Paper Reference(s)

6663/01

Edexcel GCE

Core Mathematics C1
Silver Level S3

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
71	64	57	50	42	37

1. Given that $y = x^4 + x^{\frac{1}{3}} + 3$, find $\frac{\mathrm{d}y}{\mathrm{d}x}$.

(3)

January 2010

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2. (*a*) Expand and simplify $(7 + \sqrt{5})(3 - \sqrt{5})$.

(3)

(*b*) Express $\frac{7+\sqrt{5}}{3+\sqrt{5}}$ in the form $a + b\sqrt{5}$, where a and b are integers.

(3)

January 2010

3.

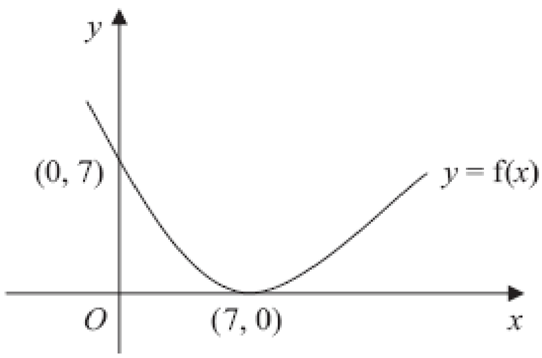

Figure 1

Figure 1 shows a sketch of the curve with equation $y = \mathrm{f}(x)$. The curve passes through the point (0, 7) and has a minimum point at (7, 0).

On separate diagrams, sketch the curve with equation

(*a*) $y = \mathrm{f}(x) + 3$,

(3)

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

(2)

On each diagram, show clearly the coordinates of the minimum point and the coordinates of the point at which the curve crosses the y-axis.

May 2008

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

(2)

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

(3)

May 2013

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

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

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)

May 2013

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6. An arithmetic sequence has first term a and common difference d. The sum of the first 10 terms of the sequence is 162.

(*a*) Show that $10a + 45d = 162$.

(2)

Given also that the sixth term of the sequence is 17,

(*b*) write down a second equation in a and d,

(1)

(*c*) find the value of a and the value of d.

(4)

January 2011

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7. A curve with equation $y = f(x)$ passes through the point (2, 10). Given that

$$f'(x) = 3x^2 - 3x + 5,$$

find the value of f(1).

(5)

January 2012

8.

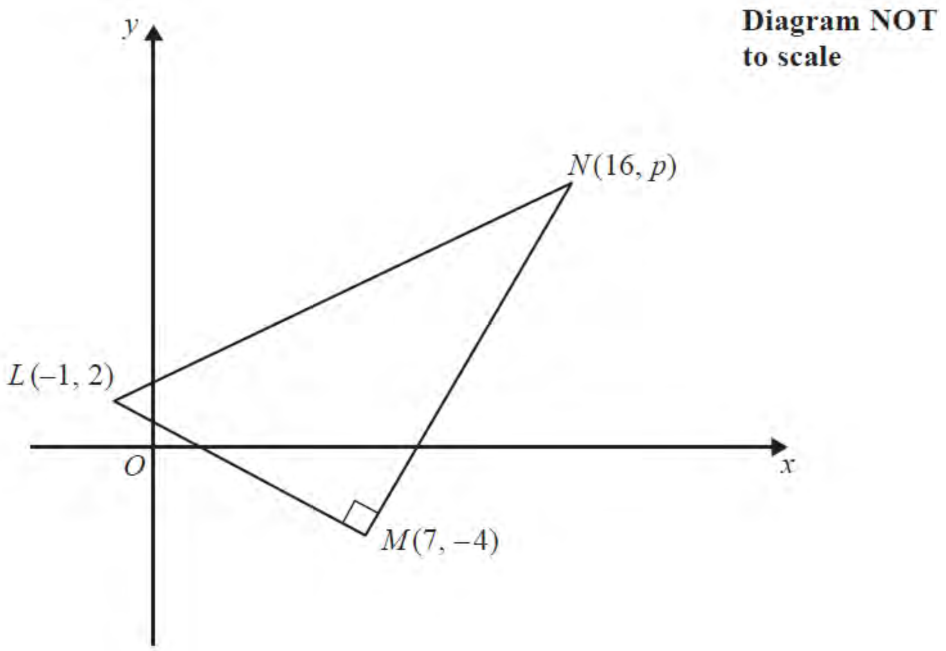

Figure 2

Figure 2 shows a right angled triangle *LMN*.

The points *L* and *M* have coordinates (–1, 2) and (7, –4) respectively.

(*a*) Find an equation for the straight line passing through the points *L* and *M*.

Give your answer in the form $ax + by + c = 0$, where a, b and c are integers.

(4)

Given that the coordinates of point *N* are (16, *p*), where *p* is a constant, and angle *LMN* = 90°,

(*b*) find the value of *p*.

(3)

Given that there is a point *K* such that the points *L*, *M*, *N*, and *K* form a rectangle,

(*c*) find the *y* coordinate of *K*.

(2)

May 2014 (R)

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9. The equation $x^2 + (k - 3)x + (3 - 2k) = 0$, where k is a constant, has two distinct real roots.

(*a*) Show that k satisfies

$$k^2 + 2k - 3 > 0.$$

(3)

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

(4)

January 2011

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10. (*a*) Sketch the graphs of

(i) $y = x(x + 2)(3 - x)$,

(ii) $y = -\dfrac{2}{x}$.

showing clearly the coordinates of all the points where the curves cross the coordinate axes.

(6)

(*b*) Using your sketch state, giving a reason, the number of real solutions to the equation

$$x(x + 2)(3 - x) + \frac{2}{x} = 0.$$

(2)

January 2011

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11. The curve C has equation $y = x^2(x - 6) + \dfrac{4}{x}$, $x > 0$.

The points P and Q lie on C and have x-coordinates 1 and 2 respectively.

(*a*) Show that the length of PQ is $\sqrt{170}$.

(4)

(*b*) Show that the tangents to C at P and Q are parallel.

(5)

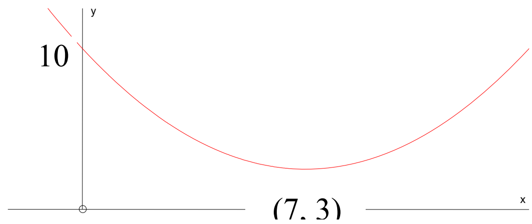
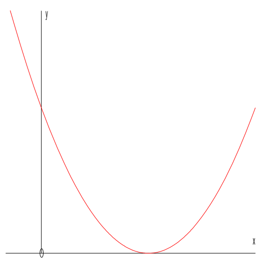
(*c*) Find an equation for the normal to C at P, giving your answer in the form $ax + by + c = 0$, where a, b and c are integers.

(4)

May 2007

TOTAL FOR PAPER: 75 MARKS

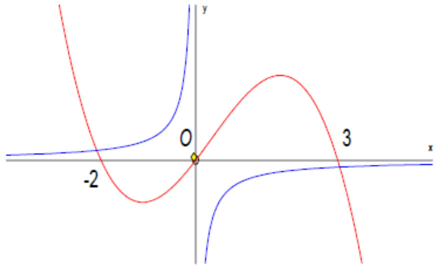
END

Question number	Scheme	Marks
1	$x^4 \to kx^3$ or $x^{1/3} \to kx^{-2/3}$ or $3 \to 0$ (k a non-zero constant)	M1
	$\left(\frac{dy}{dx} =\right)$ $4x^3$.......... , with '3' differentiated to zero (or 'vanishing')	A1
	$\left(\frac{dy}{dx} =\right)$ .... $+\frac{1}{3}x^{-2/3}$ or equivalent, e.g. $\frac{1}{3\sqrt[3]{x^2}}$ or $\frac{1}{3\left(\sqrt[3]{x}\right)^2}$	A1
		[3]
2 (a)	$(7+\sqrt{5})(3-\sqrt{5}) = 21-5+3\sqrt{5}-7\sqrt{5}$ Expand to get 3 or 4 terms	M1
	$=16,\ -4\sqrt{5}$ (1^{st} A for 16, 2^{nd} A for $-4\sqrt{5}$)	A1 A1
	(i.s.w. if necessary, e.g. $16-4\sqrt{5} \to 4-\sqrt{5}$)	**(3)**
(b)	$\frac{7+\sqrt{5}}{3+\sqrt{5}} \times \frac{3-\sqrt{5}}{3-\sqrt{5}}$ (This is sufficient for the M mark)	M1
	Correct denominator without surds, i.e. $9-5$ or 4	A1
	$4-\sqrt{5}$ or $4-1\sqrt{5}$	A1
		(3)
		[6]
3 (a)		B1 B1 B1
		(3)
(b)		B1 B1
		(2)
		[5]

Question number	Scheme	Marks
4 (a)	$8^{\frac{1}{3}} = 2$ or $8^5 = 32768$	M1
	$\left(8^{\frac{5}{3}} =\right)$ 32	A1 cao
		(2)
(b)	$\left(2x^{\frac{1}{2}}\right)^3 = 2^3 x^{\frac{3}{2}}$	M1
	$\dfrac{8x^{\frac{3}{2}}}{4x^2} = 2x^{-\frac{1}{2}}$ or $\dfrac{2}{\sqrt{x}}$	dM1A1
		(3)
		[5]
5 (a)	$(a_2 =)$ $k(4+2)$ $(= 6k)$	B1
		(1)
(b)	$a_3 = k(\text{their } a_2 + 2)$ $(= 6k^2 + 2k)$	M1
	$a_1 + a_2 + a_3 = 4 + (6k) + (6k^2 + 2k)$	M1
	$4 + (6k) + (6k^2 + 2k) = 2$	A1
	Solves $6k^2 + 8k + 2 = 0$ to obtain $k =$ $(6k^2 + 8k + 2 = 2(3k+1)(k+1))$	M1
	$k = -1/3$	A1
	$k = -1$	B1
		(6)
		[7]

Question number	Scheme	Marks
6 (a)	$S_{10} = \frac{10}{2}[2a + 9d]$ or	M1
	$S_{10} = a + a + d + a + 2d + a + 3d + a + 4d + a + 5da + 6d + a + 7d + a + 8d + a + 9d$ $162 = 10a + 45d$ *	A1 cso
		(2)
(b)	$(u_n = a + (n-1)d \;\; \Rightarrow \;\;)17 = a + 5d$	B1 **(1)**
(c)	$10 \times (b)$ gives $10a + 50d = 170$ (a) is $10a + 45d = 162$	M1
	Subtract $5d = 8$ so $d = \underline{1.6}$ o.e.	A1
	Solving for a $a = 17 - 5d$	M1
	so $a = \underline{9}$	A1
		(4)
		[7]
7 (a)	$[\text{f}(x) =]\frac{3x^3}{3} - \frac{3x^2}{2} + 5x[+c]$ <u>or</u> $\left\{x^3 - \frac{3}{2}x^2 + 5x(+c)\right\}$	M1 A1
	$10 = 8 - 6 + 10 + c$	M1
	$c = -2$	A1
	$\text{f}(1) = 1 - \frac{3}{2} + 5 \;\; "-2" = \underline{\frac{5}{2}}$ (o.e.)	A1ft
		[5]

Question number	Scheme	Marks
8 (a)	Method 1: $gradient = \frac{y_1 - y_2}{x_1 - x_2} = \frac{2-(-4)}{-1-7}, = -\frac{3}{4}$ Method 2: $\frac{y - y_1}{y_2 - y_1} = \frac{x - x_1}{x_2 - x_1}$,so $\frac{y - y_1}{6} = \frac{x - x_1}{-8}$	M1 A1
	$y-2 = -\frac{3}{4}(x+1)$ or $y+4 = -\frac{3}{4}(x-7)$ or $y = their\ '-\frac{3}{4}'x + c$	M1
	$\Rightarrow \pm(4y+3x-5)=0$	A1
		(4)
	Method 3: Substitute $x = -1$, $y = 2$ and $x = 7$, $y = -4$ into $ax + by + c=0$	M1
	$-a + 2b + c = 0$ and $7a - 4b + c = 0$	A1
	Solve to obtain $a = 3$, $b = 4$ and $c = -5$ or multiple of these numbers	M1 A1
		(4)
(b)	Attempts $gradient\ LM \times gradient\ MN = -1$ so $-\frac{3}{4} \times \frac{p+4}{16-7} = -1$ or $\frac{p+4}{16-7} = \frac{4}{3}$ Or $(y+4) = \frac{4}{3}(x-7)$ equation with $x =$ 16 substituted	M1
	$p+4 = \frac{9\times 4}{3} \Rightarrow p = \ldots$, $p = 8$ So $y =$, $y = 8$	M1 A1
		(3)
(c)	Either (y=) $p+6$ or $2+p+4$ Or use 2 perpendicular line equations through L and N and solve for y	M1
	(y =) 14	A1
		(2)
		[9]
9 (a)	$b^2 - 4ac = (k-3)^2 - 4(3-2k)$	M1
	$k^2 - 6k + 9 - 4(3-2k) > 0$ or $(k-3)^2 - 12 + 8k > 0$ or better	M1
	$\underline{k^2 + 2k - 3 > 0}$ *	A1 cso
		(3)
(b)	$(k+3)(k-1)[=0]$	M1
	Critical values are $k = 1$ or $k = -3$	A1
	choosing “outside” region	M1
	$\underline{k > 1 \text{ or } k < -3}$	A1 cso
		(4)
		[7]

Question number	Scheme	Marks
10 (a)	 (i) correct shape (-ve cubic) Crossing at (-2, 0) Through the origin Crossing at (3, 0) (ii) 2 branches in correct quadrants not crossing axes One intersection with cubic on each branch	B1 B1 B1 B1 B1 B1 **(6)**
(b)	"2" solution Since only "2" intersections	B1ft dB1FT **(2)** **[8]**
11 (a)	$x=1:\ y=-5+4=-1,\qquad x=2:\ y=-16+2=-14$ 1st B1 for −1, 2nd B1 for −14 $PQ=\sqrt{(2-1)^2+(-14-(-1))^2}=\sqrt{170}$	B1 B1 M1 A1 cso **(4)**
(b)	$y=x^3-6x^2+4x^{-1}$ $\frac{\mathrm{d}y}{\mathrm{d}x}=3x^2-12x-4x^{-2}$ $x=1:\ \frac{\mathrm{d}y}{\mathrm{d}x}=3-12-4=-13$ M: Evaluate at one of the points $x=2:\ \frac{\mathrm{d}y}{\mathrm{d}x}=12-24-1=-13$ $\therefore$ Parallel A: Both correct + conclusion	M1 M1 A1 M1 A1 **(5)**
(c)	Finding gradient of normal $\left(m=\frac{1}{13}\right)$ $y--1=\frac{1}{13}(x-1)$ $\underline{x-13y-14=0}$	M1 M1 A1ft A1 cso **(4)** **[13]**

Examiner reports

Question 1

Many candidates differentiated correctly, scoring full marks. The most common mistake was to give $\frac{1}{3}x^{-\frac{1}{3}}$ as the derivative of $x^{\frac{1}{3}}$. Just a few candidates integrated or included $+C$ in their answer.

Question 2

This question was answered very well, with many candidates scoring full marks. Mistakes in part (a) were usually from incorrect squaring of the $\sqrt{5}$ term, sign errors or errors in collecting the terms. In part (b), the method for rationalising the denominator was well known and most candidates, whether using their answer to part (a) or not, proceeded to a solution. A common mistake, however, was to divide only one of the terms in the numerator by 4.

Question 3

In part (a) most realized that a translation was required but some moved the curve horizontally or downwards. Some forgot to write the coordinates of the new turning point on their curve and a few placed the point (7, 3) on their horizontal axis. In part (b) the stretch was usually identified but curves often crossed at (0, 14) or touched at (14, 0). The shape of the curve was usually "preserved" quite well but sometimes the vertex became too pointed or one end of the curve seemed to bend away towards an extra turning point. A minority of candidates still make errors by writing coordinates the wrong way round.

Question 4

On the whole part (a) was well answered, with almost all candidates going straight to $2^5 = 32$. A few attempted 8^5 first, but even when this was evaluated correctly, further progress was rare. Some candidates evaluated 2^5 incorrectly, usually reaching either 64 or 10.

In part (b), failure to apply the power to both elements of the numerator was common. The majority of candidates could score the first mark for 2^3 or $x^{\frac{3}{2}}$ but it was relatively rare to see both correct. Most of these candidates then continued to both divide their coefficients and subtract their powers of x thereby gaining the next mark but as relatively few got the numerator correct, the final mark evaded many.

Common errors in the numerator were $8x^{\frac{7}{2}}$ leading to a final answer of $2x^{\frac{3}{2}}$ and $8x^{\frac{1}{8}}$ leading to a final answer of $2x^{-\frac{15}{8}}$. Some candidates wrote the fraction as $8x^{\frac{3}{2}}(4x^{-2})$ and proceeded to multiply 8 by 4, forgetting that the 4 should also have a power of -1.

Question 5

In part (a), most candidates came up with $6k$, but quite a few stopped at $k(4 + 2)$ or $4k + 2k$ but scored the mark for the unsimplified form. Common incorrect answers were $8k$ and $4k + 2$. Some candidates used 2 instead of 4 as the first value.

Generally part (b) was answered well. The most common error here was to restart using $a_1 = 2$. Several candidates found the correct sum of terms, but equated to zero instead of 2. A surprising number of candidates achieved the correct 3TQ, factorised this correctly, but failed to solve it correctly. A common incorrect answer here was $+\frac{1}{3}$. Attempts to apply an Arithmetic Progression sum formula were seen but were less common than in previous series.

Question 6
There were many excellent, well presented solutions with 55% gaining full marks. The majority gained full marks for (a) using the S_n formula. The formula was not always stated and candidates should take care to show sufficient method in 'show that' questions. A minority worked from first principles, writing out all of the terms and adding them but did not get the credit if they missed out terms.

Common incorrect equations seen in (b) were: $6a + 15d = 17$ (from finding the sum of 6 terms), $a + 16d = 17$ and $a + 6d = 17$. In some cases, 17 and ($a + 5d$) were seen but not equated.

In part (c), the elimination method was favoured, but some careless arithmetical errors were made. Sometimes $\frac{8}{5}$ was changed to an incorrect decimal, e.g. 1.4, which meant that their value for a was incorrect (if they found d first). There were several algebraic mistakes in part (c), such as $5d = 8$ then $d = \frac{5}{8}$.

A few candidates omitted to calculate a second variable.

Question 7
Most candidates knew they had to integrate here and this was usually carried out correctly but some omitted the $+C$ and simply substituted $x = 1$ into the integrated expression. Those who did include a constant of integration invariably went on to substitute $x = 2$ but sometimes they equated their expression to 0 rather than 10. Arithmetic slips were the most common cause of lost marks but the follow through on the final mark restricted the loss to 1 mark for many.

Question 8
This proved more challenging than the earlier questions.

In part (a) students were usually able to get the first three marks by a variety of methods, although a few transposed the x and y coordinates when substituting, or mixed them up. Signs were an issue for some, particularly when finding the gradient.

Having got the correct equation, some made no attempt to change it to the correct form. Others made arithmetic/algebraic errors. Those who did have all three terms on one side sometimes ignored the need for 'integers' or '= 0'.

In part (b) the most common method used was finding the equation of MN, then substituting $x = 16$. Those using Pythagoras were often successful.

In part (c) it was usual to see their final answer as the coordinates of K, rather than just the y coordinate as requested. (This was not penalised). Some realised that they just needed to add 6 to p (although they did it in a variety of different ways). Quite a few correctly solved the simultaneous equations generated by the line equations for KL and KN. A handful used vectors. Those who tried to use Pythagoras were usually unsuccessful, not realising that it would generate two solutions, so were confused if they managed to reduce it to a quadratic equation. A significant minority assumed wrongly that $x = 7$. An interesting method came from those who realised that, as it is a rectangle, the diagonals LN and KM bisect each other, hence the midpoints are the same.

Question 9

In part (a) most candidates appreciated the need to use $b^2 - 4ac$ and the majority of these stated that $b^2 - 4ac > 0$ is necessary for two real roots. Some candidates however only included the inequality in the final line of the answer. They should be aware that a full method is needed in a question where the answer is given. The algebraic processing in solutions was usually correct but common errors were squaring the bracket to give $k^2 + 9$ and incorrect multiplication by -4.

In part (b), the critical values of -3 and 1 were generally found by factorisation but many candidates struggled to give the correct region; others used poor notation $1 < k < -3$. Candidates who gave their final answer in terms of x lost the final accuracy mark.

Question 10

For part (a)(i) the majority of candidates drew a curve which was recognisably of a cubic form, although the occasional straight line and other non-cubic curves were seen. Very few candidates did not label the points where the curves crossed the axes, but it was quite common to see the curve passing through $(-3, 0)$, $(-2, 0)$ and the origin.

The most common error was to draw a "positive" cubic curve, not appreciating that the equation of the curve was of the form $y = -x^3 + \ldots\ldots$; even having made this error, however, many candidates were still able to gain three marks for this curve.

Most candidates seem to know that the equation in part (a)(ii) represents a rectangular hyperbola, and the majority placed the branches in the correct quadrants, although it was not uncommon to see them placed in the first and third quadrants, and occasionally in the first and second. Although the curves were sympathetically marked, it should be said that some of the sketches of the hyperbola were quite poor, some looking as though they had asymptotes at $x = -2$ and $x = +2$, and some needing examiners to have quite an imagination to see the axes as asymptotes.

In part (b), only candidates who had correctly positioned graphs were able to gain both marks in this part; some, but by no means all of this group, clearly had a good understanding of what was being tested here and gained both marks. Candidates with an incorrect sketch were still able to gain the first mark, if their answer was compatible with their sketch, and supported with an acceptable reason. A disappointingly large number of candidates, however, did not seem to appreciate how their graphs could be used to provide the number of real roots, often giving the number of intersections with the x-axis. Some candidates did not refer to their sketch at all and often did quite a bit of work trying to find the actual roots.

Question 11

A number of candidates did not attempt this question or only tackled part of it. In part (a) the *y*-coordinates were usually correct and the distance formula was often quoted and usually used correctly to obtain *PQ*, although some drew a diagram and used Pythagoras' theorem. Most of the attempts at part (b) gained the first two method marks but the negative index was not handled well and errors in the derivative were sometimes seen. Those with a correct derivative were usually able to establish the result in part (b). Some candidates thought that they needed to find the equations of the tangents at *P* and *Q* in order to show that the tangents were parallel and this wasted valuable time. It was unfortunate that the gradient of *PQ* was also equal to – 13 and a number of candidates did not attempt to use any calculus but simply used this gradient to find the tangents and tackle part (c). Errors in the arithmetic sometimes led to the abandonment of the question at this point which was a pity as some marks could have been earned in part (c). Those who did attempt part (c) were usually aware of the perpendicular gradient rule and used it correctly to find the equation of the normal at *P*. Mistakes in rearranging the equation sometimes led to the loss of the final mark but there were a good number of fully correct solutions to this part and indeed the question as a whole.

Statistics for C1 Practice Paper Silver Level S3

				Mean score for students achieving grade:							
Qu	**Max score**	**Modal score**	**Mean %**	**ALL**	**A***	**A**	**B**	**C**	**D**	**E**	**U**
1	3		89	2.68		2.94	2.87	2.82	2.73	2.68	2.33
2	6		87	5.22		5.92	5.74	5.49	5.15	4.96	3.75
3	5		74	3.70		4.72	4.34	3.92	3.44	2.94	2.07
4	5	5	80	3.98	4.9	4.74	4.48	4.24	3.95	3.69	2.85
5	7	7	81	5.67	6.93	6.89	6.64	6.38	5.97	5.41	3.30
6	7		74	5.16	6.93	6.85	6.68	6.39	5.67	5.15	3.46
7	5		74	3.69	4.88	4.84	4.59	4.35	3.80	3.51	1.93
8	9		78.0	7.02	8.76	8.16	7.23	6.87	6.39	5.43	3.31
9	7		67	4.68	6.83	6.63	5.87	5.23	4.40	3.64	2.38
10	8		63	5.05	7.80	7.26	6.49	5.57	4.77	4.05	2.53
11	13		64	8.32		12.48	11.38	9.65	7.32	5.09	2.00
	75		**73.56**	**55.17**	**47.03**	**71.43**	**66.31**	**60.91**	**53.59**	**46.55**	**29.91**