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Paper Reference(s)

6663/01

Edexcel GCE

Core Mathematics C1

Gold Level G2

Time: 1 hour 30 minutes

Materials required for examination	**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 11 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
65	58	50	43	36	29

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1. Find $\int (2+5x^2)\ \mathrm{d}x$.

(3)

June 2008

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2. Factorise completely $x^3 - 9x$.

(3)

June 2008

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3. Simplify

$$\frac{5-2\sqrt{3}}{\sqrt{3}-1},$$

giving your answer in the form $p + q\sqrt{3}$, where p and q are rational numbers.

(4)

January 2011

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4. Solve the simultaneous equations

$$y - 3x + 2 = 0$$

$$y^2 - x - 6x^2 = 0$$

(7)

January 2010

5.

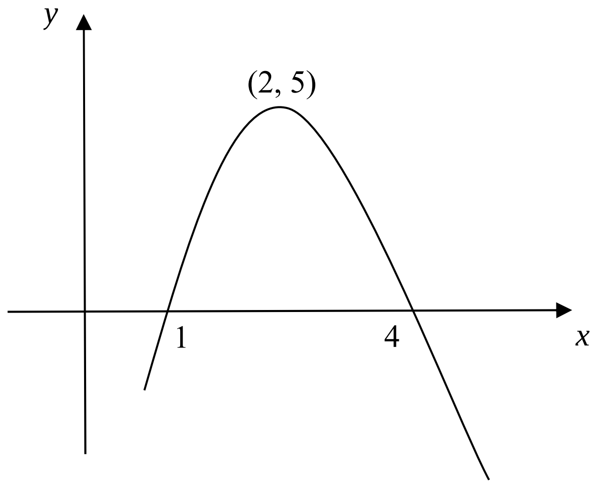

Figure 1

Figure 1 shows a sketch of the curve with equation $y = \text{f}(x)$. The curve crosses the x-axis at the points (1, 0) and (4, 0). The maximum point on the curve is (2, 5).

In separate diagrams, sketch the curves with the following equations. On each diagram show clearly the coordinates of the maximum point and of each point at which the curve crosses the x-axis.

(a) $y = 2\text{f}(x)$,

(3)

(b) $y = \text{f}(-x)$.

(3)

The maximum point on the curve with equation $y = \text{f}(x + a)$ is on the y-axis.

(c) Write down the value of the constant a.

(1)

January 2008

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

$$a_1 = k,$$

$$a_{n+1} = 2a_n - 7, \quad n \geq 1,$$

where k is a constant.

(*a*) Write down an expression for a_2 in terms of k.

(1)

(*b*) Show that $a_3 = 4k - 21$.

(2)

Given that $\sum_{r=1}^{4} a_r = 43$,

(*c*) find the value of k.

(4)

June 2009

7.

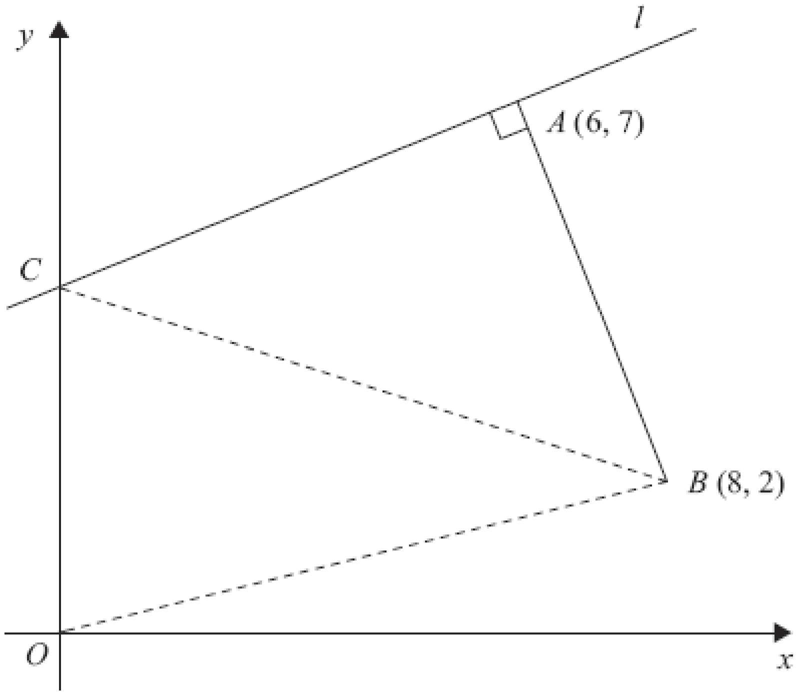

Figure 2

The points A and B have coordinates (6, 7) and (8, 2) respectively.

The line l passes through the point A and is perpendicular to the line AB, as shown in Figure 2.

(a) Find an equation for l in the form $ax + by + c = 0$, where a, b and c are integers.

(4)

Given that l intersects the y-axis at the point C, find

(b) the coordinates of C,

(2)

(c) the area of ΔOCB, where O is the origin.

(2)

June 2009

8. The curve C has equation $y = \frac{1}{3}x^2 + 8$.

The line L has equation $y = 3x + k$, where k is a positive constant.

(a) Sketch C and L on separate diagrams, showing the coordinates of the points at which C and L cut the axes.

(4)

Given that line L is a tangent to C,

(b) find the value of k.

(5)

May 2014 (R)

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9. 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)

May 2013

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10. The first term of an arithmetic sequence is 30 and the common difference is –1.5.

(a) Find the value of the 25th term.

(2)

The rth term of the sequence is 0.

(b) Find the value of r.

(2)

The sum of the first n terms of the sequence is S_n.

(c) Find the largest positive value of S_n.

(3)

January 2008

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11. The curve C has equation

$$y = 2x - 8\sqrt{x} + 5, \quad x \geq 0.$$

(*a*) Find $\frac{dy}{dx}$, giving each term in its simplest form.

(3)

The point P on C has x-coordinate equal to $\frac{1}{4}$.

(*b*) Find the equation of the tangent to C at the point P, giving your answer in the form $y = ax + b$, where a and b are constants.

(4)

The tangent to C at the point Q is parallel to the line with equation $2x - 3y + 18 = 0$.

(*c*) Find the coordinates of Q.

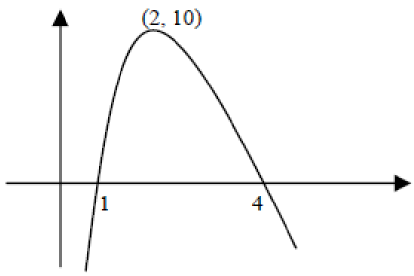
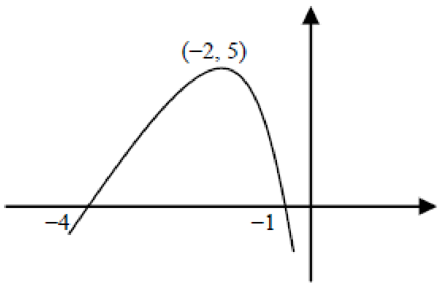
(5)

January 2013

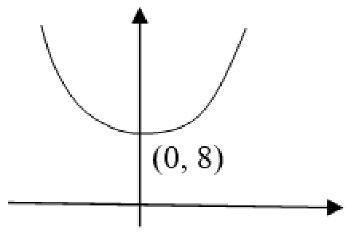
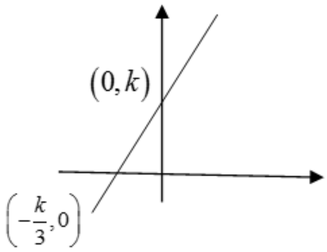
TOTAL FOR PAPER: 75 MARKS

END

Question number	Scheme	Marks
1	$2x+\frac{5}{3}x^3+c$	M1A1A1 **[3]**
2	$x(x^2-9)$ or $(x\pm 0)(x^2-9)$ or $(x-3)(x^2+3x)$ or $(x+3)(x^2-3x)$	B1
	$x(x-3)(x+3)$	M1A1 **[3]**
3	$\frac{5-2\sqrt{3}}{\sqrt{3}-1}\times\frac{(\sqrt{3}+1)}{(\sqrt{3}+1)}$	M1
	$=\frac{\dots}{2}$ denominator of 2	A1
	Numerator $=5\sqrt{3}+5-2\sqrt{3}\sqrt{3}-2\sqrt{3}$	M1
	So $\frac{5-2\sqrt{3}}{\sqrt{3}-1}=-\frac{1}{2}+\frac{3}{2}\sqrt{3}$	A1 **[4]**
4	$y=3x-2$ $\quad(3x-2)^2-x-6x^2(=0)$	M1
	$9x^2-12x+4-x-6x^2=0$	
	$3x^2-13x+4=0$ (or equiv., e.g. $3x^2=13x-4$)	M1 A1cso
	$(3x-1)(x-4)=0$	
	$x=\dots$	M1
	$x=\frac{1}{3}$ (or <u>exact</u> equivalent) $\quad x=4$	A1
	$y=-1\quad y=10$ (Solutions need not be "paired")	M1 A1 **[7]**

<table>
<tr><th>Question number</th><th colspan="2">Scheme</th><th>Marks</th></tr>
<tr><td>5 (a)</td><td></td><td>Shape: Max in 1st quadrant and 2 intersections on positive x-axis
1 and 4 labelled (in correct place) or clearly stated as coordinates
(2, 10) labelled or clearly stated</td><td>B1
B1
B1
(3)</td></tr>
<tr><td>(b)</td><td></td><td>Shape: Max in 2nd quadrant and 2 intersections on negative x-axis
–1 and –4 labelled (in correct place) or clearly stated as coordinates
(–2, 5) labelled or clearly stated</td><td>B1
B1
B1
(3)</td></tr>
<tr><td>(c)</td><td colspan="2">$(a =)\ 2$ May be implicit, i.e. $f(x + 2)$
Beware: The answer to part (c) may be on the first page.</td><td>B1
(1)
[7]</td></tr>
<tr><td>6 (a)</td><td colspan="2">$(a_2 =)2k-7$</td><td>B1
(1)</td></tr>
<tr><td>(b)</td><td colspan="2">$(a_3 =)2(2k-7)-7$ or $4k-14-7, = 4k-21$ (*)</td><td>M1 A1 cso
(2)</td></tr>
<tr><td>(c)</td><td colspan="2">$(a_4 =)2(4k-21)-7 \quad (= 8k-49)$
$\sum_{r=1}^{4} a_r = k + "(2k-7)" + (4k-21) + "(8k-49)"$
$k + (2k-7) + (4k-21) + (8k-49) = 15k - 77 = 43 \qquad k = 8$</td><td>M1
M1
M1 A1
(4)
[7]</td></tr>
</table>

Question number	Scheme	Marks
7 (a)	AB: $m = \frac{2-7}{8-6}$, $\left(= -\frac{5}{2}\right)$	B1
	Using $m_1 m_2 = -1$: $m_2 = \frac{2}{5}$	M1
	$y - 7 = \frac{2}{5}(x-6)$, $2x - 5y + 23 = 0$ (o.e. with integer coefficients)	M1 A1
		(4)
(b)	Using $x = 0$ in the answer to (a), $y = \frac{23}{5}$ or 4.6	M1 A1ft
		(2)
(c)	Area of triangle = $\frac{1}{2} \times 8 \times \frac{23}{5} = \frac{92}{5}$ (o.e) e.g. $\left(18\frac{2}{5},\ 18.4,\ \frac{184}{10}\right)$	M1 A1
		(2)
		[8]

Question number	Scheme		Marks
8 (a)		U shaped parabola - symmetric about y axis	B1
		Graph passes through (0, 8)	B1
		Shape and position for L	M1
		Both $\left(-\frac{k}{3}, 0\right)$ and $(0, k)$	A1
	Allow marks even if on the same diagram		**(4)**
(b)	Equate curves $\frac{1}{3}x^2 + 8 = 3x + k$ and proceed to collect terms on one side		M1
	$\frac{1}{3}x^2 - 3x + (8 - k)$		A1
	Method 1a	Method 1b	
	Uses "$b^2 = 4ac$"	Attempt $\frac{1}{3}(x - \frac{9}{2})^2 - \lambda + 8 - k$	dM1
	$9 = 4 \times \frac{1}{3} \times (8 - k) \Rightarrow k = ..$	Deduce that $k = 8 - \lambda$	dM1
	$k = \frac{5}{4}$ o.e.		A1
			(5)
			[9]

Question number	Scheme	Marks
9 (a)	$x^2 - 4k(1-2x) + 5k(=0)$	M1
	So $x^2 + 8kx + k = 0$ *	A1cso
		(2)
(b)	$(8k)^2 - 4k$	M1 A1
	$k = \frac{1}{16}$ (oe)	A1
		(3)
(c)	$x^2 + \frac{1}{2}x + \frac{1}{16} = 0$ so $(x + \frac{1}{4})^2 = 0 \Rightarrow x =$	M1
	$x = -\frac{1}{4}$, $y = 1\frac{1}{2}$	A1 A1
		(3)
		[8]
10 (a)	$u_{25} = a + 24d = 30 + 24 \times (-1.5)$	M1
	$= -6$	A1
		(2)
(b)	$a + (n-1)d = 30 - 1.5(r-1) = 0$	M1
	$r = 21$	A1
		(2)
(c)	$S_{20} = \frac{20}{2}\{60 + 19(-1.5)\}$ or $S_{21} = \frac{21}{2}\{60 + 20(-1.5)\}$ or $S_{21} = \frac{21}{2}\{30 + 0\}$	M1 A1ft
	$= 315$	A1
		(3)
		[7]

Question number	Scheme	Marks
11 (a)	$C: y = 2x - 8\sqrt{x} + 5, \quad x \geqslant 0$	
	So, $y = 2x - 8x^{\frac{1}{2}} + 5$	
	$\frac{dy}{dx} = 2 - 4x^{-\frac{1}{2}} + \{0\}$ $\quad (x > 0)$	M1A1A1
		(3)
(b)	(When $x = \frac{1}{4}$, $y = 2\left(\frac{1}{4}\right) - 8\sqrt{\left(\frac{1}{4}\right)} + 5$ so) $\quad y = \frac{3}{2}$	B1
	(gradient $= \frac{dy}{dx} =$) $2 - \frac{4}{\sqrt{\left(\frac{1}{4}\right)}}$ $\{= -6\}$	M1
	Either : $y - "\frac{3}{2}" = "-6"\left(x - \frac{1}{4}\right)$ **or**: $y = "-6"x + c$ and $"\frac{3}{2}" = "-6"\left(\frac{1}{4}\right) + c \Rightarrow c = "3"$	M1
	So $\underline{y = -6x + 3}$	A1
		(4)
(c)	Tangent at Q is parallel to $2x - 3y + 18 = 0$ ($y = \frac{2}{3}x + 6 \Rightarrow$) Gradient $= \frac{2}{3}$. so tangent gradient is $\frac{2}{3}$	B1
	So, $"2 - \frac{4}{\sqrt{x}}" = "\frac{2}{3}"$ Sets their gradient function = their numerical gradient.	M1
	$\Rightarrow \frac{4}{3} = \frac{4}{\sqrt{x}} \Rightarrow x = 9$ Ignore extra answer $x = -9$	A1
	When $x = 9$, $y = 2(9) - 8\sqrt{9} + 5 = -1$ Substitutes their found x into equation of curve.	M1
	$y = -1$.	A1
		(5)
		[12]

Examiner reports

Question 1

Most candidates showed a clear understanding of basic integration and many achieved full marks. Omitting the constant of integration was a common error as was a failure to integrate the 2. Some integrated $5x^2$ and obtained $\frac{5x^3}{2}$ or $10x^3$ and a few differentiated thereby obtaining $10x$.

Question 2

The factor of x was usually extracted but a significant number of candidates stopped at this point and did not appear to recognise the difference of two squares. Some candidates who did identify the need to factorise $x^2 - 9$ wrote $(x + 3)^2$ or $(x - 3)^2$ or sometimes $(x - \sqrt{9})$ or $(x + \sqrt{9})$. Some candidates do not appreciate the difference between 'factorising' and 'solving' and there were a number of inappropriate attempts to 'solve' the given expression but this was not penalised on this occasion.

Question 3

This was generally well done with most candidates correctly multiplying both numerator and denominator by the same correct expression. $(\sqrt{3} + 1)$ was the expected choice but a surprising number used $(-\sqrt{3} - 1)$ instead. They then usually obtained 2 (or –2) in the denominator and most candidates were able to expand the numerator to obtain 4 terms.

Some expanded $5 - 2\sqrt{3}(\sqrt{3} + 1)$ instead of $(5 - 2\sqrt{3})(\sqrt{3} + 1)$, simplifying the question and not earning the method mark. Some had difficulty dealing with the simplification of $2\sqrt{3} \times \sqrt{3}$. A number of candidates lost the final mark by unwisely multiplying through by 2 or by failing to express their answer as two separate terms.

Question 4

Many candidates scored full marks for this standard question on simultaneous equations. Mistakes were usually in signs or in combining terms, leading to a loss of accuracy rather than method marks, but an exception to this was the squaring of the equation $y - 3x + 2 = 0$ to give $y^2 - 9x^2 + 4 = 0$. A few candidates, having found solutions for x, failed to find y values. It was disappointing to see many candidates resorting to the quadratic formula when factorisation was possible.

Question 5

In part (a), most candidates knew that a stretch was required. It was common to see full marks scored, although the final mark was sometimes lost because the maximum was not labelled. A common wrong answer for the maximum was (4, 10) instead of (2, 10). Other mistakes included stretches in the x direction instead of the y direction and stretches with scale factor $\frac{1}{2}$ instead of 2.

The most common mistake in part (b) was to reflect in the x-axis instead of the y-axis (scoring just 1 mark out of 3). It was not unusual in this part to see the required points carelessly mislabelled with minus signs omitted. Many candidates did not answer part (c), but for those that did there were several common wrong answers, particularly 5, −2 or 3.

Question 6
There were far fewer cases of candidates not understanding how an inductive formula like this works and many were able to answer parts (a) and (b) successfully. Part (b) required the candidates to "show" a given result and most gave the expression $2(2k-7)-7$ which was fine but a small minority thought the pattern must be $2\times 2k-3\times 7$. Part (c) met with mixed success: many found a_4 but some then solved $a_4=43$ whilst others assumed that the series was arithmetic and attempted to use a formula such as $\frac{4}{2}(a_1+a_4)$. Those who did attempt the correct sum occasionally floundered with the arithmetic but there were plenty of fully correct solutions seen.

Question 7
Most candidates had clearly learnt the coordinate geometry formulae and were able to give a correct expression for the gradient of *AB* although some had *x* and *y* the wrong way round. The perpendicular gradient rule was well known too and the majority of candidates used this successfully to find the gradient of *l*. Many went on to find a correct expression for the equation of *l* (although some used the point *B* here instead of *A*) but the final mark in part (a) was often lost as candidates struggled to write their equation in the required form. In part (b) most substituted *x* =0 into their equation and the examiners followed through their working for the coordinates of *C*, only a few used *y* = 0 here.

Part (c) caused the usual problems and a variety of approaches (many unsuccessful) were tried. Those who identified *OC* as the base and 8 as the height usually had little problem in gaining the marks. Some candidates felt uneasy using a height that wasn't a side of their triangle and split the triangle into two then adding the areas, others used a trapezium minus a triangle or a determinant approach. A few attempted to find *OB* and *BC* using Pythagoras' theorem in the vain hope of using the $\frac{1}{2}ab\sin C$ formula.

Question 8
This question was a reasonable discriminator.

In part (a) the quadratic and linear graphs were generally well drawn. Marks were lost due to the omission of co-ordinates particularly the $\frac{-k}{3}$.

For part (b) students were asked to determine a value for *k* for which the given line was a tangent to the given curve. There were several possible methods of solution. The method using $\frac{dy}{dx}$ was the most popular approach. Those who began correctly by this method putting the gradient expression for the curve equal to the gradient of the line, usually completed it to find *x*, then *y*, then *k*. Many who attempted instead to set the curve expression equal to the line expression obtained a quadratic but proceeded no further. Of those who continued with this method, use of the condition for equal roots, putting the discriminant equal to zero usually was more successful than completion of square methods.

Question 9
In part (a), full marks were achieved by virtually all candidates. Most tried the substitution for $y = 1 - 2x$ in the second equation, with only a very few making a mistake with signs, resulting in $-8kx$.

In part (b), most candidates quoted and used the condition $b^2 - 4ac = 0$ but often no brackets were used in the subsequent substitution resulting in $8k^2$ rather than $64k^2$. Common incorrect answers for k were $\frac{1}{2}$ (from an incorrect start) or as 16 (from a correct start). Solving the quadratic in k by completing the square was attempted by some candidates.

Few candidates got $k = \frac{1}{16}$ and so most candidates could achieve at most one mark in part (c). Even those that used $k = \frac{1}{16}$ frequently made mistakes in the substitution and subsequent solving of the equation in x. Many also restarted with the two original equations and gave themselves the task of eliminating y again, making it a slightly more difficult solution. After finding the wrong value of k, they were left with an equation which would not factorise. Many still obtained a method mark by attempting to use the formula or complete the square. Having obtained a quadratic with fractional coefficients, most candidates multiplied through by a common denominator as they found it easier to solve with integer coefficients.

Question 10
Most candidates knew in part (a) how to use the term formula for an arithmetic sequence. Some, effectively using $a + nd$ instead of $a + (n-1)d$, reached the answer -7.5 instead of -6, while the omission of a minus sign was a surprisingly common mistake, leading to $30 + 36 = 66$ instead of $30 - 36 = -6$.

In part (b), many candidates equated the correct expression to zero to score the method mark, but mistakes in calculation were very common. Dividing 31.5 by 1.5 sometimes caused problems. Other approaches, such as counting back from the 25th term found in part (a), were sometimes successful.

Few students seemed to fully appreciate the connection between part (b) and part (c) but those who did invariably scored all the marks. Many ended up trying to solve an equation with two unknowns (S_n and n) or assumed that S_n was zero, which led to the commonly seen, incorrect $n = 41$. Many candidates seemed completely confused by part (c) and made no real progress. In the question as a whole, inefficient methods involving ‘listing’ terms were infrequently seen.

Question 11

On the whole Q11(a) was very well done with the majority of candidates gaining full marks. Only a very small minority attempted integration and hardly anyone received less than two marks from the three available. The majority of candidates reached $2 - 4x^{-\frac{1}{2}}$. Common errors seen were $2 - 4x^{\frac{3}{2}}$ or $2 - 4x^{-\frac{1}{2}} + 5x$. The fractional powers were usually dealt with correctly on this part of the question.

In Q11(b) many reached the correct answer of $y = -6x + 3$. Errors were made substituting $x = \frac{1}{4}$ into $4x^{-\frac{1}{2}}$ to obtain gradient and further errors made substituting into the expression for y. Some candidates found working with fractions challenging, e.g. $\frac{1}{4}^{\frac{1}{2}} = 2$, so gradient equal to $2 - 4/2 = 0$. Some did not substitute $x = \frac{1}{4}$ into the function to get a y value but used (0, 5) to find the equation.

More able candidates answered Q11(c) well, realising that they were required to set their gradient function obtained in Q11(a) to $\frac{2}{3}$, the gradient of the given line. Some who got as far as $\frac{2}{3} = 2 - 4x^{-\frac{1}{2}}$ made errors in their algebra and these included $\frac{1}{\sqrt{x}} = \frac{1}{3}$, leading to $x = \frac{1}{9}$, or even $x = 3$ and $\sqrt{x} = 3$ leading to $x = \sqrt{3}$. Of those who successfully reached $x = 9$, some attempted to find the y value by substituting into $y = \frac{2}{3}x + 6$ instead of substituting into the original equation. There was a significant proportion of the candidates who, after rearranging the equation of the straight line into the form $y = mx + c$, were unable to progress to gain any marks at all for Q11(c). Of those who proceeded unsuccessfully, it was common to see $y = 0$, so $\frac{2}{3}x + 6 = 0$ leading to $x = -9$. Others found the points of intersection of $2x - 3y + 18 = 0$ and $y = -6x + 3$ or found the co-ordinates of points of intersection of $2x - 3y + 18 = 0$ with the x and y axes thus getting (0, 6) and (–9, 0). These answers did not answer the question set and gained no credit.

Statistics for C1 Practice Paper Gold Level G2

				Mean score for students achieving grade:							
Qu	**Max score**	**Modal score**	**Mean %**	**ALL**	**A***	**A**	**B**	**C**	**D**	**E**	**U**
1	3		88	2.63		2.94	2.87	2.79	2.67	2.53	1.87
2	3		78	2.33		2.86	2.65	2.45	2.22	2.05	1.46
3	4		75	3.01	3.99	3.84	3.49	3.21	3.07	2.66	1.84
4	7		78	5.49		6.75	6.46	6.15	5.57	5.15	3.72
5	7		72	5.06		6.50	5.93	5.43	4.82	4.27	3.04
6	7		68	4.75		6.40	5.85	5.34	4.68	3.77	1.88
7	8		62	4.96		7.31	6.49	5.64	4.52	3.24	1.33
8	9		65.0	5.85	8.83	7.97	6.14	4.70	3.85	2.55	1.54
9	8	8	61	4.87	7.77	7.25	6.20	5.23	4.42	3.70	2.28
10	7		57	3.99		5.91	4.72	3.91	3.36	2.92	1.87
11	12	3	52	6.23	11.80	10.30	7.99	6.36	5.39	4.43	2.90
	75		**65.56**	**49.17**	**32.39**	**68.03**	**58.79**	**51.21**	**44.57**	**37.27**	**23.73**