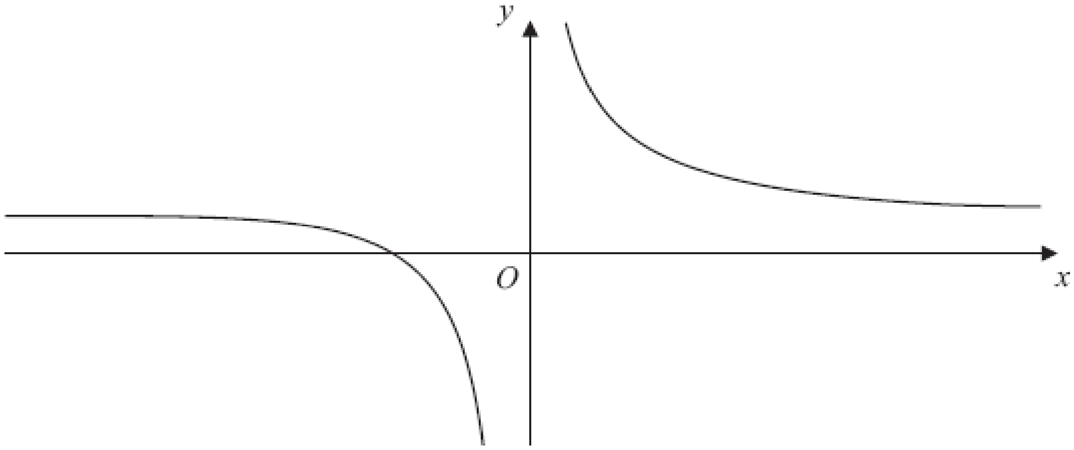


Figure 2

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.

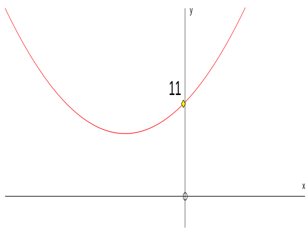
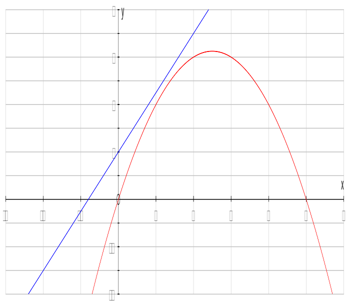
(d) Find the length of the line segment AB. Give your answer as a surd.

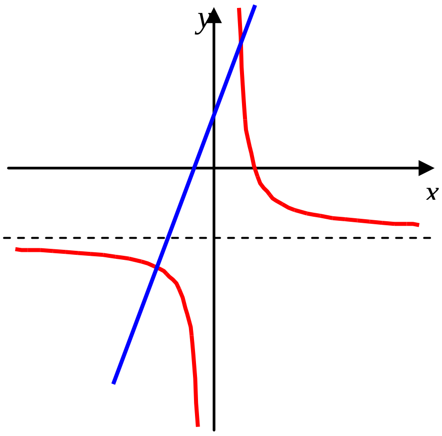
(3)

May 2013

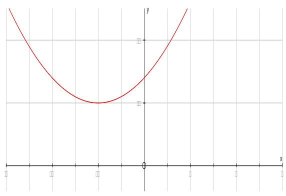
TOTAL FOR PAPER: 75 MARKS

END

Question Number	Scheme	Marks
1.	$x(1-4x^2)$ Accept $x(-4x^2+1)$ or $-x(4x^2-1)$ or $-x(-1+4x^2)$ or even $4x(\frac{1}{4}-x^2)$ or equivalent quadratic (or initial cubic) into two brackets $x(1-2x)(1+2x)$ or $-x(2x-1)(2x+1)$ or $x(2x-1)(-2x-1)$	B1 M1 A1 **[3]**
2.	$(8^{2x+3}=\left(2^3\right)^{2x+3})=2^{3(2x+3)}$ or 2^{ax+b} with $a=6$ **or** $b=9$ $=2^{6x+9}$ *or* $=2^{3(2x+3)}$ as **final** answer with no errors or $(y=)6x+9$ or $3(2x+3)$	M1 A1 **[2]**
3. (a)	$(x+3)^2+2$ or $p=3$ or $\frac{6}{2}$ $q=2$	B1 B1 (2)
(b)	 U shape with min in 2nd quad (Must be above *x*-axis and not on *y*=axis) U shape crossing *y*-axis at (0, 11) only (Condone (11,0) marked on *y*-axis)	B1 B1 (2)
(c)	$b^2-4ac=6^2-4\times 11$ $=\underline{-8}$	M1 A1 (2) **[6]**
4. (a)	$x(5-x)=\frac{1}{2}(5x+4)$ (o.e.) $2x^2-5x+4(=0)$ (o.e.) e.g. $x^2-2.5x+2(=0)$ $b^2-4ac=(-5)^2-4\times 2\times 4$ $=25-32$ <0, so no roots <u>or</u> no intersections <u>or</u> no solutions	M1 A1 M1 A1 (4)
(b)	 Curve: $\cap$ shape and passing through (0, 0) $\cap$ shape and passing through (5, 0) Line : +ve gradient and no intersections with *C*. If no *C* drawn score B0 Line passing through (0, 2) and (−0.8, 0) marked on axes	B1 B1 B1 B1 (4) **[8]**

Question Number	Scheme	Marks
5. (a)		
	$y = \frac{2}{x}$ is translated up or down.	M1
	$y = \frac{2}{x} - 5$ is in the correct position.	A1
	Intersection with x-axis at $\left(\frac{2}{5}, \{0\}\right)$ **only**	B1
	$y = 4x + 2$: attempt at straight line, with positive gradient with positive y intercept.	B1
	Intersection with x-axis at $\left(-\frac{1}{2}, \{0\}\right)$ **and** y-axis at $\left(\{0\}, 2\right)$.	B1
		(5)
(b)	Asymptotes : $x = 0$ (or y-axis) and $y = -5$.	B1B1
		(2)
(c)	Method 1: $\frac{2}{x} - 5 = 4x + 2$ Method 2: $\frac{y-2}{4} = \frac{2}{y+5}$	M1
	$4x^2 + 7x - 2 = 0 \Rightarrow x =$ $y^2 + 3y - 18 = 0 \rightarrow y =$	dM1
	$x = -2, \frac{1}{4}$ $y = -6, 3$	A1
	When $x = -2$, $y = -6$, When $y = -6$, $x = -2$	M1A1
	When $x = \frac{1}{4}$, $y = 3$ When $y = 3$, $x = \frac{1}{4}$.	
		(5) **[12]**
6. (a)	$600 = 200 + (N - 1)20 \Rightarrow N = \ldots$	M1
	$N = 21$	A1 cso (2)
(b)	$S = \frac{21}{2}(2 \times 200 + 20 \times 20)$ or $\frac{21}{2}(200 + 600)$ or $S = \frac{20}{2}(2 \times 200 + 19 \times 20)$ or $\frac{20}{2}(200 + 580)$ (= 8400 or 7800)	M1A1
	$600 \times (52 - "N")$ (= 18600)	M1A1ft
	So total is 27000	A1 cao
		(5) **[7]**

Question Number	Scheme	Marks
7. (a)	$x^2 + kx + (8 - k)$ $\quad(= 0)$	M1
	$b^2 - 4ac = k^2 - 4(8 - k)$	M1
	$b^2 - 4ac < 0 \quad \Rightarrow k^2 + 4k - 32 < 0$	A1cso
		(3)
(b)	$(k + 8)(k - 4) = 0 \quad k = \ldots$	M1
	$k = -8 \quad k = 4$	A1
	Choosing 'inside' region (between the two k values)	M1
	$-8 < k < 4$ or $4 > k > -8$	A1
		(4)
		[7]
8. (a)	Series has 50 terms	B1
	$S = \frac{1}{2}(50)(2 + 100) = 2550$ or $S = \frac{1}{2}(50)(4 + 49 \times 2) = 2550$	M1 A1
		(3)
(b)(i)	$\frac{100}{k}$	B1
(ii)	Sum: $\frac{1}{2}\left(\frac{100}{k}\right)(k + 100)$ or $\frac{1}{2}\left(\frac{100}{k}\right)\left(2k + \left(\frac{100}{k} - 1\right)k\right)$	M1 A1
	$= 50 + \frac{5000}{k}$ $\quad$ (*)	A1 cso
		(4)
(c)	50^{th} term = $a + (n - 1)d$	
	$= (2k + 1) + 49"(2k + 3)"$ Or $2k + 49(2k) + 1 + 49(3)$	M1
	$= 100k + 148$ $\quad$ $= 100k + 148$	A1
		(2)
		[9]

Question Number	Scheme	Marks
9. (a)	$(x+2k)^2$ or $\left(x+\frac{4k}{2}\right)^2$	M1
	$(x\pm F)^2 \pm G \pm 3 \pm 11k$ (where F and G are <u>any</u> functions of k, not involving x)	A1
	$(x+2k)^2 - 4k^2 + (3+11k)$	M1 (3)
(b)	Accept part (b) solutions seen in part (a).	
	$"4k^2 - 11k - 3" = 0$ $\quad (4k+1)(k-3)=0 \quad k = -\frac{1}{4}$ and 3	M1 A1
	Using $b^2 - 4ac < 0$ for no real roots, i.e. $"4k^2 - 11k - 3" < 0$, to establish inequalities involving their <u>two</u> critical values m and n (<u>even if the inequalities are wrong</u>, e.g. $k < m$, $k < n$).	M1
	$-\frac{1}{4} < k < 3$	A1ft (4)
(c)	 Shape	B1
	Minimum in correct quadrant, <u>not</u> touching the x-axis, <u>not</u> on the y-axis, and there must be no other minimum or maximum.	B1
	(0, 14) or 14 on y-axis	B1 (3) **[10]**
10. (a)	$\left(-\frac{3}{4}, 0\right)$. Accept $x = -\frac{3}{4}$	B1 (1)
(b)	$y = 4$ $x = 0$ or 'y-axis'	B1B1 (2)
(c)	$\frac{dy}{dx} = -3x^{-2}$	M1
	At $x = -3$, gradient of curve = $-\frac{1}{3}$	A1
	Gradient of normal = $-1/m$	dM1
	Normal at P is $(y-3) = 3(x+3)$	dM1A1 (5)
(d)	(–4, 0) and (0, 12).	B1
	So AB has length $\sqrt{160}$ or AB^2 has length 160	M1 A1cso (3) **[11]**

Examiner reports

Question 1

This question was correctly answered by most of the candidates. The vast majority of candidates got the first mark for identifying the factor of x or $-x$ (or occasionally $4x$), though a significant number of candidates stopped at this point without taking into account that the question was worth 3 marks. A minority did not gain this first mark as they wrote erroneous statements such as $x-4x^3 = x(4x^2-1)$.

Of the candidates who progressed beyond the initial step, most correctly factorised the resulting quadratic using a difference of 2 squares correctly in their final factorisation. Some candidates made errors particularly sign errors. A number of candidates "lost" the 1 and gave $x(-4x^2)$ which demonstrated weak algebraic understanding and some went on to try and solve for x by setting the equation equal to 0. Some candidates did not distinguish between factorising and solving.

A small number of candidates gained the first mark, by a correct initial factorisation and then reversed the negatives in factorising the quadratic to give $x(2x + 1)(2x - 1)$, thus losing the accuracy marks and gaining just 2 of the 3 marks available.

Question 2

The majority of the candidates answered this question efficiently and correctly and gained the two marks. Many others did state that $8 = 2^3$ somewhere in their workings, but lacked any evidence of multiplication of the powers 3 and $2x + 3$ to gain the method mark. There were a number of candidates who incorrectly ended up using $8 = 2^{\frac{1}{3}}$. Common errors included dividing by 4, attempting to cube $(2x + 3)$ or expanding $3(2x + 3)$ wrongly to get $6x + 6$ or $6x + 3$. The most common error was to add the powers (instead of multiplying them), giving $2^{2x+}6$. A small minority attempted to use logarithms, but this was rare.

Question 3

Part (a) was answered well with many scoring both marks. Some gave $q = 20$ from adding $11 + 9$ instead of subtracting but most understood the principle of completing the square.

Quite a number of candidates struggled with the sketch in part (b). Most had the correct shape but the minimum was invariably in the wrong position: on the y-axis at (0, 11) or on the x-axis at (–3, 0) were common errors but the intercept at (0, 11) was more often correct.

Some candidates did not know what the discriminant was. Some confused it with the derivative, others knew it was something to do with the quadratic formula and simply applied the formula to the original equation. The correct formula was used by many candidates but a few faltered over the arithmetic with "36 – 44 = –12" being quite common.

Few candidates seemed to spot the connections between the parts in this question: (a) was intended to help them with the sketch in part (b) and a negative discriminant in (c) confirmed that their sketch did not cross the x-axis. Candidates should be encouraged to identify these connections.

Question 4

Most could start part (a) by attempting to form a suitable equation but slips in simplifying the equation of the line ($y = \frac{5}{2}x + 4$ was common) often meant that the correct equation was not obtained. Those who did have a correct quadratic usually used the discriminant (sometimes as part of the quadratic formula) to complete the question. A sizeable number though simply tried to factorise and concluded that since the equation did not factorise therefore there were no roots or C and L do not intersect.

The candidates usually fared better in part (b) and there were many excellent sketches scoring full marks. Weaker candidates had the parabola the wrong way up and it was not uncommon to see the line crossing the curve despite the information given in part (a). Very few lost marks for their line or curve stopping on the axes although some thought that if they drew their line stopping before it crossed the curve that would satisfy the information in part (a). Some candidates lost a mark for failing to indicate the coordinates (–0.8, 0) where the line crossed the x-axis.

Question 5

In part (a) the topic testing transformation of a graph proved to challenging to the candidates as the graph was given in the specific form $y = \frac{2}{x} - 5$ rather than the more general form of $y = \mathrm{f}(x) - 5$. The majority of answers had a correct shaped graph but many varieties of translation, left or right were quite common. Those that did perform a translation of 5 units down often omitted to find the x-intercept thus losing a mark. Poor drawing with graphs overlapping or incorrect curvature also lost marks.

The straight line graph was drawn well and was usually in the correct position, but many candidates forgot to find the intercepts, particularly the x-intercept which required some algebraic manipulation.

In part (b) candidates were asked to give the equations of the asymptotes. A common error seen was to confuse the x and y to give the asymptotes as $x = -5$ and $y = 0$ instead of $x = 0$ and $y = -5$. A large number of candidates left this section blank and a few stated $x \neq 0$ and $y \neq -5$ which lost one of the two marks. The asymptote $y = -5$ was more often given than $x = 0$ even though the question asked for the **equations** of the asymptotes. Those who translated the graph up, left or right could still obtain the correct asymptotes, as these answers could be obtained independently and correctly from the equation.

In part (c), many candidates realised that they had to eliminate one variable in order to find the point of intersection. Most chose to equate the y terms and then demonstrated their competence in solving the resulting three term quadratic. However many answers contained algebraic errors and hence incorrect co-ordinates. Candidates would be advised to look for errors in their working, when they reach an unlikely answer.

Some candidates found manipulating the fractions challenging, but continued after finding one variable.

Question 6

In part (a), those who knew the formula and how to apply it usually achieved $N = 21$, although poor manipulation sometimes led to $N = 19$. Some candidates relied on a listing method.

Many did not appreciate the demand in part (b) and simply used $n = 52$ in a sum formula. Others found the sum of the first 21 terms then treated the other 31 terms as the sum of an AP with $a = 600$ and $d = 600$. In a few cases an inconsistent value of k was used. 600×31 sometimes caused problems on this non-calculator paper with long multiplication methods employed.

Question 7

Although those candidates who started part (a) correctly were usually able to derive the required inequality, many were unsure of what was required here. A substantial number of candidates failed to form a three term quadratic equal to zero before attempting to write down the discriminant. Weaker candidates simply wrote down the discriminant of the given quadratic expression in k, or perhaps solved the quadratic in k to find the critical values required for part (b). Some candidates substituted $k = x^2 + kx + 8$ into $k^2 + 4k - 32 < 0$ and proceeded to waste time in producing some very complicated algebra.

In part (b), most candidates were able to find the critical values but not all offered a solution to the inequality. Many of those who found the correct set of values of k did so with the help of a sketch. The most common incorrect critical values were -4 and 8 (instead of -8 and 4). Some candidates lost the final mark because their inequalities $k > -8$, $k < 4$ were not combined as $-8 < k < 4$. Generally, however, part (b) was well done.

Question 8

This question was found difficult by many. Part marks 3, 0, 2 were common, although some did try to use the sum formula correctly in part (b) to obtain the method mark. Relatively few could establish the number of terms for this part, and proceed to use it correctly.

The majority of candidates knew which formula to use in part (a) and consequently gained the method mark. The problem was realising there were 50 even numbers, common errors were $n = 100$, 99, 98 or even 49. Calculating 25×102 correctly, caused problems for many. Only a small number of weaker candidates did not use the formula but wrote out all the terms and attempted to add. They were rarely successful.

Many candidates seemed unclear how to attempt part (b)(i). Often it was not attempted; nk was a common wrong answer. There were a few candidates who got $n = \frac{100}{k}$, but then failed to use this in part (b)(ii).

In part (b)(ii) many candidates scored only the method mark. Those who chose the ‘1st plus last’ formula found the easier proof, the other sum formula leading to problems with the brackets for some students. Some became confused by $\frac{1}{2}n = \frac{100}{k/2}$ arriving at $\frac{200}{k}$ or $200k$ or $50k$. Others attempted to work backwards from the result with little success.

The majority of candidates were successful with part (c) even if they had failed to score many marks in the previous sections. Many could find $d = 2k + 3$ and use a correct formula for the 50th term, but several continued after reaching $100k + 148$ to rewrite it as $50k + 74$ or $25k + 37$. Common errors were using a sum formula or making a sign slip when finding d. This type of question needs to be read carefully.

Question 9

This was a demanding question on which few candidates scored full marks. In part (a), many found the algebra challenging and their attempts to complete the square often led to mistakes such as $x^2 + 4kx = (x + 2k)^2 - 4k$.

Rather than using the result of part (a) to answer part (b), the vast majority used the discriminant of the given equation. Numerical and algebraic errors were extremely common at this stage, and even those who obtained the correct condition $4k^2 - 11k - 3 < 0$ were often unable to solve this inequality to find the required set of values for k.

The sketch in part (c) could have been done independently of the rest of the question, so it was disappointing to see so many poor attempts. Methods were too often overcomplicated, with many candidates wasting time by unnecessarily solving the equation with $k = 1$. Where a sketch was eventually seen, common mistakes were to have the curve touching the x-axis or to have the minimum on the y-axis.

Question 10

In part (a), while almost all candidates correctly used $y = 0$ in the equation of the curve, a small number were unable to rearrange the equation correctly to find x, with $-\frac{4}{3}$ being the most common error.

In part (b) many gave just one asymptote and others omitted this part of the question altogether. A common error was $y = 0$ and $x = 4$ (or $x = -\frac{3}{4}$). Some candidates substituted $x = 0$ into the equation and used this to conclude that $y = 4$ was an asymptote, but it was often unclear as to whether these candidates were stating $x = 0$ as an asymptote, or as the value of x they were using to find the horizontal asymptote.

Finding the gradient of the curve in part (c) caused problems. Many candidates attempted to find the gradient using the co-ordinates of two points. Others thought that the gradient of $y = \dfrac{3}{x}$ was 3, interpreting the equation as a straight line despite the graph of the curve being given. A number of candidates found $\dfrac{dy}{dx}$ correctly but then used $x = -\frac{3}{4}$ to calculate the gradient instead of the x-coordinate of P. Unfortunately, some candidates who obtained the correct gradient then found the equation of the tangent instead of the normal. There were a few candidates who did not use the perpendicular gradient rule correctly. Many candidates use $y = mx + c$ to obtain the equation of the line rather than $y - y_1 = m(x - x_1)$.

In part (d) most candidates knew how to find the points of intersection of their line with the co-ordinate axes and were able to attempt to find the length of the line using Pythagoras' theorem, although a few used incorrect formulae such as $\sqrt{(x_1 + x_2)^2 + (y_1 + y_2)^2}$ or $\sqrt{(x_1 - x_2)^2 - (y_1 - y_2)^2}$. There were some mistakes in arithmetic, e.g. 16 + 144 = 150. Those obtaining the correct equation in (c) usually went on to obtain full marks in part (d).

Statistics for C1 Practice Paper Gold Level G3

				Mean score for students achieving grade:							
Qu	**Max score**	**Modal score**	**Mean %**	**ALL**	**A***	**A**	**B**	**C**	**D**	**E**	**U**
1	3		63	1.90	2.96	2.73	2.38	2.16	1.92	1.65	1.35
2	2		51	1.01	1.98	1.72	1.41	1.14	0.94	0.86	0.66
3	6		65	3.88	5.57	5.24	4.57	4.05	3.62	3.17	2.15
4	8		54	4.34	7.81	7.18	6.12	5.13	4.18	3.37	1.96
5	12		61	7.32	11.56	11.11	9.90	8.56	7.24	5.71	3.21
6	7		58	4.04	6.46	6.04	5.01	4.28	3.71	3.17	2.09
7	7		56	3.91		6.64	5.38	4.32	3.42	2.79	1.84
8	9		55	4.91	8.36	7.44	5.70	4.84	4.15	3.56	2.37
9	10		45	4.54		8.65	6.35	4.77	3.29	2.14	0.97
10	11		50	5.46	10.64	9.90	8.07	6.34	4.53	2.84	0.92
	75		**55**	**41.31**		**66.65**	**54.89**	**45.59**	**37.00**	**29.26**	**17.52**