

Centre No.						Paper Reference						Surname	Initial(s)	
Candidate No.						6	6	6	4	/	0	1	Signature	

Paper Reference(s)

6664/01

Edexcel GCE

Core Mathematics C2

Advanced Subsidiary

Tuesday 10 January 2006 – Afternoon

Time: 1 hour 30 minutes

Examiner's use only

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Team Leader's use only

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[illegible]

Materials required for examination

Mathematical Formulae (Green)

Items included with question papers

Nil

Candidates may use any calculator EXCEPT those with the facility for symbolic algebra, differentiation and/or integration. Thus candidates may NOT use calculators such as the Texas Instruments TI 89, TI 92, Casio CFX 9970G, Hewlett Packard HP 48G.

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.

Check that you have the correct question paper.

You must write your answer for each question in the space following the question.

When a calculator is used, the answer should be given to an appropriate degree of accuracy.

Information for Candidates

A booklet ‘Mathematical Formulae and Statistical Tables’ is provided.

Full marks may be obtained for answers to ALL questions.

The marks for individual questions and the parts of questions are shown in round brackets: e.g. (2).

There are 9 questions in this question paper. The total mark for this paper is 75.

There are 20 pages in this question paper. Any blank pages are indicated.

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.

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Given that $f(1) = 0$,

(a) find the value of c ,

(2)

(b) factorise $f(x)$ completely,

(4)

(c) find the remainder when $f(x)$ is divided by $(2x - 3)$.

(2)



Question number	Scheme	Marks
1.	<p>(a) $2+1-5 + c = 0$ or $-2 + c = 0$</p> <p>$\underline{c = 2}$</p> <p>(b) $f(x) = (x-1)(2x^2 + 3x - 2)$ (x - 1)</p> <p style="text-align: right;">division</p> <p>$= \dots \underline{(2x-1)(x+2)}$</p> <p>(c) $f\left(\frac{3}{2}\right) = 2 \times \frac{27}{8} + \frac{9}{4} - \frac{15}{2} + c$</p> <p>Remainder = $c + 1.5$ $= \underline{3.5}$ ft their c</p>	<p>M1</p> <p>A1 (2)</p> <p>B1</p> <p>M1</p> <p>M1 A1 (4)</p> <p>M1</p> <p>A1ft (2)</p> <p>Total 8 marks</p>
2.	<p>(a) $(1+px)^9 = 1+9px ; + \binom{9}{2}(px)^2$</p> <p>(b) $9p = 36$, so $\underline{p=4}$</p> <p>$q = \frac{9 \times 8}{2} p^2$ or $36p^2$ or $36p$ if that follows from their (a)</p> <p>So $\underline{q=576}$</p>	<p>B1 B1 (2)</p> <p>M1 A1</p> <p>M1</p> <p>A1cao (4)</p> <p>Total 6 marks</p>
3.	<p>(a) $(AB)^2 = (4-3)^2 + (5)^2$ [= 26]</p> <p>$\underline{AB = \sqrt{26}}$</p> <p>(b) $p = \left(\frac{4+3}{2}, \frac{5}{2}\right)$</p> <p>$= \underline{\left(\frac{7}{2}, \frac{5}{2}\right)}$</p> <p>(c) $(x-x_p)^2 + (y-y_p)^2 = \left(\frac{AB}{2}\right)^2$ LHS</p> <p>$(x-3.5)^2 + (y-2.5)^2 = 6.5$ RHS</p> <p style="text-align: right;">oe</p>	<p>M1</p> <p>A1 (2)</p> <p>M1</p> <p>A1 (2)</p> <p>M1</p> <p>M1</p> <p>A1 c.a.o (3)</p> <p>Total 7 marks</p>

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- $$(1 + px)^9,$$

where p is a constant.

(2)

(b) Find the value of p and the value of q .

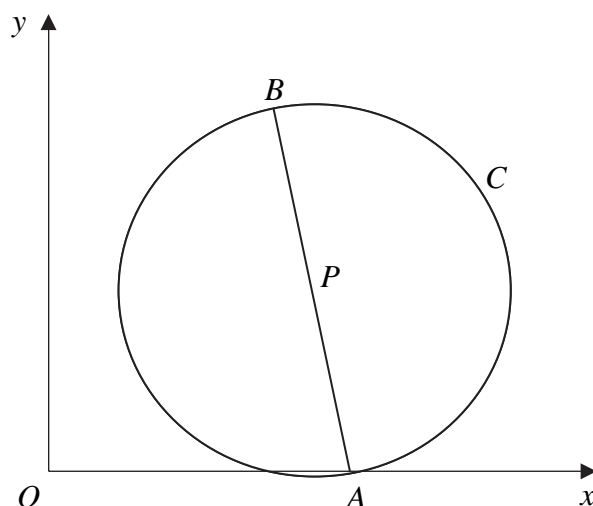
(4)



Question number	Scheme	Marks
1.	<p>(a) $2+1-5 + c = 0$ or $-2 + c = 0$</p> <p>$\underline{c = 2}$</p> <p>(b) $f(x) = (x-1)(2x^2+3x-2)$ (x-1)</p> <p style="text-align: right;">division</p> <p>$= \dots \underline{(2x-1)(x+2)}$</p> <p>(c) $f\left(\frac{3}{2}\right) = 2 \times \frac{27}{8} + \frac{9}{4} - \frac{15}{2} + c$</p> <p>Remainder = $c + 1.5$ $= \underline{3.5}$ ft their c</p>	<p>M1</p> <p>A1 (2)</p> <p>B1</p> <p>M1</p> <p>M1 A1 (4)</p> <p>M1</p> <p>A1ft (2)</p> <p>Total 8 marks</p>
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Figure 1



Find

- (a) the exact length of AB , (2)
- (b) the coordinates of the midpoint P of AB , (2)
- (c) an equation for the circle C . (3)



Question number	Scheme	Marks
1.	<p>(a) $2+1-5 + c = 0$ or $-2 + c = 0$ $\underline{c = 2}$</p> <p>(b) $f(x) = (x-1)(2x^2+3x-2)$ (x-1) <div style="text-align: right;">division</div> $= \dots \underline{(2x-1)(x+2)}$</p> <p>(c) $f\left(\frac{3}{2}\right) = 2 \times \frac{27}{8} + \frac{9}{4} - \frac{15}{2} + c$</p> <p>Remainder = $c + 1.5$ $= \underline{3.5}$ ft their c</p>	<p>M1 A1 (2)</p> <p>B1 M1 M1 A1 (4)</p> <p>M1</p> <p>A1ft (2)</p> <p>Total 8 marks</p>
2.	<p>(a) $(1+px)^9 = 1+9px; + \binom{9}{2}(px)^2$</p> <p>(b) $9p = 36$, so $\underline{p=4}$ $q = \frac{9 \times 8}{2} p^2$ or $36p^2$ or $36p$ if that follows from their (a)</p> <p>So $\underline{q=576}$</p>	<p>B1 B1 (2)</p> <p>M1 A1 M1 A1cao (4)</p> <p>Total 6 marks</p>
3.	<p>(a) $(AB)^2 = (4-3)^2 + (5)^2$ [= 26] $\underline{AB = \sqrt{26}}$</p> <p>(b) $p = \left(\frac{4+3}{2}, \frac{5}{2}\right)$ $= \underline{\left(\frac{7}{2}, \frac{5}{2}\right)}$</p> <p>(c) $(x-x_p)^2 + (y-y_p)^2 = \left(\frac{AB}{2}\right)^2$ LHS RHS $(x-3.5)^2 + (y-2.5)^2 = 6.5$ oe</p>	<p>M1 A1 (2)</p> <p>M1 A1 (2)</p> <p>M1 M1 A1 c.a.o (3)</p> <p>Total 7 marks</p>

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- (d) Calculate the smallest possible value of n . (4)

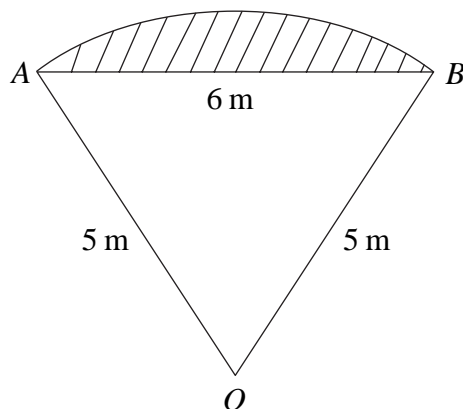


Question number	Scheme	Marks
4.	<p>(a) $\frac{a}{1-r} = 480$ $\frac{120}{1-r} = 480 \Rightarrow 120 = 480(1-r)$ $1-r = \frac{1}{4} \Rightarrow \underline{r = \frac{3}{4}} \quad *$</p> <p>(b) $u_5 = 120 \times \left(\frac{3}{4}\right)^4 [= 37.96875]$ $u_6 = 120 \times \left(\frac{3}{4}\right)^5 [= 28.4765625]$ Difference = <u>9.49</u> (allow \pm)</p> <p>(c) $S_7 = \frac{120(1-(0.75)^7)}{1-0.75}$ $= 415.9277\dots$ (AWRT) <u>416</u></p> <p>(d) $\frac{120(1-(0.75)^n)}{1-0.75} > 300$ $1-(0.75)^n > \frac{300}{480}$ (or better) $n > \frac{\log(0.375)}{\log(0.75)}$ (=3.409...) <u>$n = 4$</u></p>	<p>M1</p> <p>M1</p> <p>A1cso (3)</p> <p>either M1</p> <p>(allow \pm) A1 (2)</p> <p>M1</p> <p>A1 (2)</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>(=3.409...)</p> <p>A1cso (4)</p> <p>Total 11 marks</p>
5.	<p>(a) $\cos \hat{A}OB = \frac{5^2 + 5^2 - 6^2}{2 \times 5 \times 5}$ or $\sin \theta = \frac{3}{5}$ with use of $\cos 2\theta = 1 - 2\sin^2 \theta$ attempted $= \frac{7}{25} \quad *$</p> <p>(b) $\hat{A}OB = 1.2870022\dots$ radians 1.287 or better</p> <p>(c) Sector $= \frac{1}{2} \times 5^2 \times (b)$, $= 16.087\dots$ (AWRT) <u>16.1</u></p> <p>(d) Triangle $= \frac{1}{2} \times 5^2 \times \sin(b)$ or $\frac{1}{2} \times 6 \times \sqrt{5^2 - 3^2}$ Segment = (their sector) – their triangle = (sector from c) – 12 = (AWRT) <u>4.1</u> (ft their part(c))</p>	<p>M1</p> <p>A1cso (2)</p> <p>B1 (1)</p> <p>M1 A1 (2)</p> <p>M1</p> <p>dM1</p> <p>A1ft (3)</p>

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5.

Figure 2



In Figure 2 OAB is a sector of a circle radius 5 m. The chord AB is 6 m long.

- (a) Show that $\cos \hat{AOB} = \frac{7}{25}$. (2)
- (b) Hence find the angle \hat{AOB} in radians, giving your answer to 3 decimal places. (1)
- (c) Calculate the area of the sector OAB . (2)
- (d) Hence calculate the shaded area. (3)



Question number	Scheme	Marks
4.	<p>(a) $\frac{a}{1-r} = 480$ $\frac{120}{1-r} = 480 \Rightarrow 120 = 480(1-r)$ $1-r = \frac{1}{4} \Rightarrow \underline{r = \frac{3}{4}} \quad *$</p> <p>(b) $u_5 = 120 \times \left(\frac{3}{4}\right)^4 [= 37.96875]$ $u_6 = 120 \times \left(\frac{3}{4}\right)^5 [= 28.4765625]$ Difference = <u>9.49</u> (allow \pm)</p> <p>(c) $S_7 = \frac{120(1-(0.75)^7)}{1-0.75}$ $= 415.9277...$ (AWRT) <u>416</u></p> <p>(d) $\frac{120(1-(0.75)^n)}{1-0.75} > 300$ $1-(0.75)^n > \frac{300}{480}$ (or better) $n > \frac{\log(0.375)}{\log(0.75)}$ (=3.409...) <u>$n = 4$</u></p>	<p>M1</p> <p>M1</p> <p>A1cso (3)</p> <p>either M1</p> <p>(allow \pm) A1 (2)</p> <p>M1</p> <p>A1 (2)</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>(=3.409...)</p> <p>A1cso (4)</p> <p>Total 11 marks</p>
5.	<p>(a) $\cos \hat{A}OB = \frac{5^2 + 5^2 - 6^2}{2 \times 5 \times 5}$ or $\sin \theta = \frac{3}{5}$ with use of $\cos 2\theta = 1 - 2\sin^2 \theta$ attempted $= \frac{7}{25} \quad *$</p> <p>(b) $\hat{A}OB = 1.2870022...$ radians 1.287 or better</p> <p>(c) Sector $= \frac{1}{2} \times 5^2 \times (b)$, $= 16.087...$ (AWRT) <u>16.1</u></p> <p>(d) Triangle $= \frac{1}{2} \times 5^2 \times \sin(b)$ or $\frac{1}{2} \times 6 \times \sqrt{5^2 - 3^2}$ Segment = (their sector) – their triangle = (sector from c) – 12 = (AWRT) <u>4.1</u> (ft their part(c))</p>	<p>M1</p> <p>A1cso (2)</p> <p>B1 (1)</p> <p>M1 A1 (2)</p> <p>M1</p> <p>dM1</p> <p>A1ft (3)</p>

6. The speed, $v \text{ m s}^{-1}$, of a train at time t seconds is given by

$$v = \sqrt[3]{(1.2^t - 1)}, \quad 0 \leq t \leq 30.$$

The following table shows the speed of the train at 5 second intervals.

t	0	5	10	15	20	25	30
v	0	1.22	2.28		6.11		

- (a) Complete the table, giving the values of v to 2 decimal places.

(3)

The distance, s metres, travelled by the train in 30 seconds is given by

$$s = \int_0^{30} \sqrt{1.2^t - 1} dt .$$

- (b) Use the trapezium rule, with all the values from your table, to estimate the value of s .

(3)



Question number	Scheme	Marks
6.	<p>(a) $t = 15 \quad 25 \quad 30$ $v = \underline{3.80 \quad 9.72 \quad 15.37}$</p> <p>(b) $S \approx \frac{1}{2} \times 5; [0 + 15.37 + 2(1.22 + 2.28 + 3.80 + 6.11 + 9.72)]$ $= \frac{5}{2} [61.63] = 154.075 = \text{AWRT } \underline{154}$</p>	<p>B1 B1 B1 (3)</p> <p>B1 [M1]</p> <p>A1 (3)</p> <p>Total 6 marks</p>

7.	<p>(a) $\frac{dy}{dx} = 6x^2 - 10x - 4$</p> <p>(b) $6x^2 - 10x - 4 = 0$ $2(3x + 1)(x - 2) [=0]$ $\underline{x = 2 \text{ or } -\frac{1}{3}} \quad (\text{both } x \text{ values})$ Points are $(2, \underline{-10})$ and $(-\frac{1}{3}, 2\frac{19}{27} \text{ or } \frac{73}{27} \text{ or } 2.70 \text{ or better})$ (both y values)</p> <p>(c) $\frac{d^2y}{dx^2} = 12x - 10$</p> <p>(d) $x = 2 \Rightarrow \frac{d^2y}{dx^2} (=14) \geq 0 \therefore [(2, -10)]$ is a <u>Min</u> $x = -\frac{1}{3} \Rightarrow \frac{d^2y}{dx^2} (= -14) \leq 0 \therefore [(-\frac{1}{3}, \frac{73}{27})]$ is a <u>Max</u></p>	<p>M1 A1 (2)</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>A1 (4)</p> <p>M1 A1 (2)</p> <p>M1</p> <p>A1 (2)</p> <p>Total 10 marks</p>
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(a) Find $\frac{dy}{dx}$. (2)

(b) Using the result from part (a), find the coordinates of the turning points of C . (4)

(c) Find $\frac{d^2y}{dx^2}$.

(d) Hence, or otherwise, determine the nature of the turning points of C . (2)



Question number	Scheme	Marks
6.	<p>(a) $t = 15 \quad 25 \quad 30$ $v = 3.80 \quad 9.72 \quad 15.37$</p> <p>(b) $S \approx \frac{1}{2} \times 5; [0 + 15.37 + 2(1.22 + 2.28 + 3.80 + 6.11 + 9.72)]$ $= \frac{5}{2} [61.63] = 154.075 = \text{AWRT } 154$</p>	<p>B1 B1 B1 (3)</p> <p>B1 [M1]</p> <p>A1 (3)</p> <p>Total 6 marks</p>

7.	<p>(a) $\frac{dy}{dx} = 6x^2 - 10x - 4$</p> <p>(b) $6x^2 - 10x - 4 = 0$ $2(3x + 1)(x - 2) [=0]$ $x = 2 \text{ or } -\frac{1}{3}$ (both x values)</p> <p>Points are (2, -10) and $(-\frac{1}{3}, 2\frac{19}{27} \text{ or } \frac{73}{27} \text{ or } 2.70 \text{ or better})$ (both y values)</p> <p>(c) $\frac{d^2y}{dx^2} = 12x - 10$</p> <p>(d) $x = 2 \Rightarrow \frac{d^2y}{dx^2} (=14) \geq 0 \therefore [(2, -10)]$ is a <u>Min</u></p> <p>$x = -\frac{1}{3} \Rightarrow \frac{d^2y}{dx^2} (= -14) \leq 0 \therefore [(-\frac{1}{3}, \frac{73}{27})]$ is a <u>Max</u></p>	<p>M1 A1 (2)</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>A1 (4)</p> <p>M1 A1 (2)</p> <p>M1</p> <p>A1 (2)</p> <p>Total 10 marks</p>
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8. (a) Find all the values of θ , to 1 decimal place, in the interval $0^\circ \leq \theta < 360^\circ$ for which

$$5 \sin(\theta + 30^\circ) = 3.$$

(4)



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Question 8 continued

(b) Find all the values of θ , to 1 decimal place, in the interval $0^\circ \leq \theta < 360^\circ$ for which

$$\tan^2 \theta = 4.$$

(5)

Q8

(Total 9 marks)



Question number	Scheme	Marks
8.	<p>(a) $\sin(\theta + 30) = \frac{3}{5}$ ($\frac{3}{5}$ on RHS)</p> <p>$\theta + 30 = 36.9$ ($\alpha = \text{AWRT } 37$)</p> <p>or $\theta = 143.1$ ($180 - \alpha$)</p> <p><u>$\theta = 6.9, 113.1$</u></p> <p>(b) $\tan \theta = \pm 2$ or $\sin \theta = \pm \frac{2}{\sqrt{5}}$ or $\cos \theta = \pm \frac{1}{\sqrt{5}}$</p> <p>$(\tan \theta = 2 \Rightarrow) \theta = \underline{63.4}$ ($\beta = \text{AWRT } 63.4$)</p> <p>or $\theta = \underline{243.4}$ ($180 + \beta$)</p> <p>$(\tan \theta = -2 \Rightarrow) \theta = \underline{116.6}$ ($180 - \beta$)</p> <p>or $\theta = \underline{296.6}$ ($180 + \text{their } 116.6$)</p>	<p>B1</p> <p>B1</p> <p>M1</p> <p>A1cao (4)</p> <p>B1</p> <p>B1</p> <p>M1</p> <p>M1</p> <p>M1 (5)</p> <p>Total 9 marks</p>

9.

Figure 3

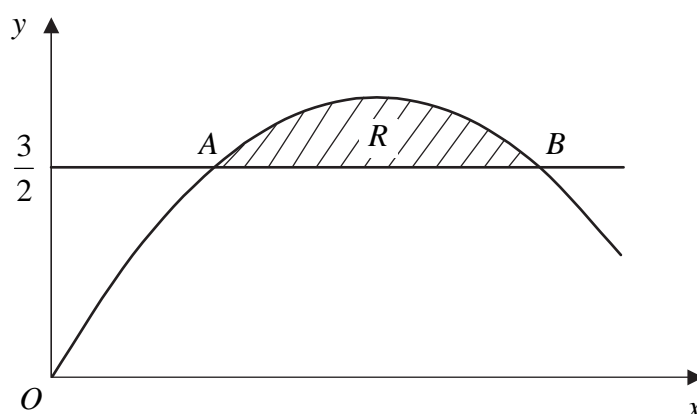


Figure 3 shows the shaded region R which is bounded by the curve $y = -2x^2 + 4x$ and the line $y = \frac{3}{2}$. The points A and B are the points of intersection of the line and the curve.

(a) the x -coordinates of the points A and B ,

(4)

(b) the exact area of R .

(6)



Question number	Scheme	Marks
9.	<p>(a) $\frac{3}{2} = -2x^2 + 4x$</p> <p>$4x^2 - 8x + 3 (= 0)$</p> <p>$(2x - 1)(2x - 3) = 0$</p> <p><u>$x = \frac{1}{2}, \frac{3}{2}$</u></p> <p>(b) Area of $R = \int_{\frac{1}{2}}^{\frac{3}{2}} (-2x^2 + 4x) \, dx - \frac{3}{2}$ (for $-\frac{3}{2}$)</p> <p>$\int (-2x^2 + 4x) \, dx = \left[-\frac{2}{3}x^3 + 2x^2 \right]$ (Allow $\pm [\]$, accept $\frac{4}{2}x^2$)</p> <p>$\int_{\frac{1}{2}}^{\frac{3}{2}} (-2x^2 + 4x) \, dx = \left(-\frac{2}{3} \times \frac{3^3}{2^3} + 2 \times \frac{3^2}{2^2} \right) - \left(-\frac{2}{3} \times \frac{1}{2^3} + 2 \times \frac{1}{2^2} \right)$</p> <p>$\left(= \frac{11}{6} \right)$</p> <p>Area of $R = \frac{11}{6} - \frac{3}{2} = \frac{1}{3}$ (Accept exact equivalent but not 0.33...)</p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1 (4)</p> <p>B1</p> <p>M1 [A1]</p> <p>M1 M1</p> <p>A1cao (6)</p> <p>Total 10 marks</p>