Paper Reference(s)

6664/01

Edexcel GCE

Core Mathematics C2

Silver Level S1

Time: 1 hour 30 minutes

Materials required for examination papers	**Items included with question**
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 C2), the paper reference (6664), 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
70	63	56	50	43	36

1. Find the first 3 terms, in ascending powers of x, of the binomial expansion of

$$(3 - x)^6$$

and simplify each term.

(4)

January 2010

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2. (a) Use the binomial theorem to find all the terms of the expansion of

$$(2 + 3x)^4.$$

Give each term in its simplest form.

(4)

(b) Write down the expansion of

$$(2 - 3x)^4$$

in ascending powers of x, giving each term in its simplest form.

(1)

May 2013

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3. $$f(x) = 2x^3 + ax^2 + bx - 6,$$

where a and b are constants.

When $f(x)$ is divided by $(2x - 1)$ the remainder is -5.

When $f(x)$ is divided by $(x + 2)$ there is no remainder.

(a) Find the value of a and the value of b.

(6)

(b) Factorise $f(x)$ completely.

(3)

January 2010

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4. Solve, for $0 \leq x < 180°$,

$$\cos(3x - 10°) = -0.4,$$

giving your answers to 1 decimal place. You should show each step in your working.

(7)

January 2013

5.

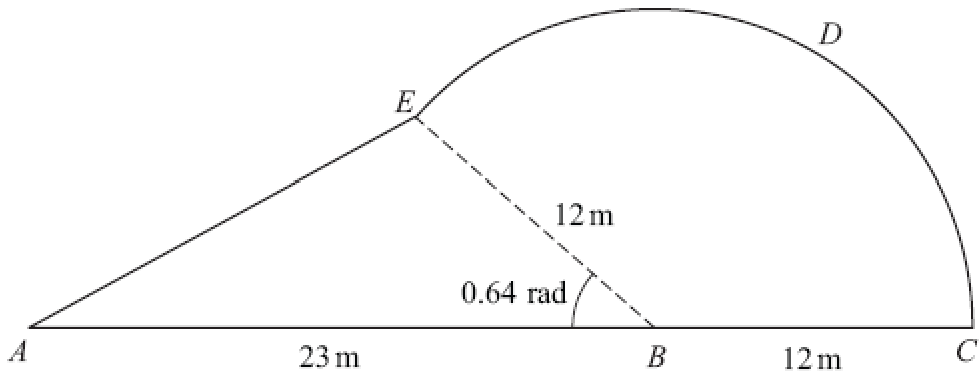

Figure 1

Figure 1 shows a plan view of a garden.

The plan of the garden *ABCDEA* consists of a triangle *ABE* joined to a sector *BCDE* of a circle with radius 12 m and centre *B*.

The points *A*, *B* and *C* lie on a straight line with *AB* = 23 m and *BC* = 12 m.

Given that the size of angle *ABE* is exactly 0.64 radians, find

(*a*) the area of the garden, giving your answer in m^2, to 1 decimal place,

(4)

(*b*) the perimeter of the garden, giving your answer in metres, to 1 decimal place.

(5)

May 2013

6.

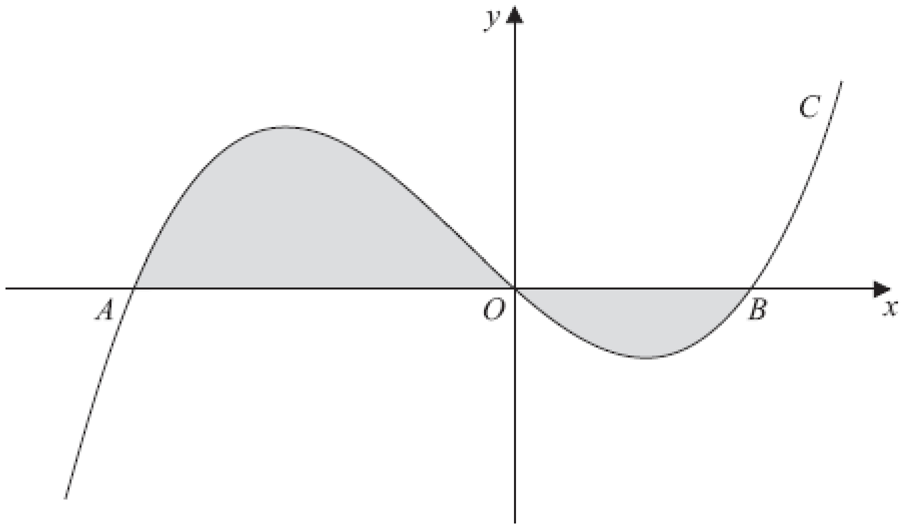

Figure 2

Figure 2 shows a sketch of part of the curve C with equation

$$y = x(x + 4)(x - 2).$$

The curve C crosses the x-axis at the origin O and at the points A and B.

(a) Write down the x-coordinates of the points A and B.

(1)

The finite region, shown shaded in Figure 3, is bounded by the curve C and the x-axis.

(b) Use integration to find the total area of the finite region shown shaded in Figure 2.

(7)

May 2013

7.

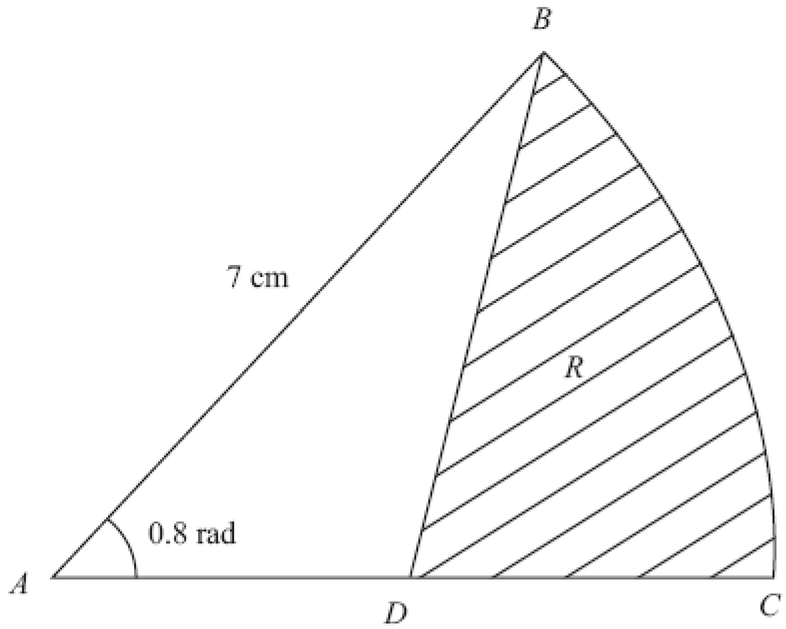

Figure 3

Figure 3 shows *ABC*, a sector of a circle with centre *A* and radius 7 cm.

Given that the size of $\angle BAC$ is exactly 0.8 radians, find

(*a*) the length of the arc *BC*,

(2)

(*b*) the area of the sector *ABC*.

(2)

The point *D* is the mid-point of *AC*. The region *R*, shown shaded in Figure 3, is bounded by *CD*, *DB* and the arc *BC*.

Find

(*c*) the perimeter of *R*, giving your answer to 3 significant figures,

(4)

(*d*) the area of *R*, giving your answer to 3 significant figures.

(4)

June 2008

8. A circle C has centre $M(6, 4)$ and radius 3.

(*a*) Write down the equation of the circle in the form

$$(x-a)^2 + (y-b)^2 = r^2.$$

(2)

Figure 4

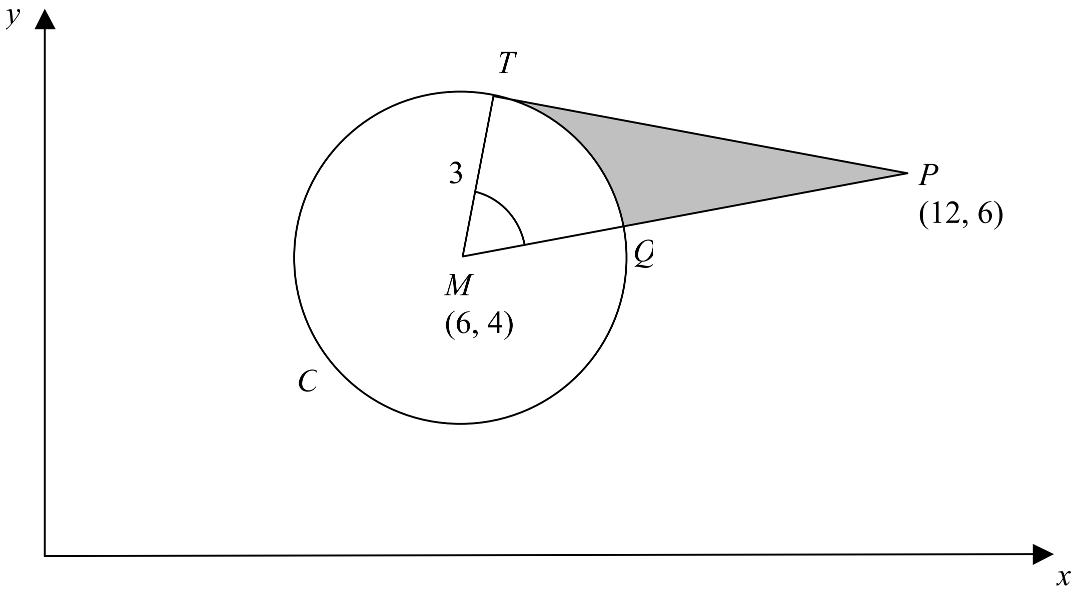

Figure 4 shows the circle C. The point T lies on the circle and the tangent at T passes through the point $P(12, 6)$. The line MP cuts the circle at Q.

(*b*) Show that the angle TMQ is 1.0766 radians to 4 decimal places.

(4)

The shaded region TPQ is bounded by the straight lines TP, QP and the arc TQ, as shown in Figure 4.

(*c*) Find the area of the shaded region TPQ. Give your answer to 3 decimal places.

(5)

January 2008

9. The curve C has equation $y = 12\sqrt{(x)} - x^{\frac{3}{2}} - 10,\ x > 0$.

(a) Use calculus to find the coordinates of the turning point on C.

(7)

(b) Find $\dfrac{d^2y}{dx^2}$.

(2)

(c) State the nature of the turning point.

(1)

January 2010

TOTAL FOR PAPER: 75 MARKS

END

Question Number	Scheme	Marks
1.	$\left[(3-x)^6 =\right] 3^6 + 3^5 \times 6 \times (-x) + 3^4 \times \begin{pmatrix} 6 \\ 2 \end{pmatrix} \times (-x)^2$	M1
	$= 729, \quad -1458x, \quad +1215x^2$	B1 A1 A1
		[4]
	$(2 + 3x)^4$ - Mark (a) and (b) together	
2. (a)	$2^4 + {}^4C_1 2^3(3x) + {}^4C_2 2^2(3x)^2 + {}^4C_3 2^1(3x)^3 + (3x)^4$	
	First term of 16	B1
	$\left({}^4C_1 \times ... \times x\right) + \left({}^4C_2 \times ... \times x^2\right) + \left({}^4C_3 \times ... \times x^3\right) + \left({}^4C_4 \times ... \times x^4\right)$	M1
	$=(16 +)\ 96x + 216x^2 + 216x^3 + 81x^4$	A1 A1
		(4)
(b)	$(2 - 3x)^4 = 16 - 96x + 216x^2 - 216x^3 + 81x^4$	B1ft
		(1)
		[5]
3. (a)	$\mathrm{f}\left(\frac{1}{2}\right) = 2 \times \frac{1}{8} + a \times \frac{1}{4} + b \times \frac{1}{2} - 6$	M1
	$\mathrm{f}\left(\frac{1}{2}\right) = -5 \Rightarrow \frac{1}{4}a + \frac{1}{2}b = \frac{3}{4}$ or $a + 2b = 3$	A1
	$\mathrm{f}(-2) = -16 + 4a - 2b - 6$	M1
	$\mathrm{f}(-2) = 0 \Rightarrow 4a - 2b = 22$	A1
	Eliminating one variable from 2 linear simultaneous equations in a and b	M1
	$a = 5$ and $b = -1$	A1
		(6)
(b)	$2x^3 + 5x^2 - x - 6 = (x+2)(2x^2 + x - 3)$	M1
	$= (x+2)(2x+3)(x-1)$	M1A1
		(3)
		[9]
4.	$\cos^{-1}(-0.4) = 113.58\ (\alpha)$	B1
	$3x - 10 = \alpha \Rightarrow x = \dfrac{\alpha + 10}{3}$	M1
	$x = 41.2$	A1
	$(3x - 10 =)360 - \alpha\ \ (246.4....)$	M1
	$x = 85.5$	A1
	$(3x - 10 =)360 + \alpha\ (= 473.57....)$	M1
	$x = 161.2$	A1
		[7]

Question Number	Scheme	Marks
5. (a)	**Usually answered in radians:**	
	Uses either $\frac{1}{2}ab\sin(\text{angle})$ **or** $\frac{1}{2}(12)^2(\text{angle})$ or both	M1
	Area $= \frac{1}{2}(23)(12)\sin 0.64$ **or** $\frac{1}{2}(12)^2(\pi - 0.64)$ $\{= 82.41297091...$ **or** $180.1146711...\}$	A1
	Area $= \frac{1}{2}(23)(12)\sin 0.64 + \frac{1}{2}(12)^2(\pi - 0.64)$ $\{= 82.41297091... + 180.1146711...\}$	A1
	$\{\text{Area} = 262.527642...\}$ = awrt 262.5 (m^2) or 262.4(m^2) or 262.6 (m^2)	A1
		(4)
(b)	$CDE = 12\times(angle)$, $= 12(\pi - 0.64)\{\Rightarrow CDE = 30.01911...\}$	M1, A1
	$AE^2 = 23^2 + 12^2 - 2(23)(12)\cos(0.64) \Rightarrow AE^2 =$ or $AE =$ $\{AE = 15.17376...\}$	M1
	Perimeter = 23 + 12 + 15.17376... + 30.01911...	M1
	= 80.19287... = awrt 80.2 (m)	A1
		(5)
		[9]
6. (a)	Seeing -4 and 2.	B1
		(1)
(b)	$x(x+4)(x-2) = \underline{x^3 + 2x^2 - 8x}$ or $\underline{x^3 - 2x^2 + 4x^2 - 8x}$	B1
	$\int (x^3 + 2x^2 - 8x)\,dx = \frac{x^4}{4} + \frac{2x^3}{3} - \frac{8x^2}{2}\{+c\}$ or $\frac{x^4}{4} - \frac{2x^3}{3} + \frac{4x^3}{3} - \frac{8x^2}{2}\{+c\}$	M1A1ft
	$\left[\frac{x^4}{4} + \frac{2x^3}{3} - \frac{8x^2}{2}\right]_{-4}^{0} = (0) - \left(64 - \frac{128}{3} - 64\right)$ **or** $\left[\frac{x^4}{4} + \frac{2x^3}{3} - \frac{8x^2}{2}\right]_{0}^{2} = \left(4 + \frac{16}{3} - 16\right) - (0)$	dM1
	One integral $= \pm\, 42\frac{2}{3}$ (42.6 or awrt 42.7) **or** other integral $= \pm\, 6\frac{2}{3}$ (6.6 or awrt 6.7)	A1
	Hence Area $= "their 42\frac{2}{3}" + "their 6\frac{2}{3}"$ or Area $= "their 42\frac{2}{3}" - "-their 6\frac{2}{3}"$	dM1
	$= 49\frac{1}{3}$ or 49.3 or $\frac{148}{3}$	A1
		(7)
		[8]

Question Number	Scheme	Marks
7. (a)	$r\theta = 7 \times 0.8 = 5.6$ (cm)	M1 A1 (2)
(b)	$\frac{1}{2}r^2\theta = \frac{1}{2}\times 7^2 \times 0.8 = 19.6$ (cm^2)	M1 A1 (2)
(c)	$BD^2 = 7^2 + (\text{their } AD)^2 - (2\times 7\times(\text{their } AD)\times\cos 0.8)$	M1
	$BD^2 = 7^2 + 3.5^2 - (2\times 7\times 3.5\times\cos 0.8)$ (or awrt 46° for the angle)	A1
	Perimeter = (their DC) + "5.6" + "5.21" = 14.3 (cm)	M1 A1 (4)
(d)	$\Delta ABD = \frac{1}{2}\times 7\times(\text{their } AD)\times\sin 0.8$ (ft their AD) (= 8.78…)	M1 A1ft
	Area = "19.6" – "8.78…" 10.8 (cm^2)	M1 A1 (4) **[12]**
8. (a)	$(x-6)^2 + (y-4)^2 = ;\ 3^2$	B1; B1 (2)
(b)	Complete method for MP: $= \sqrt{(12-6)^2 + (6-4)^2}$	M1
	$= \sqrt{40}$ or awrt 6.325	A1
	Complete method for cos θ, sin θ or tan θ	M1
	e.g. $\cos\theta = \frac{MT}{MP} = \frac{3}{\text{candidate's}\sqrt{40}}$ (= 0.4743) (θ = 61.6835°)	
	θ = 1.0766 rad	A1 (4)
(c)	Complete method for area TMP;	M1
	e.g. $\frac{1}{2}\times 3\times\sqrt{40}\sin\theta$	
	$\frac{3}{2}\sqrt{31}$ (= 8.3516…) allow awrt 8.35	A1
	Area (sector) MTQ = 0.5 × 3^2 × 1.0766 (= 4.8446…)	M1
	Area TPQ = candidate' s (8.3516.. – 4.8446…)	M1
	= 3.507 awrt	A1 (5) **[11]**

Question Number	Scheme	Marks
9. (a)	$\left[y = 12x^{\frac{1}{2}} - x^{\frac{3}{2}} - 10\right]$	
	$[y' =]$ $\quad 6x^{-\frac{1}{2}} - \frac{3}{2}x^{\frac{1}{2}}$	M1 A1
	Puts their $\dfrac{6}{x^{\frac{1}{2}}} - \dfrac{3}{2}x^{\frac{1}{2}} = 0$	M1
	So $x =$ $\quad , \dfrac{12}{3} = 4$	M1 A1
	$x = 4, \quad \Rightarrow \quad y = 12 \times 2 - 4^{\frac{3}{2}} - 10, \quad$ so $y = 6$	dM1 A1
		(7)
(b)	$y'' = -3x^{-\frac{3}{2}} - \frac{3}{4}x^{-\frac{1}{2}}$	M1, A1
		(2)
(c)	[Since $x > 0$] It is a maximum	B1
		(1)
		[10]

Examiner reports

Question 1

This binomial expansion was answered well, with a majority of the candidates scoring three or four marks. The binomial coefficients were usually correct, though a few used ${}^5C_r$ instead of ${}^6C_r$. Those using the $(a+b)^n$ formula were the most accurate. The majority of errors with that method being with +/– signs: using x instead of $-x$, $(-x)^2$ becoming $-x^2$, not simplifying $1458(-x)$ to $-1458x$ or leaving as $+(-1458x)$. Attempts to take out the 3 to use the $(1 + x)^n$ expansion were generally less successful with candidates not raising 3 to a power or not dividing the x term by 3. There were a number of marks lost by slips such as miscopying 729 as 792 or 726, or neglecting the x in the second term.

Question 2

This question was generally answered very well with many candidates gaining 4 or 5 marks.

In part (a) most candidates were able to find the correct coefficients for each term using either binomial coefficients or Pascal's triangle. Occasionally candidates gave the fully correct first four terms but then omitted the final (x^4) term. This could possibly be due to previous years' papers asking for expansions only up to the term in x^3.

Candidates who took out a factor of 2^4 before applying the binomial theorem were generally less successful in obtaining correct simplified terms. A common mistake was not to use a bracket for $3x$, resulting for example in $3x^2$ instead of $(3(x))^2$ and hence wrong coefficients. A small minority added the powers of '2' and '$3x$' rather than multiplying them.

In part (b) the correct answer was frequently seen without any further working, but it was not uncommon to have minus signs for the last 4 terms or for the expansion to remain exactly the same as in part (a), perhaps with the terms reversed. A number of candidates were able to gain this follow-through mark after having made a calculation error in part (a).

Some, surprisingly, applied a full binomial expansion again, failing to spot the connection to the first part of the question.

Question 3

Part (a): Most who used the remainder theorem correctly used $f(\frac{1}{2})$ and equated it to -5, then used $f(-2)$ and equated it to zero. They then solved simultaneous equations. There were a number of errors simplifying fractions and dealing with negative numbers and so a significant minority of the candidates scored the three method marks but lost all three accuracy marks. Some candidates forgot to equate their first expression to -5 and some wrote expressions not equations. There were also a number of errors rearranging terms and dealing with fractions. A small minority thought that $a(½)^2$ became $¼a^2$. It was obvious from the multiple efforts and crossings-out that a number of candidates were unhappy with their a and b values, but were often unable to resolve their problems.

Those who used long division very rarely got as far as a correct remainder. They usually made little progress, and penalised themselves by the excessive time taken to do the complicated algebra required.

Part (b): Most candidates attempted this part of the question, even after limited success in part (a). It was common for those candidates who found fractional values for a or b to multiply $f(x)$ by a denominator to create integer coefficients here. Division by $(x + 2)$ was generally done well using “long division” or synthetic division and candidates who had achieved full marks in part (a) normally went on to achieve full marks in (b), with the common error being failing to factorise their quadratic expression correctly. A significant group stopped at the quadratic factor and so lost the final two marks.

Candidates completing this question successfully were careful and accurate candidates and the question proved discriminating. A number of candidates made several attempts, sometimes achieving success on the third try.

Question 4

The majority of candidates began by correctly finding arccos (–0.4) (113.578…) and then proceeded to find the first angle (41.2). However, is was noted that in solving the equation $3x - 10 = 113.578\ldots$, quite a few candidates used incorrect processing. A significant number subtracted 10 and divided by 3 and others divided by 3 and then added 10. In finding the other two angles that solved the given trigonometric equation, there were a variety of approaches including using the ‘quadrant’ method or by using sketches of $\cos x$ or $\cos (3x - 10)$. A number of candidates found all three angles correctly and gave them to the required accuracy.

Question 5

This question proved quite difficult for some candidates, although those who were familiar with the required formulae and comfortable in the use of radians often achieved full marks.

It was noticed that some candidates persisted in applying formulae including π, for example sector area = $\frac{1}{2}\pi r^2\theta$, despite using angles in radians.

Although most knew how to approach part (a) correctly, the area of a triangle formula and the area of a sector formula were sometimes incorrectly quoted. Also, many candidates used a wrong calculation to find the obtuse angle, for example $(2\pi - 0.64)$ or $(1 - 0.64)$. In spite of this many candidates did obtain one numerically correct area, scoring at least 2 marks out of 4. Those who worked in radians were far more successful than those who converted unnecessarily to degrees.

A few candidates treated triangle ABE as ‘right-angled’ and consequently used an incorrect formula. Others complicated the problem by splitting triangle ABE into two right-angled triangles. Some used this method successfully but others either miscalculated or used a wrong angle or side in their final calculation. A few candidates found the area of the semicircle then subtracted that of the small sector EBA.

Many candidates achieved more marks in part (b) than they did in part (a). The formula for arc length was generally quoted correctly but in many cases the wrong angle was used. The majority of candidates used the cosine rule successfully to determine the length of AE, but occasionally the rule was misquoted or there were errors in calculation.

A surprisingly common mistake was a misunderstanding of what was meant by the perimeter so that, for example, an additional 12m radius from inside the shape was added.

Question 6

Most candidates achieved the first 4 marks comfortably with just the rare wrong expansion of brackets, the most common wrong answer being $x^3 + 2x^2 - 8$ (i.e. they "lost" the x from $8x$). There were occasional integration errors.

Thereafter, there was a widespread failure to recognise the need for two separate integrals and many candidates reached the consequential answer of $-6\frac{2}{3} - (-42\frac{2}{3}) = 36$. Others obtained the correct final answer by altering the signs: $-6\frac{2}{3} + (-42\frac{2}{3}) = -49\frac{1}{3}$ … etc.

Some of those that found two integrals did not evaluate these correctly, changing the limits around and ignoring the zeros fairly indiscriminately. Another fairly common error was to substitute the limits the wrong way round and some students changed -4 to 4, which fortuitously produced the same value as the integral from -4 to 0, but did not receive credit. A few scripts showed very limited working from which it was difficult to tell whether one or two integrals had been attempted. A number of candidates gave the correct x-values where the curve crossed the axis, but then proceeded to use different values for the limits in their integrals, 3 being quite often used instead of 2.

The best answers showed clearly the substitution and evaluation of the limits, and explained the negative answer for the integral between 0 and 2. The two areas were then combined to get the final answer. A surprising number, having obtained $42\frac{2}{3}$ and $-6\frac{2}{3}$ correctly then added them without changing the sign of the second definite integral.

Many calculations were compromised by a failure to deal correctly with the sign of the powers of -4. Some students had solutions which showed correct method throughout but premature rounding resulted in the loss of the final accuracy mark.

There were several instances of students simply using graphical calculators to find the area with no evidence of any integration (or indeed, in some cases, of any expansion!). Such answers scored no marks as the question made it clear that integration should be used.

Question 7

Many fully correct solutions to this question were seen. Those candidates who were unwilling to work in radians, however, made things more difficult for themselves (and sometimes lost accuracy) by converting angles into degrees.

In parts (a) and (b), those who knew the correct formulae scored easy marks while those who used formulae for the circumference and the area of a circle sometimes produced muddled working. A few thought that the angle should be 0.8π.

In finding the perimeter in part (c), most candidates realised that they needed to find the lengths DC and BD. It was surprising to see 4.5 occurring occasionally for DC as half of 7. In finding BD, most made a good attempt to use the cosine formula, although calculation slips were not uncommon. Some assumed that BD was perpendicular to AC and worked with Pythagoras' Theorem or basic triangle trigonometry, scoring no more than one mark in this part. In part (d) some candidates tried, with varying degrees of success, to use $\frac{1}{2}bh$ and some produced lengthy methods involving the sine rule. Occasionally the required area was interpreted as a segment and the segment area formula was used directly. Without any method for the area of an appropriate triangle, this scored no marks. Some did use the segment together with the area of triangle BDC, and although this was lengthy, the correct answer was often achieved.

Question 8

Part (a) provided 2 marks for the majority of candidates but it was surprising, as the form was given, to see such "slips" as $(x - 6) + (y - 4) = 9$ or $(x - 6)^2 - (y - 4)^2 = 9$. There were some good solutions to part (b) but this did prove to be quite discriminating: Many candidates did not really attempt it; some actually used the given answer to calculate TP or PM, and then used these results to show that angle TMQ = 1.0766; and a large number of candidates made the serious error of taking TP = 6. It was disappointingly to see even some of the successful candidates using the cosine rule in triangle TMP, having clearly recognised that it was right-angled.

Part (c) was answered much better, with most candidates having a correct strategy. However, there were some common errors: use of the wrong sides in ½absinC; careless use of Pythagoras to give TP = 7 ($\sqrt{40 + 9}$); mixing up the formulae for arc length and sector area; and through inaccuracy or premature approximation, giving answers like 3.51 or 3.505.

Question 9

Part (a): A pleasing majority of the candidates were able to differentiate these fractional powers correctly, but a sizeable group left the constant term on the end. They then put the derivative equal to zero. Solving the equation which resulted caused more problems as the equation contained various fractional powers. Some tried squaring to clear away the fractional powers, but often did not deal well with the square roots afterwards. There were many who expressed $6x^{-1/2} = 1/(6x^{1/2})$ and tended to get in a muddle after that. Those who took out a factor $x^{1/2}$ usually ended with $x = 0$ as well as $x = 4$ and if it was not discounted, they lost an accuracy mark. Those who obtained the solution $x = 4$ sometimes neglected to complete their solution by finding the corresponding y value. Some weaker candidates did not differentiate at all in part (a), with some integrating, and others substituting various values into y.

Part (b): The second derivative was usually correct and those who had made a slip earlier by failing to differentiate 10, usually differentiated it correctly this time!

Part (c): Candidates needed to have the correct second derivative to gain this mark. As the derivative was clearly negative this mark was for just stating that the turning point was a maximum.

Statistics for C2 Practice Paper Silver Level S1

				Mean score for students achieving grade:							
Qu	**Max score**	**Modal score**	**Mean %**	**ALL**	**A***	**A**	**B**	**C**	**D**	**E**	**U**
1	4		81	3.22		3.71	3.42	3.06	2.65	2.39	1.64
2	5		79	3.96	4.93	4.77	4.49	4.23	3.86	3.46	2.32
3	9		71	6.37		8.13	7.20	6.00	4.67	3.61	2.19
4	7		67	4.68	6.94	6.41	5.26	4.19	3.32	2.23	1.09
5	9		73	6.56	8.72	8.57	8.05	7.38	6.43	5.08	2.35
6	8		75	6.01	7.37	7.24	6.71	6.36	5.92	5.39	3.73
7	12		67	8.03		11.33	10.05	8.46	6.47	4.50	1.78
8	11		66	7.23		10.17	8.24	6.57	5.12	4.07	2.32
9	10		64	6.39		8.67	6.90	5.65	4.31	3.41	2.09
	75		**70**	**52.45**		**69.00**	**60.32**	**51.90**	**42.75**	**34.14**	**19.51**