Paper Reference(s)

**6664/01**

# Edexcel GCE

## Core Mathematics C2

## Gold Level G1

## 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 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 9 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 |
|---|---|---|---|---|---|
| 69 | 60 | 51 | 43 | 35 | 27 |

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

$$(2 - 3x)^5,$$

giving each term in its simplest form.

**(4)**

**May 2012**

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**2.** (*a*) Find the first 4 terms, in ascending powers of $x$, of the binomial expansion of $(1 + ax)^{10}$, where $a$ is a non-zero constant. Give each term in its simplest form.

**(4)**

Given that, in this expansion, the coefficient of $x^3$ is double the coefficient of $x^2$,

(*b*) find the value of $a$.

**(2)**

**June 2008**

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**3.**

$$f(x) = 2x^3 - 5x^2 + ax + 18$$

where $a$ is a constant.

Given that $(x - 3)$ is a factor of f($x$),

(*a*) show that $a = -9$,

**(2)**

(*b*) factorise f($x$) completely.

**(4)**

Given that

$$g(y) = 2(3^{3y}) - 5(3^{2y}) - 9(3^y) + 18,$$

(*c*) find the values of $y$ that satisfy $g(y) = 0$, giving your answers to 2 decimal places where appropriate.

**(3)**

**May 2013**

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**4.** (*a*) Show that the equation

$$3 \sin^2 \theta - 2 \cos^2 \theta = 1$$

can be written as

$$5 \sin^2 \theta = 3.$$

**(2)**

(*b*) Hence solve, for $0° \leq \theta < 360°$, the equation

$$3 \sin^2 \theta - 2 \cos^2 \theta = 1,$$

giving your answer to 1 decimal place.

**(7)**

**January 2008**

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**5.** Given that $a$ and $b$ are positive constants, solve the simultaneous equations

$$a = 3b,$$

$$\log_3 a + \log_3 b = 2.$$

Give your answers as exact numbers.

**(6)**

**January 2008**

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**6.** The first term of a geometric series is 20 and the common ratio is $\frac{7}{8}$. The sum to infinity of the series is $S_\infty$.

(*a*) Find the value of $S_\infty$.

**(2)**

The sum to $N$ terms of the series is $S_N$.

(*b*) Find, to 1 decimal place, the value of $S_{12}$.

**(2)**

(*c*) Find the smallest value of $N$, for which $S_\infty - S_N < 0.5$.

**(4)**

**May 2014**

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**7.**

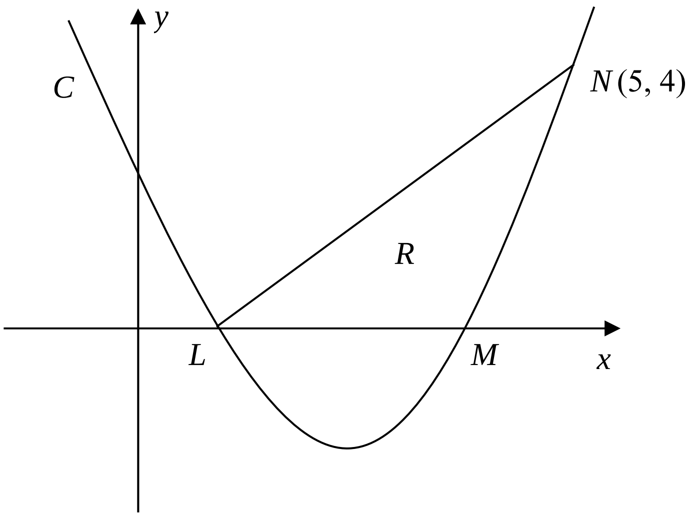


**Figure 1**

The curve $C$ has equation $y = x^2 - 5x + 4$. It cuts the $x$-axis at the points $L$ and $M$ as shown in Figure 1.

($a$) Find the coordinates of the point $L$ and the point $M$.

**(2)**

($b$) Show that the point $N(5, 4)$ lies on $C$.

**(1)**

($c$) Find $\int (x^2 - 5x + 4) \, dx$.

**(2)**

The finite region $R$ is bounded by $LN$, $LM$ and the curve $C$ as shown in Figure 1.

($d$) Use your answer to part ($c$) to find the exact value of the area of $R$.

**(5)**

**January 2010**

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**8.**

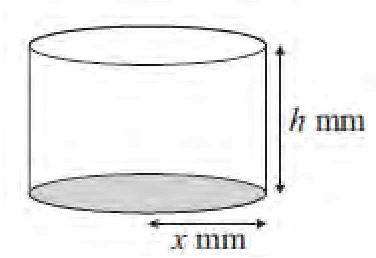


**Figure 2**

A manufacturer produces pain relieving tablets. Each tablet is in the shape of a solid circular cylinder with base radius $x$ mm and height h mm, as shown in Figure 2.

Given that the volume of each tablet has to be 60 $mm^3$,

($a$) express $h$ in terms of $x$,

**(1)**

($b$) show that the surface area, $A$ $mm^2$, of a tablet is given by $A = 2\pi x^2 + \dfrac{120}{x}$.

**(3)**

The manufacturer needs to minimise the surface area $A$ $mm^2$, of a tablet.

($c$) Use calculus to find the value of $x$ for which $A$ is a minimum.

**(5)**

($d$) Calculate the minimum value of $A$, giving your answer to the nearest integer.

**(2)**

($e$) Show that this value of $A$ is a minimum.

**(2)**

**May 2012**

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**9.** Solve, for $0 \leq x < 360°$,

($a$) $\sin(x - 20°) = \dfrac{1}{\sqrt{2}}$,

**(4)**

($b$) $\cos 3x = -\dfrac{1}{2}$.

**(6)**

**May 2008**

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**TOTAL FOR PAPER: 75 MARKS**

**END**

| Question number | Scheme | Marks |
|---|---|---|
| **1** | $\left[(2-3x)^5\right] = \;...\quad +\binom{5}{1}2^4(-3x)+\binom{5}{2}2^3(-3x)^2+..$ | M1 |
| | $=32,\; -240x,\; +720x^2$ | B1,A1,A1 |
| | | **[4]** |
| **2 (a)** | $(1+ax)^{10} = 1+10ax......$ | B1 |
| | $+\dfrac{10\times 9}{2}(ax)^2+\dfrac{10\times 9\times 8}{6}(ax)^3$ | M1 |
| | $+45(ax)^2,\, +120(ax)^3$ or $+45a^2x^2,\, +120a^3x^3$ | A1 A1 |
| | | **(4)** |
| **(b)** | $120a^3 = 2\times 45a^2$ $\quad a=\dfrac{3}{4}$ or equiv. $\left(\text{e.g.} \dfrac{90}{120}, 0.75\right)$ | M1 A1 |
| | | **(2)** |
| | | **[6]** |

| Question number | Scheme | Marks |
|---|---|---|
| **3 (a)** | Either (Way 1) : Attempt $\mathrm{f}(3)$ or $\mathrm{f}(-3)$ <br> $\mathrm{f}(3) = 54 - 45 + 3a + 18 = 0 \Rightarrow 3a = -27 \Rightarrow a = -9$ * <br> Or (Way 2): Assume $a$ = -9 and attempt $\mathrm{f}(3)$ or $\mathrm{f}(-3)$ <br> f(3) = 0 so ($x$ -3) is factor | M1 <br> A1 * cso |
| | Or (Way 3): $\left(2x^3 - 5x^2 + ax + 18\right) \div \left(x - 3\right) = 2x^2 + px + q$ where $p$ is a number and $q$ is an expression in terms of $a$ <br> Sets the remainder 18+3$a$+9 = 0 and solves to give $a = -9$ | M1 <br> A1* cso <br> **(2)** |
| | Either (Way 1): $\mathrm{f}(x) = (x - 3)(2x^2 + x - 6)$ <br> $= (x - 3)(2x - 3)(x + 2)$ | M1A1 <br> M1A1 <br> **(4)** |
| | Or (Way 2) Uses trial or factor theorem to obtain $x$ = -2 **or** $x$ = 3/2 <br> Uses trial or factor theorem to obtain both $x$ = -2 **and** $x$ = 3/2 <br> Puts three factors together (see notes below) <br> Correct factorisation : $(x - 3)(2x - 3)(x + 2)$ or $(3 - x)(3 - 2x)(x + 2)$ or $2(x - 3)(x - \frac{3}{2})(x + 2)$ oe | M1 <br> A1 <br> M1 <br> A1 <br> **(4)** |
| | Or (Way 3) No working three factors $(x - 3)(2x - 3)(x + 2)$ otherwise need working | M1 A1 M1A1 |
| | $\{3^y = 3 \Rightarrow\}$ $\underline{y = 1}$ or g(1) = 0 | B1 |
| | $\{3^y = 1.5 \Rightarrow\}\log\left(3^y\right) = \log 1.5$ or $y = \log_3 1.5$ | M1 |
| | $\{y = 0.3690702...\} \Rightarrow y = $ awrt 0.37 | A1 <br> **(3)** <br> **[9]** |

| Question number | Scheme | Marks |
|---|---|---|
| **4 (a)** | $3\sin^2\theta - 2\cos^2\theta = 1$ | |
| | $3\sin^2\theta - 2(1 - \sin^2\theta) = 1$ (M1: Use of $\sin^2\theta + \cos^2\theta = 1$) | M1 |
| | $3\sin^2\theta - 2 + 2\sin^2\theta = 1$ | |
| | $5\sin^2\theta = 3$ cso AG | A1 |
| | | **(2)** |
| **(b)** | $\sin^2\theta = \frac{3}{5}$, so $\sin\theta = (\pm)\sqrt{0.6}$ | M1 |
| | Attempt to solve both $\sin\theta$ = +.. and $\sin\theta$ = - ...(may be implied by later work) | M1 |
| | $\theta = 50.7685°$ awrt $\theta = 50.8°$ (dependent on first M1 only) | A1 |
| | $\theta$ $(= 180° - 50.7685_c°)$; $= 129.23...°$ awrt $129.2°$ | M1; A1 |
| | [f.t. dependent on first M and 3rd M] | |
| | $\sin\theta = -\sqrt{0.6}$ | |
| | $\theta = 230.785°$ and $309.23152°$ awrt $230.8°$, $309.2°$ (both) | M1 A1 |
| | | **(7)** |
| | | **[9]** |

| Question number | Scheme | Marks |
|---|---|---|
| 5 | Method 1 (Substituting a = 3b into second equation at some stage) | |
| | Using a law of logs correctly (anywhere) e.g. $\log_3 ab = 2$ | M1 |
| | Substitution of $3b$ for $a$ (or a/3 for b) e.g. $\log_3 3b^2 = 2$ | M1 |
| | Using base correctly on **correctly derived** $\log_3$ p= q e.g. $3b^2 = 3^2$ | M1 |
| | First correct value $b = \sqrt{3}$ (allow $3^{½}$) | A1 |
| | Correct method to find other value ( dep. on at least first M mark) | M1 |
| | Second answer $a = 3b = 3\sqrt{3}$ or $\sqrt{27}$ | A1 |
| | Method 2 (Working with two equations in $\log_3 a$ and $\log_3 b$) | |
| | " Taking logs" of first equation and " separating" $\log_3 a = \log_3 3 + \log_3 b$ $(= 1 + \log_3 b)$ | M1 |
| | Solving simultaneous equations to find $\log_3 a$ or $\log_3 b$ | M1 |
| | [ $\log_3 a = 1½$, $\log_3 b = ½$ ]<br>Using base correctly to find a or b | M1 |
| | Correct value for $a$ or $b$ $a = 3\sqrt{3}$ or $b = \sqrt{3}$ | A1 |
| | Correct method for second answer, dep. on first M; correct second answer<br>[Ignore negative values] | M1;A1 |
| | | **[6]** |
| 6 (a) | $S_\infty = \dfrac{20}{1-\frac{7}{8}}$ ; $= 160$ | M1A1 |
| | | **(2)** |
| (b) | $S_{12} = \dfrac{20\left(1-\left(\frac{7}{8}\right)^{12}\right)}{1-\frac{7}{8}}$ ; $= 127.77324...$ | M1A1 |
| | | **(2)** |
| (c) | $160 - \dfrac{20(1-(\frac{7}{8})^N)}{1-\frac{7}{8}} < 0.5$ | M1 |
| | $160\left(\dfrac{7}{8}\right)^N < (0.5)$ or $\left(\dfrac{7}{8}\right)^N < \left(\dfrac{0.5}{160}\right)$ | dM1 |
| | $N\log\left(\dfrac{7}{8}\right) < \log\left(\dfrac{0.5}{160}\right)$ | M1 |
| | $N > \dfrac{\log\left(\frac{0.5}{160}\right)}{\log\left(\frac{7}{8}\right)} = 43.19823... \Rightarrow N = 44$ | A1 cso |
| | | **(4)** |
| | | **[8]** |

| Question number | Scheme | Marks |
|---|---|---|
| 7 (a) | Puts $y = 0$ and attempts to solve quadratic e.g. $(x-4)(x-1)=0$ | M1 |
| | Points are (1,0) and (4, 0) | A1 |
| | | **(2)** |
| (b) | $x = 5$ gives $y = 25 - 25 + 4$ and so (5, 4) lies on the curve | B1cso |
| | | **(1)** |
| (c) | $\int\left(x^2-5x+4\right)\mathrm{d}x = \frac{1}{3}x^3 - \frac{5}{2}x^2 + 4x \quad (+c)$ | M1A1 |
| | | **(2)** |
| (d) | Area of triangle = $\frac{1}{2}\times 4\times 4 = 8$ or $\int(x-1)\mathrm{d}x = \frac{1}{2}x^2 - x$ with limits 1 and 5 to give 8 | B1 |
| | Area under the curve = $\int_4^5$ $\quad \frac{1}{3}\times 5^3 - \frac{5}{2}\times 5^2 + 4\times 5 \quad \left[=-\frac{5}{6}\right]$ | M1 |
| | $\frac{1}{3}\times 4^3 - \frac{5}{2}\times 4^2 + 4\times 4 \quad \left[=-\frac{8}{3}\right]$ | M1 |
| | $\int_4^5 = -\frac{5}{6} - -\frac{8}{3} = \frac{11}{6}$ or equivalent (allow 1.83 or 1.8 here) | A1cao |
| | Area of $R$ = $8 - \frac{11}{6} = 6\frac{1}{6}$ or $\frac{37}{6}$ or $6.1\dot{6}$ (not 6.17) | A1cao |
| | | **(5)** |
| | | **[10]** |

| Question number | Scheme | Marks |
|---|---|---|
| **8 (a)** | $(h=)\dfrac{60}{\pi x^2}$ or **equivalent exact** (not decimal) expression e.g. $(h=)60\div\pi x^2$ | B1 |
| | | **(1)** |
| **(b)** | $(A=)2\pi x^2+2\pi xh$ or $(A=)2\pi r^2+2\pi rh$ or $(A=)2\pi r^2+\pi dh$<br>may not be simplified and may appear on separate lines | B1 |
| | Either $(A)=2\pi x^2+2\pi x\left(\dfrac{60}{\pi x^2}\right)$ or As $\pi xh=\dfrac{60}{x}$ then $(A=)2\pi x^2+2\left(\dfrac{60}{x}\right)$ | M1 |
| | $A=2\pi x^2+\left(\dfrac{120}{x}\right)$ * | A1 cso |
| | | **(3)** |
| **(c)** | $(\dfrac{dA}{dx})=4\pi x-\dfrac{120}{x^2}$ or $=4\pi x-120x^{-2}$ | M1 A1 |
| | $4\pi x-\dfrac{120}{x^2}=0$ implies $x^3=$ (Use of $>0$ or $<0$ is M0 then M0A0) | M1 |
| | $x=\sqrt[3]{\dfrac{120}{4\pi}}$ or answers which round to 2.12 ( -2.12 is A0) | dM1 A1 |
| | | **(5)** |
| **(d)** | $A=2\pi(2.12)^2+\dfrac{120}{2.12}$, $=85$ (only ft $x=2$ or 2.1 – both give 85) | M1, A1 |
| | | **(2)** |
| **(e)** | **Either** $\dfrac{d^2A}{dx^2}=4\pi+\dfrac{240}{x^3}$ and sign considered ( May appear in (c) )<br>**Or** *(method 2)* considers gradient to left and right of their 2.12 (e.g at 2 and 2.5)<br>**Or** (*method 3*) considers value of $A$ either side | M1 |
| | which is $>0$ and therefore minimum (most substitute 2.12 but it is not essential to see a substitution ) (may appear in (c))<br>Finds numerical values for gradients and observes gradients go from negative to zero to positive so concludes minimum<br>**OR** finds numerical values of $A$, observing greater than minimum value and draws conclusion | A1 |
| | | **(2)** |
| | | **[13]** |

| Question number | Scheme | Marks |
|---|---|---|
| **9 (a)** | 45 $(\alpha)$ | B1 |
| | $180-\alpha$, Add 20 (for at least one angle) | M1 M1 |
| | 65 155 | A1 |
| | | **(4)** |
| **(b)** | 120 or 240 $(\beta)$: | B1 |
| | $360-\beta$, $360+\beta$ | M1 M1 |
| | Dividing by 3 (for at least one angle) | M1 |
| | 40 80 160 200 280 320 | A1 A1 |
| | | **(6)** |
| | | **[10]** |

# Examiner reports

## Question 1

This was a straightforward starter question allowing candidates to settle into the paper, with 59% of candidates achieving full marks and only 14% failing to gain at least half marks. Students confidently applied the binomial series and had no problem with binomial coefficients which were usually found using a formula though some candidates simply quoted the 5th line of Pascal's triangle. The most common error was in missing out the brackets around the term in $x^2$, leading to an incorrect coefficient for this term. Some did not simplify $+ -240x$, and a small proportion of candidates complicated the expansion by taking out a factor of $2^5$, which introduced fractions and then involved further simplification at the end. This latter method frequently led to errors. A few wrote the expansion in descending order but most of these gave all the terms and so managed to score full marks.

## Question 2

In part (a), most candidates were aware of the structure of a binomial expansion and were able to gain the method mark. Coefficients were generally found using ${}^nC_r$, but Pascal's triangle was also frequently seen. The most common mistake was to omit the powers of $a$, either completely or perhaps in just the simplified version of the answer.

Part (b) was often completed successfully, but a significant number of candidates included powers of $x$ in their 'coefficients', resulting in some very confused algebra and indicating misunderstanding of the difference between 'coefficients' and 'terms'. Sometimes the wrong coefficient was doubled and sometimes the coefficients were equated with no doubling. Some candidates, having lost marks in part (a) due to the omission of powers of $a$, recovered in part (b) and achieved the correct answer.

## Question 3

The first two parts of this question were very familiar and the vast majority of candidates answered them well, but part (c) was less familiar and proved very challenging for all but the very good candidates.

Part (a) was accessible to almost all students with most taking the route of setting $f(3) = 0$ and solving to get $a = -9$. Very few slips were seen in the evaluation of f (3) and most students who started with this approach gained both marks. The common error of failing to equate the expression to zero explicitly led to many students losing a mark. We saw very few students erroneously using $f(-3)$. Some candidates chose to assume the value $a = -9$ and proceeded to show that f(3) did indeed equate to zero, or by long division showed that the result was a three termed quadratic. However, often such candidates lost the A mark because there was no suitable concluding statement, such as "so $(x - 3)$ is a factor". There were relatively few attempts using "way 3" in the mark scheme, dividing $f(x)$ by $(x - 3)$ to give a remainder in terms of $a$, and full marks by this approach were rare.

In part (b) students were generally well rehearsed in the methods for fully factorising the cubic equation, with many preferring the long division approach. Some slips were observed in the signs, particularly with the $x$ term. More students remembered to factorise their quadratic compared to previous papers, with most achieving three factors in their final expression. The most common error seen was with the signs when factorising the three-term quadratic. It was rare to see a factor theorem only approach.

In part (c) the question presented real challenge and was a useful tool for differentiating between the weaker and more able students. Those more able who had spotted the link between this part and the previous part of the question generally answered it well, using logs effectively, although a significant number lost the last mark by giving a solution for $3^y = -2$.

However, a large number of candidates did not spot the link between f($x$) and g($y$) and hence attempted to solve g($y$) = 0 by many inappropriate and ineffectual methods, and poor simplification such as $2(3^{3y}) = 6^{3y}$ was often seen. One mark was often salvaged for the solution $y = 1$, found usually by spotting that g(1) = 0, although it sometimes emerged from wrong work, such as $3y = 3$, rather than $3^y = 3$.

**Question 4**

For the majority of candidates part (a) produced 2 marks, but part (b) was variable. Good candidates could gain full marks in (b) in a few lines but the most common solution, scoring a maximum of 4 marks, did not consider the negative value of $\sin\theta$. There were many poorly set out solutions and in some cases it was difficult to be sure that candidates deserved the marks given; a statement such as $5\sin^2\theta = 3 \Rightarrow \sin\theta = \frac{\sqrt{3}}{\sqrt{5}}$ , so $\theta$ = 50.8º, 309.2º, could be incorrect thinking, despite having two of the four correct answers.

**Question 5**

This was a more unusual question on logarithms, and whilst many full marks were gained by good candidates, this proved taxing for many candidates and one or two marks were very common scores. The vast majority of candidates used the first method in the mark scheme.

The most common errors seen were, log3b + logb = log4b and log3b2 = 2log3b, and marks were lost for not giving answers in exact form. Some candidates made the question a little longer by changing the base.

**Question 6**

Part (a) was done very well with nearly all students obtaining the correct answer.

Part (b) was also attempted very well. A few students made errors evaluating their answers and some used an incorrect sum formula such as $\dfrac{a(1-r^{n-1})}{1-r}$ and some mistakenly used $n = 20$, which cost them both marks in this part. A few students used the formula $ar^{n-1}$, thereby finding the 12th term instead of finding the sum. It was rare for students to try to find the sum by finding each of the 12 individual terms and then adding. Occasional truncation errors lost the accuracy mark.

Fully correct solutions to part (c) were uncommon. Although the majority managed to earn the first method mark, not many of the students could deal with the inequalities. It was common for students to write $20\left(\frac{7}{8}\right)^N$ as $(17.5)^N$ or to take logs prematurely. Of the students able to get as far as $\left(\frac{7}{8}\right)^N < \frac{1}{320}$, most were able to take logs to reach 43.2. However, not many students managed to achieve the final accuracy mark, either because of errors with their inequality signs or because they gave their answers as $N = 43.2$ or $N = 43$. Many failed to realise that $\log\left(\frac{7}{8}\right)$ is a negative number and therefore did not reverse the final inequality when dividing through by this. This left them with $N < 43.2$ as their solution, even though they went on to state $N = 44$.

Some students used trial and improvement in part (c). Although many of these reached the answer $N = 44$, insufficient working often meant that full marks were not awarded. Some students, for instance, failed to consider both $S_{43}$ and $S_{44}$ and others over-rounded their answers, thus being unable to show $S_\infty - S_{44}$ was actually less than 0.5.

**Question 7**
This question was accessible to all students and the later part differentiated between weak and strong candidates.

(a) This part of the question was generally well done with most candidates gaining both marks.

(b) Candidates had great difficulty showing that (5,4) lies on $C$. It was common to see numerical work, then $4 = 4$ or $0 = 0$ followed by no conclusion. The expectation is to see:
$x = 5$, so $y = 5^2 - 5.5 + 4$ i.e. $y = 4$ So (5,4) lies on the curve.

(c) A large proportion of the candidates gained full marks in this part of the question, showing that they understand the symbolisation for integration. Many included a constant of integration and some even proceeded to find a value for it via substitution, usually using the coordinate $N$. (Such constants were ignored.) There were very few candidates that mistakenly differentiated.

(d) There were a number of ways to find the shaded area. The easiest method was to evaluate the integral between $x = 4$ and $x = 5$. This represents an area of a region below the curve, which together with $R$ makes up a triangle, with base of length 4 and height 4. So the area of $R$ could then be found by subtraction. Unfortunately the area of the triangle when calculated was more likely to be : ½ × 3 × 4 or ½ × 5 × 4 rather than the correct ½ × 4 × 4.

Some chose to find the equation of the line $LN$ and integrate, but unfortunately the limits were regularly incorrect, most commonly given as 4 and 1. There were a fair number of completely correct solutions seen but also many cases of arithmetic errors in the evaluation of integrals. Many students felt they needed to subtract a line and a curve without really considering the nature of the shapes involved in this question. Few successfully applied the alternative approaches stated on the scheme.

**Question 8**
Numerous candidates found this question difficult but 18% achieved full marks. Weaker candidates sometimes managed no more than 2 marks (for differentiation). 28% achieved only zero, one or two marks out of the thirteen available.

In part (a) most candidates knew the formula for the volume of a cylinder but some were unable to make $h$ the subject.

In part (b), those candidates who were able to write down an expression for the surface area in terms of two circles and a rectangle (of length equal to the circumference) were usually able to go on to gain all 3 marks. However, many candidates did not realise that this was the way to approach this part of the question, often seemingly trying to work back from the answer, but then showing insufficient working to convince that they were using the area of the two circles and the rectangle as required. The formula $S = 2\pi r^2 + \frac{2V}{r}$ was sometimes seen, but this was only accepted if it had been properly derived as the $\frac{2V}{r}$ is not obvious and the answer was printed. Some also started from an incorrect formula, $S = 2\pi x^2 + (2)\pi x^2 h$ being seen quite frequently, followed by mistakes in cancellations to achieve the required result. Presentation was sometimes a problem, especially for those who confused a multiplication sign with the letter $x$.

Part (c) required the use of calculus and no marks were available for correct answers obtained by trial and error or by graphical means. Given the formula for the surface area, most candidates were able to differentiate it and equate it to zero. The negative power in the resulting equation caused some candidates problems but many were able to end with an equation in $x$ cubed which they cube- rooted to obtain $x$, the radius. Two common errors at this stage were to find the cube root of $30\pi$ instead of $\frac{30}{\pi}$ and to square root rather than cube root. Some candidates used inequalities as their condition for a stationary value rather than equating their derivative to zero, and could only score two of the marks available for part (c). Other candidates differentiated twice and solved $\frac{\mathrm{d}^2A}{\mathrm{d}x^2} = 0$, which was also an incorrect method.

Part (d) was omitted by quite a few candidates. A high number of candidates however successfully substituted their value for $x$ into their equation for the surface area although a number lost the final mark because they did not give the correct value as an integer. For some candidates, this was the only mark they lost on this question.

Almost all candidates attempted part (e), with most sensibly choosing to demonstrate that the second differential was positive, rather than other acceptable methods such as considering the gradient. Of the candidates using the second derivative method, those who lost marks on this part had usually differentiated the second term incorrectly although there was sometimes confusion over exactly what had to be positive for a minimum. Some weaker candidates considered the sign of $A$ here, "85 > 0, therefore minimum" being quite often seen. Others confused the 85 with the value for $x$ and substituted $x = 85$ into their second derivative. Some stronger candidates could see that the second derivative was positive for all values of $x$ and made a clear conclusion to show the minimum.

**Question 9**

The most able candidates completed this question with little difficulty, sometimes using sketches of the functions to identify the possible solutions. Generally speaking, however, graphical approaches were not particularly successful.

In part (a), most candidates were able to obtain 45° and went onto get $x$ = 65° but it was disappointing to see 115° so frequently as the second answer (180 − 65). A surprising number of candidates subtracted 20 rather than adding, giving the answers 25° and 115°. A number of candidates gave their first angle in radians and then proceeded to get further solutions by mixing degrees with radians. It was encouraging that few candidates thought $\sin(x-20)$ was equivalent to $\sin x - \sin 20$.

In part (b), the majority of candidates were able to obtain one or two correct solutions, but sometimes 'correct' answers followed incorrect working. Those with a good understanding of trigonometric functions produced very concise solutions, adding 360° and 720° to their values of 3$x$, then dividing all values by 3. Weaker candidates often gave solutions with no clear indication of method, which were very difficult for examiners to follow. As in part (a), disastrous initial steps such as $\cos 3x = -\frac{1}{2} \Rightarrow \cos x = -\frac{1}{6}$ were rare.

## Statistics for C2 Practice Paper Gold Level G1

| Qu | Max score | Modal score | Mean % | ALL | A* | A | B | C | D | E | U |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Mean score for students achieving grade: | | | | | | | |
| **1** | 4 | | 80 | 3.21 | 3.95 | 3.82 | 3.62 | 3.41 | 3.13 | 2.76 | 1.76 |
| **2** | 6 | | 69 | 4.11 | | 5.72 | 5.06 | 4.28 | 3.41 | 2.54 | 1.19 |
| **3** | 9 | 6 | 69 | 6.23 | 8.75 | 8.12 | 7.12 | 6.43 | 5.81 | 5.10 | 3.34 |
| **4** | 9 | | 65 | 5.87 | | 7.83 | 6.59 | 5.89 | 4.84 | 3.68 | 1.88 |
| **5** | 6 | | 67 | 4 | | 5.54 | 4.54 | 3.62 | 2.97 | 2.24 | 1.42 |
| **6** | 8 | | 70 | 5.62 | 7.51 | 6.98 | 6.14 | 5.53 | 5.02 | 4.66 | 3.96 |
| **7** | 10 | | 64 | 6.40 | | 7.73 | 6.41 | 5.92 | 5.23 | 4.76 | 3.38 |
| **8** | 13 | | 54 | 7.04 | 12.59 | 11.74 | 9.37 | 6.76 | 4.50 | 2.79 | 0.92 |
| **9** | 10 | | 55 | 5.53 | | 8.62 | 6.73 | 5.34 | 4.03 | 2.72 | 1.22 |
| | **75** | | **64.01** | **48.01** | **32.80** | **66.10** | **55.58** | **47.18** | **38.94** | **31.25** | **19.07** |