Paper Reference(s)

6664/01

Edexcel GCE

Core Mathematics C2

Gold Level G2

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 8 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
68	59	50	41	33	24

1. In the triangle ABC, $AB = 11$ cm, $BC = 7$ cm and $CA = 8$ cm.

(a) Find the size of angle C, giving your answer in radians to 3 significant figures.

(3)

(b) Find the area of triangle ABC, giving your answer in cm^2 to 3 significant figures.

(3)

January 2011

2.

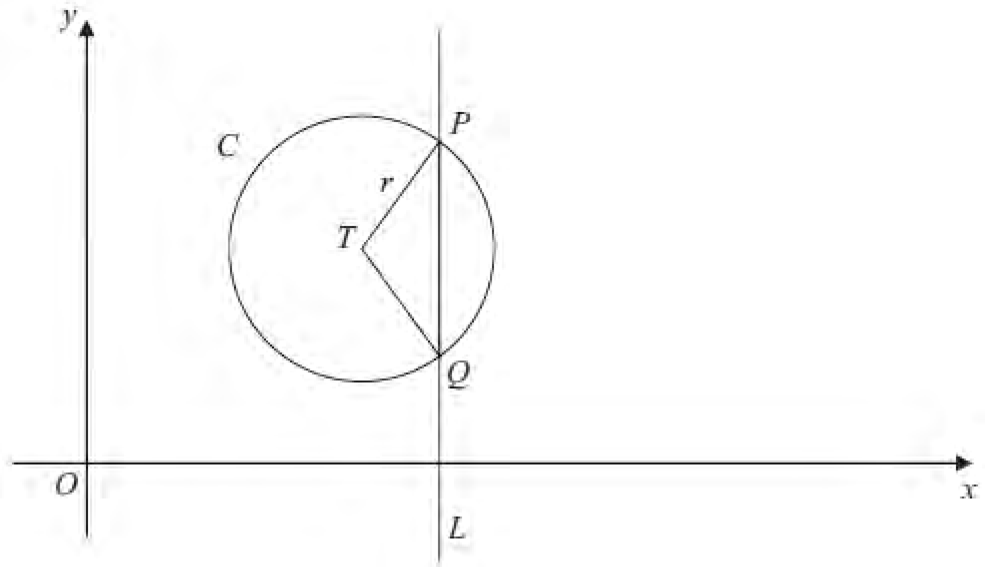

Figure 1

The circle C with centre T and radius r has equation

$$x^2 + y^2 - 20x - 16y + 139 = 0.$$

(a) Find the coordinates of the centre of C.

(3)

(b) Show that $r = 5$

(2)

The line L has equation $x = 13$ and crosses C at the points P and Q as shown in Figure 1.

(c) Find the y coordinate of P and the y coordinate of Q.

(3)

Given that, to 3 decimal places, the angle PTQ is 1.855 radians,

(d) find the perimeter of the sector PTQ.

(3)

May 2012

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3. (i) All the terms of a geometric series are positive. The sum of the first two terms is 34 and the sum to infinity is 162.

Find

(*a*) the common ratio,

(4)

(*b*) the first term.

(2)

(ii) A different geometric series has a first term of 42 and a common ratio of $\frac{6}{7}$.

Find the smallest value of n for which the sum of the first n terms of the series exceeds 290.

(4)

May 2015

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4. (*a*) Show that the equation

$$\tan 2x = 5 \sin 2x$$

can be written in the form

$$(1 - 5 \cos 2x) \sin 2x = 0.$$

(2)

(*b*) Hence solve, for $0 \leq x \leq 180°$,

$$\tan 2x = 5 \sin 2x,$$

giving your answers to 1 decimal place where appropriate.
You must show clearly how you obtained your answers.

(5)

May 2012

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5. (*a*) Find, to 3 significant figures, the value of x for which $8^x = 0.8$.

(2)

(*b*) Solve the equation

$$2 \log_3 x - \log_3 7x = 1.$$

(4)

May 2007

6.

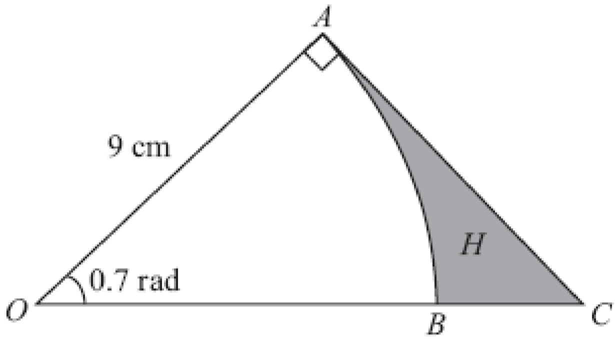

Figure 2

Figure 2 shows the sector *OAB* of a circle with centre *O*, radius 9 cm and angle 0.7 radians.

(*a*) Find the length of the arc *AB*.

(2)

(*b*) Find the area of the sector *OAB*.

(2)

The line *AC* shown in Figure 2 is perpendicular to *OA*, and *OBC* is a straight line.

(*c*) Find the length of *AC*, giving your answer to 2 decimal places.

(2)

The region *H* is bounded by the arc *AB* and the lines *AC* and *CB*.

(*d*) Find the area of *H*, giving your answer to 2 decimal places.

(3)

May 2010

7.

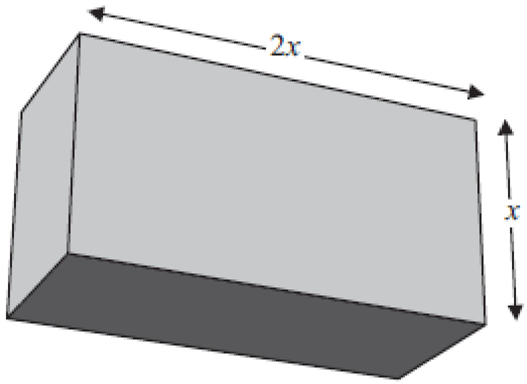

Figure 3

A cuboid has a rectangular cross-section where the length of the rectangle is equal to twice its width, x cm, as shown in Figure 3.

The volume of the cuboid is 81 cubic centimetres.

(a) Show that the total length, L cm, of the twelve edges of the cuboid is given by

$$L = 12x + \frac{162}{x^2}.$$

(3)

(b) Use calculus to find the minimum value of L.

(6)

(c) Justify, by further differentiation, that the value of L that you have found is a minimum.

(2)

May 2011

8.

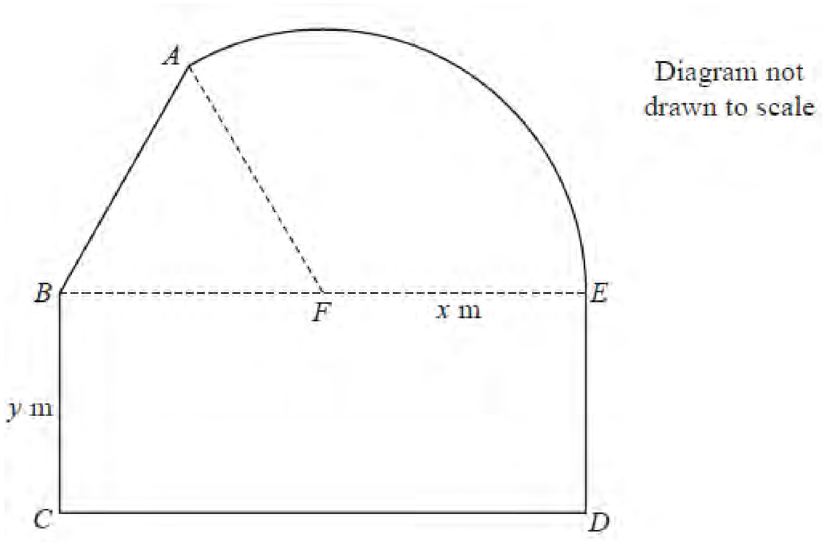

Figure 4

Figure 4 shows a plan view of a sheep enclosure.

The enclosure *ABCDEA*, as shown in Figure 4, consists of a rectangle *BCDE* joined to an equilateral triangle *BFA* and a sector *FEA* of a circle with radius x metres and centre *F*.

The points *B*, *F* and *E* lie on a straight line with $FE = x$ metres and $10 \leq x \leq 25$.

(*a*) Find, in m^2, the exact area of the sector *FEA*, giving your answer in terms of x, in its simplest form.

(2)

Given that $BC = y$ metres, where $y > 0$, and the area of the enclosure is 1000 m^2,

(*b*) show that

$$y = \frac{500}{x} - \frac{x}{24}\left(4\pi + 3\sqrt{3}\right).$$

(3)

(*c*) Hence show that the perimeter P metres of the enclosure is given by

$$P = \frac{1000}{x} + \frac{x}{12}\left(4\pi + 36 - 3\sqrt{3}\right).$$

(3)

(*d*) Use calculus to find the minimum value of P, giving your answer to the nearest metre.

(5)

(*e*) Justify, by further differentiation, that the value of P you have found is a minimum.

(2)

May 2016

TOTAL FOR PAPER: 75 MARKS

END

Question number	Scheme	Marks
1(a)	$11^2 = 8^2 + 7^2 - (2 \times 8 \times 7\cos C)$	M1
	$\cos C = \dfrac{8^2 + 7^2 - 11^2}{2 \times 8 \times 7}$ (or equivalent)	A1
	$\{\hat{C} = 1.64228...\} \Rightarrow \hat{C} = \text{awrt } 1.64$	A1 cso
		(3)
(b)	Use of Area $\Delta ABC = \dfrac{1}{2}ab\sin(\text{their } C)$, where a, b are any of 7, 8 or 11.	M1
	$= \dfrac{1}{2}(7 \times 8)\sin C$ using the value of their C from part (a).	A1 ft
	$\{= 27.92848... \text{ or } 27.93297...\} = \text{awrt } 27.9$ (from angle of either 1.64^c or 94.1°)	A1 cso
		(3)
		[6]
2 (a)	Obtain $\underline{(x \pm 10)^2}$ **and** $\underline{\underline{(y \pm 8)^2}}$	M1
	Obtain $\underline{(x - 10)^2}$ **and** $\underline{\underline{(y - 8)^2}}$	A1
	Centre is $(10, 8)$. N.B. This may be indicated on **diagram only** as $(10, 8)$	A1
		(3)
(b)	See $\underline{(x \pm 10)^2} + \underline{\underline{(y \pm 8)^2}} = 25 (= r^2)$ or $(r^2 =)\text{"}100\text{"}+\text{"}64\text{"}-139$	M1
	$r = 5$ * (this is a printed answer so need one of the above two reasons)	A1
		(2)
(c)	Use $x = 13$ in either form of equation of circle and solve resulting quadratic to give $y =$ e.g $x = 13 \Rightarrow (13-10)^2 + (y-8)^2 = 25 \Rightarrow (y-8)^2 = 16$ so $y=$ or $13^2 + y^2 - 20\times13 - 16y + 139 = 0 \Rightarrow y^2 - 16y + 48 = 0$ so $y =$	M1
	$y = 4$ or 12 (on EPEN mark one correct value as A1A0 and both correct as A1 A1)	A1, A1
		(3)
(d)	Use of $r\theta$ with $r = 5$ and $\theta = 1.855$ (may be implied by 9.275)	M1
	Perimeter $PTQ = 2r$ + their **arc** PQ (Finding perimeter of triangle is M0 here)	M1
	$= 19.275$ or 19.28 or 19.3	A1
		(3)
		[11]

Question number	Scheme	Marks
3 (i)(a)	$a + ar = 34$ or $\frac{a(1-r^2)}{(1-r)} = 34$ or $\frac{a(r^2-1)}{(r-1)} = 34$; $\frac{a}{1-r} = 162$	B1; B1
	Eliminate a to give $(1+r)(1-r) = \frac{17}{81}$ or $1 - r^2 = \frac{34}{162}$.. (not a cubic)	aM1
	(and so $r^2 = \frac{64}{81}$ and) $r = \frac{8}{9}$ only	aA1
		(4)
(b)	Substitute their $r = \frac{8}{9}$ ($0 < r < 1$) to give $a =$	bM1
	$a = 18$	bA1
		(2)
(ii)	$\frac{42(1-\frac{6}{7}^n)}{1-\frac{6}{7}} > 290$	M1
	to obtain So $(\frac{6}{7})^n < (\frac{4}{294})$ or equivalent e.g. $(\frac{7}{6})^n > (\frac{294}{4})$ or $(\frac{6}{7})^n < (\frac{2}{147})$	A1
	So $n > \frac{\log"(\frac{4}{294})"}{\log(\frac{6}{7})}$ or $\log_{\frac{6}{7}}"(\frac{4}{294})"$ or equivalent but must be log of positive quantity	M1
	(i.e. $n >$ 27.9) so $n = 28$	A1
		(4)
		[10]
4 (a)	States or uses $\tan 2x = \frac{\sin 2x}{\cos 2x}$	M1
	$\frac{\sin 2x}{\cos 2x} = 5\sin 2x \Rightarrow \sin 2x - 5\sin 2x \cos 2x = 0 \Rightarrow \sin 2x(1 - 5\cos 2x) = 0$ *	A1
		(2)
(b)	$\sin 2x = 0$ gives $2x = 0, 180, 360$ so $x = 0, 90, 180$ — B1 for two correct answers, second B1 for all three correct. Excess in range – lose last B1	B1, B1
	$\cos 2x = \frac{1}{5}$ gives $2x =$ 78.46 (or 78.5 or 78.4) **or** $2x = 281.54$ (or 281.6)	M1
	$x = 39.2$ (or 39.3), 140.8 (or 141)	A1, A1
		(5)
		[7]

Question number	Scheme	Marks
5 (a)	$x = \dfrac{\log 0.8}{\log 8}$ or $\log_8 0.8$, $= -0.107$ Allow awrt	M1 A1
		(2)
(b)	$2\log x = \log x^2$	B1
	$\log x^2 - \log 7x = \log \dfrac{x^2}{7x}$	M1
	"Remove logs" to form equation in x, using the base correctly: $\dfrac{x^2}{7x} = 3$	M1
	$x = 21$ (Ignore $x = 0$, if seen)	A1 cso
		(4)
		[6]
6 (a)	$r\theta = 9 \times 0.7 = 6.3$ (Also allow 6.30, or awrt 6.30)	M1 A1
		(2)
(b)	$\frac{1}{2}r^2\theta = \frac{1}{2} \times 81 \times 0.7 = 28.35$	M1 A1
	(Also allow 28.3 or 28.4, or awrt 28.3 or 28.4)	
	(Condone 28.35^2 written instead of $28.35\,\text{cm}^2$)	
		(2)
(c)	$\tan 0.7 = \dfrac{AC}{9}$	M1
	$AC = 7.58$ (Allow awrt) <u>NOT</u> 7.59 (see below)	A1
		(2)
(d)	Area of triangle $AOC = \frac{1}{2}(9 \times \text{their } AC)$ (or other complete method)	M1
	Area of R = "34.11" – "28.35" (triangle – sector) or (sector – triangle) (needs a <u>value</u> for each)	M1
	$= 5.76$ (Allow awrt)	A1
		(3)
		[9]

Question number	Scheme		Marks
7 (a)	$\{V =\}\ 2x^2y = 81$	$2x^2y = 81$	B1 oe
	$\{L = 2(2x + x + 2x + x) + 4y \Rightarrow L = 12x + 4y\}$		
	$y = \dfrac{81}{2x^2} \Rightarrow L = 12x + 4\left(\dfrac{81}{2x^2}\right)$	Making y the subject of their expression and substitute this into the correct L formula.	M1
	So, $L = 12x + \dfrac{162}{x^2}$ **AG**	Correct solution only.	A1 cso
			(3)
(b)	$\dfrac{dL}{dx} = 12 - \dfrac{324}{x^3}\ \{= 12 - 324x^{-3}\}$	Either $12x \to 12$ or $\dfrac{162}{x^2} \to \dfrac{\pm\lambda}{x^3}$	M1
		Correct differentiation (need not be simplified).	A1 aef
	$\left\{\dfrac{dL}{dx} =\right\} 12 - \dfrac{324}{x^3} = 0 \Rightarrow x^3 = \dfrac{324}{12}; = 27 \Rightarrow x = 3$	$L' = 0$ and "their $x^3 = \pm$ value" or "their $x^{-3} = \pm$ value"	M1;
		$x = \sqrt[3]{27}$ or $x = 3$	A1 **cso**
	$\{x = 3,\}\quad L = 12(3) + \dfrac{162}{3^2} = 54$ (cm)	Substitute candidate's value of $x\,(\neq 0)$ into a formula for L.	ddM1
		54	A1 **cao**
			(6)
(c)	$\{\text{For } x = 3\},\ \dfrac{d^2L}{dx^2} = \dfrac{972}{x^4} > 0 \Rightarrow$ Minimum	Correct ft L'' and considering sign.	M1
		$\dfrac{972}{x^4}$ and > 0 and conclusion.	A1
			(2)
			[11]

Question number	Scheme	Marks
8 (a)	$\text{Area}(FEA) = \frac{1}{2}x^2\left(\frac{2\pi}{3}\right);\ = \frac{\pi x^2}{3}$	M1 A1
		(2)
(b)	$\{A =\}\ \frac{1}{2}x^2 \sin 60^\circ + \frac{1}{3}\pi x^2 + 2xy$	M1 A1
	$1000 = \frac{\sqrt{3}\,x^2}{4} + \frac{\pi x^2}{3} + 2xy \Rightarrow y = \frac{500}{x} - \frac{\sqrt{3}\,x}{8} - \frac{\pi x}{6}$	
	$\Rightarrow \underline{y = \frac{500}{x} - \frac{x}{24}\left(4\pi + 3\sqrt{3}\right)}$ *	A1 *
		(3)
(c)	$\{P =\}\ x + x\theta + y + 2x + y\ \left\{= 3x + \frac{2\pi x}{3} + 2y\right\}$	B1ft
	$...2y = \ + 2\left(\frac{500}{x} - \frac{x}{24}\left(4\pi + 3\sqrt{3}\right)\right)$	M1
	$P = 3x + \frac{2\pi x}{3} + \frac{1000}{x} - \frac{\pi x}{3} - \frac{\sqrt{3}}{4}x \Rightarrow P = \frac{1000}{x} + 3x + \frac{\pi x}{3} - \frac{\sqrt{3}}{4}x$	
	$\Rightarrow \underline{P = \frac{1000}{x} + \frac{x}{12}\left(4\pi + 36 - 3\sqrt{3}\right)}$ *	A1 *
		(3)
(d)	$\frac{\mathrm{d}P}{\mathrm{d}x} = -1000x^{-2} + \frac{4\pi + 36 - 3\sqrt{3}}{12};\ = 0$	M1 A1; M1
	$\Rightarrow x = \sqrt{\frac{1000(12)}{4\pi + 36 - 3\sqrt{3}}}\ \ (= 16.63392808...)$	A1
	$\left\{P = \frac{1000}{(16.63...)} + \frac{(16.63...)}{12}\left(4\pi + 36 - 3\sqrt{3}\right)\right\} \Rightarrow P = 120.236..\ \text{(m)}$	A1
		(5)
(e)	$\frac{\mathrm{d}^2P}{\mathrm{d}x^2} = \frac{2000}{x^3} > 0 \Rightarrow \text{Minimum}$	M1 A1ft
		(2)
		[15]

Examiner reports

Question 1

This question was well answered with a considerable number of candidates gaining full marks. It was rare to see a solution assuming that the triangle was right-angled, although there were a few candidates who did not proceed beyond using right-angled trigonometric ratios.

In part (a), the majority of candidates were able to correctly state or apply the correct cosine rule formula. In rearranging to make cos C the subject a significant minority of candidates incorrectly deduced that cos $C = \frac{1}{14}$. A negative sign leading to an obtuse angle appeared to upset these candidates. The more usual error, however, was to use the formula to calculate one of the other two angles. This was often in spite of a diagram with correctly assigned values being drawn by candidates, thus indicating a lack of understanding of how the labeling of edges and angles on a diagram relates to the application of the cosine rule formula. Although the question clearly stated that the answer should be given in radians, it was not unusual to see an otherwise completely correct solution losing just one mark due to candidates giving the answer to part (a) in degrees. It was also fairly common to see evidence of candidates preferring to have their calculator mode in degrees, by evaluating their answer in degrees and then converting their answer to radians.

Part (b) was a good source of marks, with most candidates showing competence in using $\frac{1}{2}ab\sin C$ correctly. Of those candidates who "really" found angle A or B in part (a), most assumed it was angle C and applied $\frac{1}{2}(7)(8)\sin(\text{their } C)$, thus gaining 2 out of the possible 3 marks available. A few candidates correctly found the height of the triangle and applied $\frac{1}{2}$(base)(height) to give the correct answer.

Question 2

36.5% achieved full marks and 13.4% achieved no marks on this circle question. In part (a), good candidates easily produced $(x - a)^2 + (y - b)^2 = r^2$ from the equation given, leading to $(x - 10)^2 + (y - 8)^2 = 25$ and therefore giving the co-ordinates of the centre correctly as (10, 8). Weaker candidates either could not rearrange the equation or gave the centre of the circle as (20, 16). A few obtained the equation of the circle but then failed to state the coordinates of the centre.

Most candidates then took the equation of the circle and showed that $r^2 = 25$ and therefore $r = 5$. Some just stated that the root of 25 was 5 with no reference to r^2 or r and a few even stated wrongly that $r = \sqrt{-25} = 5$ so achieving the printed answer but not gaining the marks.

In part (c) numerous candidates substituted 13 into the equation of the circle and found the co-ordinates of P and Q. For a number of candidates, this was the only part of the question that they could answer. A few candidates successfully used geometry and the 3-4-5 triangle to find these points.

Part (d) asked for the perimeter of the sector PTQ but many candidates found the perimeter of a triangle making 18 rather than 19.275. A few tried to use $\frac{1}{2}r^2\theta$ and found the area of the sector instead of the perimeter.

Question 3
Generally candidates struggled with much of the algebra in part (i) and many only obtained the first two marks due to their poor algebraic manipulation.

Part (i) needed the formula for the sum of two terms of a geometric series and the formula for sum to infinity. Candidates usually gave the correct expressions. Those candidates who identified that the first two terms were a and ar, so used $a + ar = 34$ as their first equation were generally successful in finding r and then a. Those candidates who used the formula for the sum of a GP leading to $a(1 - r^2)/(1 - r) = 34$ were, more often than not, unsuccessful. Mostly they failed to factorise $1 - r^2$ in order to cancel the factor of $(1 - r)$ and thus ended up with a cubic equation which they could not deal with. Substitution of 162 for $a/(1- r)$ in the S_2 formula led to a very elegant solution which a number of candidates spotted. Most eliminated a to find r first. This was the easier option. A few candidates managed to eliminate r successfully although many floundered with the algebra that followed and were unable to solve the quadratic in 'a'. Incorrect and invalid values of r, for example where $r > 1$ or $r < 0$, were frequently obtained, and then used to evaluate a. Some candidates found the correct values of r and a without showing any working.

In part (ii) the majority of candidates stated and substituted values into the correct expression for the sum of n terms and gained the first method mark. A very small minority used the nth term instead, in which case no marks were available for this part of the question, as it led to a simpler but contradictory equation. Most candidates were obviously familiar with how to proceed with this sort of question and many scored 3 out of the 4 available marks. There were however various errors such as expanding $42(1 - \frac{6}{7}^n)$ to get $42 - 36^n$, or multiplying the 290 by 7 rather than 1/7. Where candidates managed to isolate $\frac{6}{7}^n$, most were able to use logs correctly to progress from this point and achieve a solution, with correct interpretation of the value of n. However the last mark was often not obtained due to inconsistent inequality work. Final statements were frequently seen such as $n < 27.9$, $n = 28$. Many failed to recognise $\log \frac{6}{7}$ as being negative and consequently lost the accuracy mark by not reversing their inequality sign after dividing. Many avoided the issue of inequality signs by using '=' throughout. They were able to gain full marks provided they stated that $n = 27.9$ prior to concluding that n must equal 28. Trial and improvement was attempted by a small number of candidates, usually resulting in a value of $n = 28$, but not always supported with the value of the sum when $n = 27$ for comparison to show that $n = 28$ was indeed the smallest value to satisfy the inequality.

Question 4
Many candidates showed little or no skill in trigonometry. 48.4% of candidates achieved zero or only one mark on this question.

In part (a) some appeared to lack the basic knowledge that $\tan 2x = \frac{\sin 2x}{\cos 2x}$ (or even that $\tan x = \frac{\sin x}{\cos x}$ or equivalent). There was also badly devised notation such as $\tan = \frac{\sin}{\cos} 2x$, as if the trig "words" were separate variables unconnected to the ($2x$). Some gained the first mark and multiplied throughout by $\cos 2x$ to obtain $\sin 2x = 5 \sin 2x \cos 2x$, but couldn't make the link from there to the required answer.

In part (b) candidates demonstrated an inability to recognize that two expressions multiplied together to equal zero mean that either or both must be zero. There were many instances of trying to draw trig curves without knowing how to interpret them into solving the equations. Very few candidates gained any B marks as they failed to solve *sin2x = 0,* and of those who did this even fewer obtained all 3 solutions. More candidates did achieve cos $2x = \frac{1}{5}$, and those who then reached $2x = 78.5$ usually proceeded to obtain one or both required solutions for x. Overall performance on this question was extremely disappointing with only 11% achieving full marks.

Question 5

Answers to part (a) were usually correct, although a surprising number of candidates seemed to think that −0.11 (rather than −0.107) was a 3 significant figure answer.

Part (b) caused many problems and highlighted the fact that the theory of logarithms is often poorly understood at this level. While many candidates scored a mark for expressing 2log x as log x^2, some wrote $2\log x - \log 7x = 2\log\left(\frac{x}{7x}\right)$. A very common mistake was to proceed from the correct equation $\log_3\left(\frac{x^2}{7x}\right) = 1$ to the equation $\frac{x^2}{7x} = 1$, using the base incorrectly. Candidates who resorted to changing the base sometimes lost accuracy by using their calculator. Weaker candidates frequently produced algebra that was completely unrecognisable in the context of logarithms, and even good candidates were seen to jump from $\log x^2 - \log 7x = 1$ to the quadratic equation $x^2 - 7x - 1 = 0$. Amongst those who scored full marks, it was rare but gratifying to see a justification of the invalidity of the 'solution' $x = 0$.

Question 6

In parts (a) and (b) of this question, most candidates were able to quote and accurately use the formulae for length of an arc and area of a sector. Wrong formulae including π were occasionally seen and it was sometimes felt necessary to convert 0.7 radians into degrees.

Despite the right-angled triangle, a very popular method in part (c) was to find the angle at C and use the sine rule. For the angle at C, many candidates used 0.87 radians (or a similarly rounded version in degrees) rather than a more accurate value. This premature approximation resulted in an answer for AC that was not correct to 2 decimal places, so the accuracy mark was lost.

In part (d), although a few candidates thought the region H was a segment, most were able to make a fair attempt to find the required area. There was again an unwillingness to use the fact that triangle OAC was right-angled, so that $\frac{1}{2}ab\sin C$ appeared frequently. Unnecessary calculations (such as the length of OC) were common and again premature approximation often led to the loss of the accuracy mark.

Question 7

In part (a), responses either scored no marks, one mark or all three marks. Those candidates who scored no marks often failed to recognise the significance of the volume. Some tried to calculate surface area, while others failed to introduce another variable for the height of the cuboid and usually wrote down $2x^3 = 81$. It was obvious that many candidates were trying (often unsuccessfully) to work back from the given result. Quite often $\frac{81}{2x^2}$ was simplified to $\frac{162}{x^2}$. A few candidates gave up at this stage and failed to attempt the remainder of the question.

In part (b), many candidates were able to gain the first 4 marks through accurate differentiation and algebra. Mistakes were occasionally made in the differentiation of $162x^{-2}$; in manipulating $12 - \frac{324}{x^3} = 0$ to give $x = \frac{1}{3}$; and in solving $x^3 = 27$ to give $x = \pm 3$. The last two marks of this part were too frequently lost as candidates neglected to find the minimum value of L. This is a recurring problem and suggests that some candidates may lack an understanding of what 'minimum' (or maximum) refers to; in this case L, and not x. This is a common misconception but does suggest that while some candidates have mastered the techniques of differentiation they may lack a deeper understanding of what they are actually finding.

In part (c), a significant number of candidates were able to successfully find the second derivative and usually considered the sign and made an acceptable conclusion. Most candidates found the value of the second derivative when $x = 3$, although a few candidates left $\frac{\mathrm{d}^2L}{\mathrm{d}x^2}$ as $\frac{972}{x^4}$, without considering its sign or giving a conclusion. Occasionally the second derivative was equated to zero, but there were very few candidates offering non-calculus solutions.

Question 8

Question 8 was worth 15 marks and so equivalent, in marks available, to two of the earlier questions. Candidates needed to apportion enough time to attempt all parts of this question. A significant number achieved 12 or more of the 15 marks available. Unfortunately some achieved no marks.

In part (a) most candidates knew and quoted a formula for area of a sector, and they were able to use this successfully with either radians or degrees as appropriate. However a significant minority tried to use degrees in the formula appropriate for radian measure.

In part (b) a majority of the candidates realised that they needed to find the total area of the shape and so needed to sum the areas of the three portions (triangle *ABF*, sector *AFE* and rectangle *BCDE*) and set the given total equal to 1000. A correct expression for the area of the rectangular portion was far more common than that for the triangular portion. Many candidates did not use the formula $\frac{1}{2}ab \sin C$ for the area of the triangle, choosing instead to find the perpendicular height of the triangle and then struggling with the algebra.

Those candidates gaining all three marks on this part were in the minority, although most of those with a correct initial expression for the total area could deal with the ensuing algebraic manipulation and gain these marks. Many had only two areas correct and some made arithmetical errors particularly with the signs. Candidates need to be aware of the need to write down sufficient intermediate steps for proofs where the final answer is given.

Part (c) was the most commonly omitted part of the question. Many candidates failed to gain a correct expression for the perimeter of the shape, with some unable to gain a correct expression for the length of arc AE. An answer of $120x$ for those who worked in degrees was common. Many of the candidates who gained a correct expression for P in terms of both x and y made errors trying to eliminate y and obtain the printed answer. Those who gained full marks in this part often gained full marks for the whole question.

Part (d) was possibly the best attempted part of the question with many candidates attempting the differentiation. Some struggled with the linear term. Successful candidates were able to deal well with the differentiation of both terms and go on to gain all five marks in this part; weaker candidates often did not recognise the need for differentiation, trying instead to gain a minimum value of P by substituting the minimum allowed value from the given valid range. Many candidates who found x correctly, omitted finding the value for P, in effect, failing to answer the question asked.

Most candidates who reached part (e) were able to gain, express and use the second derivative to gain the first if not both marks for this part. Substituting P instead of x was a common error as was using a value of x outside the given range. Some candidates did not draw a clear conclusion and so also lost the final mark.

Statistics for C2 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	6		77	4.64	5.81	5.65	5.09	4.53	3.72	2.86	1.98
2	11		68	7.53	10.56	10.17	9.36	8.33	6.84	5.03	1.98
3	10	10	58	5.80	9.54	8.62	7.00	5.79	4.69	3.75	2.15
4	7		41	2.85	6.67	5.27	3.56	2.39	1.61	1.02	0.42
5	6		62	3.72		5.43	4.45	3.68	2.95	2.29	1.20
6	9		66	5.95	8.64	8.13	7.18	6.33	5.23	3.99	1.89
7	11		53	5.87	10.38	9.49	7.44	5.58	3.88	2.60	0.95
8	15	0	53	7.98	14.17	12.74	10.15	7.88	5.74	3.80	1.42
	75		**59.12**	**44.34**	**65.77**	**65.50**	**54.23**	**44.51**	**34.66**	**25.34**	**11.99**