

**6663/01**

# **Edexcel GCE**

## **Core Mathematics C1**

### **Gold Level G1**

**Time: 1 hour 30 minutes**

**Materials required for examination**  
**papers**

Mathematical Formulae (Green)

**Items included with question**

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**

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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**

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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**

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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:**

<b>A*</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>
<b>66</b>	<b>58</b>	<b>50</b>	<b>42</b>	<b>34</b>	<b>26</b>

1. Given  $y = x^3 + 4x + 1$ , find the value of  $\frac{dy}{dx}$  when  $x = 3$ .

(4)

May 2013 (R)

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2. (a) Write down the value of  $16^{\frac{1}{4}}$ .

(1)

- (b) Simplify  $(16x^{12})^{\frac{3}{4}}$ .

(2)

January 2008

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3. Find the set of values of  $x$  for which

- (a)  $3(x - 2) < 8 - 2x$ ,

(2)

- (b)  $(2x - 7)(1 + x) < 0$ ,

(3)

- (c) both  $3(x - 2) < 8 - 2x$  **and**  $(2x - 7)(1 + x) < 0$ .

(1)

May 2010

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4. A 40-year building programme for new houses began in Oldtown in the year 1951 (Year 1) and finished in 1990 (Year 40).

The numbers of houses built each year form an arithmetic sequence with first term  $a$  and common difference  $d$ .

Given that 2400 new houses were built in 1960 and 600 new houses were built in 1990, find

- (a) the value of  $d$ ,

(3)

- (b) the value of  $a$ ,

(2)

- (c) the total number of houses built in Oldtown over the 40-year period.

(3)

June 2009

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5. A sequence  $x_1, x_2, x_3, \dots$  is defined by

$$x_1 = 1,$$

$$x_{n+1} = (x_n)^2 - kx_n, \quad n \geq 1,$$

where  $k$  is a constant.

- (a) Find an expression for  $x_2$  in terms of  $k$ .

(1)

- (b) Show that  $x_3 = 1 - 3k + 2k^2$ .

(2)

Given also that  $x_3 = 1$ ,

- (c) calculate the value of  $k$ .

(3)

- (d) Hence find the value of  $\sum_{n=1}^{100} x_n$ .

(3)

**May 2013 (R)**

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6. The equation  $kx^2 + 4x + (5 - k) = 0$ , where  $k$  is a constant, has 2 different real solutions for  $x$ .

- (a) Show that  $k$  satisfies

$$k^2 - 5k + 4 > 0.$$

(3)

- (b) Hence find the set of possible values of  $k$ .

(4)

**January 2009**

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7. The point  $P(1, a)$  lies on the curve with equation  $y = (x + 1)^2(2 - x)$ .

(a) Find the value of  $a$ .

(1)

(b) Sketch the curves with the following equations:

(i)  $y = (x + 1)^2(2 - x)$ ,

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

On your diagram show clearly the coordinates of any points at which the curves meet the axes.

(5)

(c) With reference to your diagram in part (b), state the number of real solutions to the equation

$$(x + 1)^2(2 - x) = \frac{2}{x}.$$

(1)

**January 2009**

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8. The curve  $C$  has equation  $y = kx^3 - x^2 + x - 5$ , where  $k$  is a constant.

(a) Find  $\frac{dy}{dx}$ .

(2)

The point  $A$  with  $x$ -coordinate  $-\frac{1}{2}$  lies on  $C$ . The tangent to  $C$  at  $A$  is parallel to the line with equation  $2y - 7x + 1 = 0$ .

Find

(b) the value of  $k$ ,

(4)

(c) the value of the  $y$ -coordinate of  $A$ .

(2)

**June 2008**

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9. A curve has equation  $y = f(x)$ . The point  $P$  with coordinates  $(9, 0)$  lies on the curve.

Given that

$$f'(x) = \frac{x+9}{\sqrt{x}}, \quad x > 0,$$

- (a) find  $f(x)$ .

(6)

- (b) Find the  $x$ -coordinates of the two points on  $y = f(x)$  where the gradient of the curve is equal to 10.

(4)

May 2013 (R)

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10. The curve  $C$  has equation

$$y = 9 - 4x - \frac{8}{x}, \quad x > 0.$$

The point  $P$  on  $C$  has  $x$ -coordinate equal to 2.

- (a) Show that the equation of the tangent to  $C$  at the point  $P$  is  $y = 1 - 2x$ .

(6)

- (b) Find an equation of the normal to  $C$  at the point  $P$ .

(3)

The tangent at  $P$  meets the  $x$ -axis at  $A$  and the normal at  $P$  meets the  $x$ -axis at  $B$ .

- (c) Find the area of the triangle  $APB$ .

(4)

January 2009

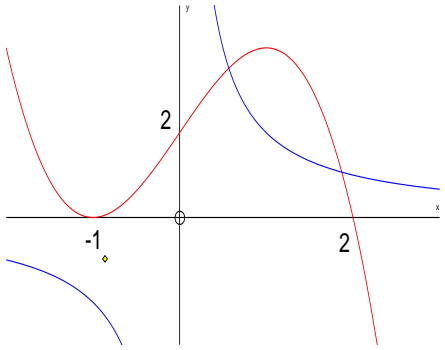


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**TOTAL FOR PAPER: 75 MARKS**

**END**

Question Number	Scheme	Marks
1.	$y = x^3 + 4x + 1 \Rightarrow \frac{dy}{dx} = 3x^2 + 4(+0)$ <p>substitute <math>x = 3 \Rightarrow \text{gradient} = 31</math></p>	M1A1 M1 A1 cao <b>[4]</b>
2. (a) (b)	<p>2</p> <p><math>x^9</math> seen, or (answer to (a))<sup>3</sup> seen, or <math>(2x^3)^3</math> seen.  <math>8x^9</math></p>	B1 (1) M1 A1 (2) <b>[3]</b>
3. (a) (b) (c)	<p><math>3x - 6 &lt; 8 - 2x \rightarrow 5x &lt; 14</math> (Accept <math>5x - 14 &lt; 0</math> (o.e.))</p> <p><math>x &lt; 2.8</math> or <math>\frac{14}{5}</math> or <math>2\frac{4}{5}</math> (condone <math>\leq</math>)</p> <p>Critical values are <math>x = \frac{7}{2}</math> and <math>-1</math></p> <p>Choosing “inside” <math>-1 &lt; x &lt; \frac{7}{2}</math></p> <p><math>-1 &lt; x &lt; 2.8</math></p> <p>Accept any exact equivalents to <math>-1, 2.8, 3.5</math></p>	M1 A1 (2) B1 M1 A1 (3) B1ft (1) <b>[6]</b>
4. (a) (b) (c)	<p><math>a + 9d = 2400 \quad a + 39d = 600</math></p> <p><math>d = \frac{-1800}{30} \quad d = -60</math> (accept <math>\pm 60</math> for A1)</p> <p><math>a - 540 = 2400 \quad a = 2940</math></p> <p>Total = <math>\frac{1}{2}n\{2a + (n-1)d\} = \frac{1}{2} \times 40 \times (5880 + 39 \times -60)</math>  (ft values of <math>a</math> and <math>d</math>)  = <u>70 800</u></p>	M1 M1 A1 (3) M1 A1 (2) M1 A1ft A1cao (3) <b>[8]</b>

Question Number	Scheme	Marks
5. (a)	$x_2 = 1 - k$	B1 (1)
(b)	$x_3 = (1 - k)^2 - k(1 - k)$ $= 1 - 3k + 2k^2$ *	M1 A1* (2)
(c)	$1 - 3k + 2k^2 = 1$ $(2k^2 - 3k = 0)$ $k(2k - 3) = 0 \Rightarrow k = ..$ $k = \frac{3}{2}$	M1 dM1 A1 Cao cso (3)
(d)	$\sum_{n=1}^{100} x_n = 1 + \left(-\frac{1}{2}\right) + 1 + .....$ Or $= 1 + (1 - 'k') + 1 + .....$ $50 \times \frac{1}{2}$ or $50 \times 1 - 50 \times \frac{1}{2}$ or $\frac{1}{2} \times 50 \times (1 - \frac{1}{2})$ $= 25$	M1 M1 A1 (3) [9]
6. (a)	$b^2 - 4ac > 0 \Rightarrow 16 - 4k(5 - k) > 0$ or equiv., e.g. $16 > 4k(5 - k)$ So $k^2 - 5k + 4 > 0$ (Allow any order of terms, e.g. $4 - 5k + k^2 > 0$ ) (*)	M1A1 A1cso (3)
(b)	<u>Critical Values</u> $(k - 4)(k - 1) = 0$ $k = ....$ $k = 1$ or $4$ Choosing “outside” region <u><math>k &lt; 1</math> or <math>k &gt; 4</math></u>	M1 A1 M1 A1 (4) [7]

Question Number	Scheme	Marks
7. (a)	$(a =) (1+1)^2(2-1) = \underline{4}$ $(1, 4)$ or $y = 4$ is also acceptable	B1 (1)
(b)	 <p>(i) Shape  or  anywhere  Min at <math>(-1, 0)</math> ... can be <math>-1</math> on <math>x</math>-axis.  Allow <math>(0, -1)</math> if marked on the <math>x</math>-axis.  Marked in the correct place, but <math>1</math>, is B0.  <math>(2, 0)</math> and <math>(0, 2)</math> can be <math>2</math> on axes</p> <p>(ii)  Top branch in 1<sup>st</sup> quadrant with 2 intersections  Bottom branch in 3<sup>rd</sup> quadrant (ignore any intersections)</p>	B1  B1 B1 B1 B1 (5)
(c)	$(2 \text{ intersections therefore}) \underline{2}$ (roots)	B1ft (1) [7]
8. (a)	$\left[ \frac{dy}{dx} = \right] 3kx^2 - 2x + 1$	M1 A1 (2)
(b)	<p>Gradient of line is <math>\frac{7}{2}</math></p> <p>When <math>x = -\frac{1}{2}</math>: <math>3k \times \left(\frac{1}{4}\right) - 2 \times \left(-\frac{1}{2}\right) + 1 = \frac{7}{2}</math></p> <p><math>\frac{3k}{4} = \frac{3}{2} \Rightarrow k = 2</math></p>	B1  M1  A1 A1 (4)
(c)	$x = -\frac{1}{2} \Rightarrow y = k \times \left(-\frac{1}{8}\right) - \left(\frac{1}{4}\right) - \frac{1}{2} - 5 = -6$	M1 A1 (2) [8]



Question Number	Scheme	Marks
9. (a)	$f'(x) = \frac{x+9}{\sqrt{x}} = \frac{x}{\sqrt{x}} + \frac{9}{\sqrt{x}} = x^{\frac{1}{2}} + 9x^{-\frac{1}{2}}$ $f(x) = \frac{x^{\frac{3}{2}}}{\frac{3}{2}} + 9 \frac{x^{\frac{1}{2}}}{\frac{1}{2}} (+c)$ $\frac{(9)^{\frac{3}{2}}}{\frac{3}{2}} + 9 \frac{(9)^{\frac{1}{2}}}{\frac{1}{2}} + c = 0 \Rightarrow c = \dots$ $f(x) = \frac{2}{3}x^{\frac{3}{2}} + 18x^{\frac{1}{2}} - 72$	M1 A1  M1 A1  M1  A1 (6)
(b)	$f'(x) = \frac{x+9}{\sqrt{x}} = 10 \Rightarrow x+9 = 10\sqrt{x}$ $(\sqrt{x}-9)(\sqrt{x}-1) = 0 \Rightarrow \sqrt{x} = \dots$ $x = 81, x = 1$	M1  dM1 A1, B1 (4) <b>[10]</b>
10. (a)	$\left(\frac{dy}{dx} = \right) -4 + 8x^{-2} \quad (4 \text{ or } 8x^{-2} \text{ for M1... sign can be wrong})$ $x = 2 \Rightarrow m = -4 + 2 = -2$ $y = 9 - 8 - \frac{8}{2} = -3$ <p>The first 4 marks <u>could</u> be earned in part (b)</p> <p>Equation of tangent is: <math>y + 3 = -2(x - 2) \rightarrow y = 1 - 2x \quad (*)</math></p>	M1A1 M1 B1 The first 4 marks <u>could</u> be earned in part (b) M1 A1 cso (6)
(b)	<p>Gradient of normal = <math>\frac{1}{2}</math></p> <p>Equation is: <math>\frac{y+3}{x-2} = \frac{1}{2}</math> or better equivalent, e.g. <math>y = \frac{1}{2}x - 4</math></p>	B1ft M1A1 (3)
(c)	<p>(A:) <math>\frac{1}{2}</math>, (B:) 8</p> <p>Area of triangle is: <math>\frac{1}{2}(x_B \pm x_A) \times y_P</math></p> <p>with values for all of <math>x_B, x_A</math> and <math>y_P</math></p> $\frac{1}{2}\left(8 - \frac{1}{2}\right) \times 3 = \frac{45}{4} \text{ or } 11.25$	B1, B1 M1 A1 (4) <b>[13]</b>

## Examiner reports

### Question 1

Almost all (94.6%) candidates scored full marks. The most common error was to substitute  $x = 3$  into the expression for  $y$  without differentiating. Largely, the only other errors were mistakes made when substituting into a correct derivative.

### Question 2

Although many candidates obtained the correct answer in part (a), they were usually unable to use this to find  $(16x^{12})^{\frac{3}{4}}$  in part (b). Even very good candidates tended to score only one mark here, with the most common incorrect answers being  $16x^9$  and  $12x^9$ . Other wrong answers included those in which powers had been added to give  $x^{\frac{51}{4}}$ . Very confused algebra was sometimes seen.

### Question 3

Most handled the linear inequality in part (a) very well with only occasional errors in rearranging terms. The responses to part (b) though were less encouraging. It was surprising how many multiplied out the brackets and then tried factorising again (often incorrectly) or used the formula to find the critical values rather than simply writing them down as was intended. Those who found the critical values did not always go on to solve the inequality and those who did often gave their answer as  $x < -1, x < 3.5$ . Those who sketched a graph of the function were usually more successful in establishing the correct interval.

Part (c) was answered well by many of those who had correct solutions to parts (a) and (b) and some successfully followed through their incorrect answers to gain the mark here. Some did not seem to realise that the intersection of the two intervals was required and simply restated their previous answers making no attempt to combine them. Drawing a number line was helpful for some candidates.

### Question 4

Many candidates did not seem to realise that this question was about Arithmetic Series initially and started with a simple arithmetic approach to obtain a difference of 60. When it came to part (b) they often did start to use arithmetic series formulae but confusion over the value of  $n$  and the sign of their 60 meant that an incorrect value for  $a$  was common. In part (c) most realised that the formula for  $S_{40}$  was required and their values were often substituted correctly.

### Question 5

Part (a) was almost always correct. In (b) most could obtain the third term correctly although there was the very occasional mistake in expanding  $(1 - k)^2$ . In part (c) most could solve the quadratic correctly although many resorted to using the quadratic formula rather than factorising the two terms. Part (d) was for many, the first challenge of the paper. The most common mistake was to assume an AP, to then attempt a value for  $d$  and then substitute in the sum formula. Some did this even when they had identified a recurring sequence.

### Question 6

Candidates who understood the demands of this question usually did well, while others struggled to pick up marks. In part (a), those who correctly used the discriminant of the original equation often progressed well, but it was sometimes unclear whether they knew the condition for different real roots. An initial statement such as " $b^2 - 4ac > 0$  for different real roots" would have convinced examiners. Irrelevant work with the discriminant of  $k^2 - 5k + 4$  was sometimes seen.

In part (b) by the vast majority of candidates scored two marks for finding the correct critical values, although it was disappointing to see so many resorting to the quadratic formula. It was surprising, however, that many did not manage to identify the required set of values of  $k$ . The inappropriate statement " $1 > k > 4$ " was sometimes given as the final answer, rather than " $k < 1$  or  $k > 4$ ".

### Question 7

In parts (a) and (b) of this question, it was common to see  $(x+1)^2(2-x)$  unnecessarily (and often wrongly) expanded. The value  $a = 4$  from part (a) was intended to help candidates to draw appropriately scaled sketches in part (b) and hence to be able to find the number of real solutions to the equation in part (c). Many, however, having correctly obtained the point (1, 4), did not use this in their sketches. While most candidates recognised that the first function was a cubic, many drew "positive cubic" shaped curves and many failed to correctly identify required features such as the minimum on the  $x$ -axis and the other points of intersection with the axes. Sketches of the rectangular hyperbola were generally satisfactory and only occasionally missing a branch or in the wrong quadrants. A few had wrong asymptotes such as  $y = 2$ .

It was not always clear in part (c) whether candidates understood that they should be looking at the number of intersection points of the curves. Their comments sometimes suggested that they were considering intersections with the  $x$ -axis. It was disappointing that some candidates ignored the instruction to refer to their diagram and wasted time by trying to solve the given equation algebraically.

### Question 8

Most candidates could start this question and there were many fully correct solutions to part (a) although some weaker candidates were confused by the  $k$  and answers such as  $2kx^2$  or  $3k^2$  were seen. Part (b) though required some careful thought and proved quite discriminating. Many candidates identified the gradient of the line as 3.5 and sometimes they equated this to their answer to part (a). Those who realised that they needed to use  $x = -0.5$  in the resulting equation often went on to find  $k$  correctly but there were many who failed to give a convincing argument that  $k = 2$ . Some found  $f'(-0.5)$  but they set this equal to 7, -7 or 0 and a few, who confused tangents and normals, used  $-\frac{2}{7}$ . In part (c) there were attempts to substitute  $x = -0.5$  into the equation of the line or the differential and those who did substitute into the equation of the curve along with their value of  $k$  (even when this was correct) often floundered with the resulting arithmetic and so completely correct solutions to this question were rare.

### Question 9

This question was probably the least well done on the paper. Some candidates were successful with part (a) and could make no headway in (b) and others could not attempt part (a) and yet were successful in part (b).

In part (a) the main errors were splitting the algebraic fraction incorrectly and problems with integrating negative fractional powers. Some candidates also missed out the constant of integration and were unable to access the last two marks in this part. Some of those who did have a constant of integration, struggled to obtain its value correctly.

Part (b) was more discriminating and many candidates did not know where to start. Even those who eliminated the fraction, failed to spot the quadratic in  $\sqrt{x}$ . Some chose to square their equation although the resulting algebra was sometimes poor.

### Question 10

Responses to this question varied considerably, ranging from completely correct, clear and concise to completely blank. Most candidates who realised the need to differentiate in part (a) were able to make good progress, although there were occasionally slips such as sign errors in the differentiation. A few lost marks by using the given equation of the tangent to find the  $y$ -coordinate of  $P$ . Those who used no differentiation at all were limited to only one mark out of six in part (a). Even candidates who were unsuccessful in establishing the equation of the tangent were sometimes able to score full marks for the normal in part (b).

Finding the area of triangle  $APB$  in part (c) proved rather more challenging. Some candidates had difficulty in identifying which triangle was required, with diagrams suggesting intersections with the  $y$ -axis instead of the  $x$ -axis. The area calculation was sometimes made more difficult by using the right angle between the tangent and the normal, i.e.  $\frac{1}{2}(AP \times BP)$ , rather than using  $AB$  as a base.

## Statistics for C1 Practice Paper Gold Level G1

Qu	Max score	Modal score	Mean %	Mean score for students achieving grade:							
				ALL	A*	A	B	C	D	E	U
1	4		97	3.88	3.97	3.98	3.91	3.93	3.92	3.98	3.46
2	3		66	1.99		2.76	2.37	2.15	2.01	1.81	1.41
3	6		69	4.13	5.81	5.47	4.77	4.27	3.73	3.26	2.33
4	8		62	4.98		7.16	6.22	5.28	4.38	3.42	1.96
5	9		80	7.24	8.66	8.17	7.18	6.89	6.47	5.99	4.37
6	7		64	4.50		6.56	5.50	4.53	3.78	3.13	1.73
7	7		60	4.19		6.29	5.19	4.42	3.74	3.10	2.09
8	8		57	4.58		7.22	5.72	4.44	3.36	2.64	1.65
9	10		70	7.01	9.67	8.82	7.25	5.94	5.23	4.16	1.87
10	13		53	6.87		12.10	10.04	7.86	5.14	3.56	1.35
	<b>75</b>		<b>66</b>	<b>49.37</b>		<b>68.53</b>	<b>58.15</b>	<b>49.71</b>	<b>41.76</b>	<b>35.05</b>	<b>22.22</b>