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

Monday 10 January 2011 – Morning

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total	

Materials required for examination	Items included with question papers
Mathematical Formulae (Pink)	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 formulae stored in them.

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and signature.
Check that you have the correct question paper.
Answer ALL the questions.
You must write your answer to 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 10 questions in this question paper. The total mark for this paper is 75.
There are 28 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 should show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.

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1. $$f(x) = x^4 + x^3 + 2x^2 + ax + b$$

where a and b are constants.

When $f(x)$ is divided by $(x - 1)$, the remainder is 7.

(a) Show that $a + b = 3$.

(2)

When $f(x)$ is divided by $(x + 2)$, the remainder is -8.

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

(5)

a/ $f(1) = 7$

$(1)^4 + (1)^3 + 2(1)^2 + a(1) + b = 7$

$4 + a + b = 7$

$a + b = 3$

b/ $f(-2) = -8$

$(-2)^4 + (-2)^3 + 2(-2)^2 + a(-2) + b = -8$

$16 - 8 + 8 - 2a + b = -8$

$16 - 2a + b = -8$

$-2a + b = -24$

$a + b = 3$

$-2a + b = -24$

$3a = 27$

$a = 9$

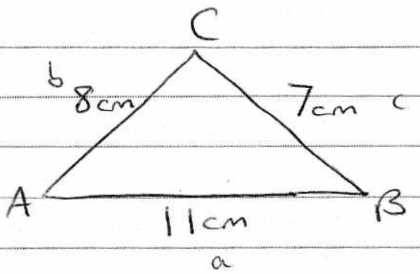
$b = -6$

Leave blank

2. 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)



a) $\cos A = \dfrac{b^2 + c^2 - a^2}{2bc}$

$= \dfrac{(8)^2 + (7)^2 - (11)^2}{2(8)(\cancel{11}\,7)}$

$\cos A = \cancel{-\frac{1}{22}}\ -\frac{1}{14}$

$A = 1.64^c\ (3sf)$

b) Area $= \frac{1}{2}ab\sin C$

$= \frac{1}{2}(8)(7)\sin(1.64)$

$= \cancel{27.97105947}\ \cancel{27.92}$

$= \cancel{28.0\ \text{cm}^2\ (3sf)}$

$= 27.92848609$

$= 27.9\ \text{cm}^2\ (3sf)$

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3. The second and fifth terms of a geometric series are 750 and –6 respectively.

Find

(a) the common ratio of the series, **(3)**

(b) the first term of the series, **(2)**

(c) the sum to infinity of the series. **(2)**

$$U_n = ar^{n-1}$$

a) $U_2 = ar = 750$

$U_5 = ar^4 = -6$

$$r^3 = -\frac{1}{125}$$

$$\underline{r = -\frac{1}{5}}$$

b) $a\left(-\frac{1}{5}\right) = 750$

$$\underline{a = -3750}$$

c)
$$S_\infty = \frac{a}{1-r}$$

$$= \frac{-3750}{1-\left(-\frac{1}{5}\right)}$$

$$= \underline{-3125}$$

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4.

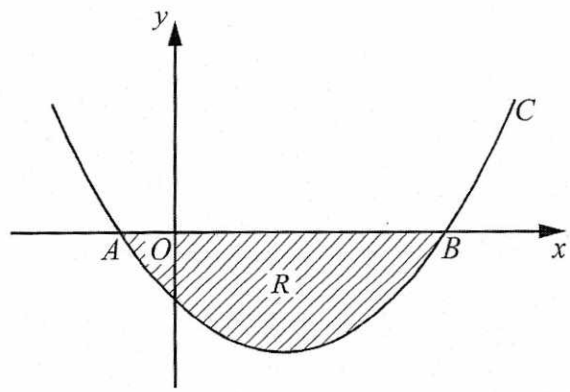

Figure 1

Figure 1 shows a sketch of part of the curve C with equation

$$y = (x+1)(x-5)$$

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

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

(1)

The finite region R, shown shaded in Figure 1, is bounded by C and the x-axis.

(b) Use integration to find the area of R.

(6)

a) crosses x when $y=0$

$0 = (x+1)(x-5)$

$x=-1 \quad x=5$

$(-1,0) \quad (5,0)$

b) $\displaystyle\int_{-1}^{5} (x+1)(x-5) \; dx$

$\displaystyle\int_{-1}^{5} x^2 - 5x + x - 5 \; dx$

$\displaystyle\int_{-1}^{5} x^2 - 4x - 5 \; dx$

$\left[\frac{x^3}{3} - \frac{4x^2}{2} - 5x + c \right]_{-1}^{5}$

Leave blank

Question 4 continued

$$\left[\frac{x^3}{3} - 2x^2 - 5x + c\right]_{-1}^{5}$$

$$\left[\frac{(5)^3}{3} - 2(5)^2 - 5(5)\right] - \left[\frac{(-1)^3}{3} - 2(-1)^2 - 5(-1)\right]$$

$= 36$ units^2

Q4

(Total 7 marks)

5. Given that $\binom{40}{4} = \frac{40!}{4!b!}$,

(a) write down the value of b.

(1)

In the binomial expansion of $(1+x)^{40}$, the coefficients of x^4 and x^5 are p and q respectively.

(b) Find the value of $\frac{q}{p}$.

(3)

a) 36

b) coefficient of $x^4 = \binom{40}{4} = 91390$

$x^5 = \binom{40}{5} = 658008$

$\frac{658008}{91390} = \underline{\underline{7.2}}$

Leave blank

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6. $$y = \frac{5}{3x^2 - 2}$$

(a) Complete the table below, giving the values of y to 2 decimal places.

x	2	2.25	2.5	2.75	3
y	0.5	0.38	0.30	0.24	0.2

(2)

(b) Use the trapezium rule, with all the values of y from your table, to find an approximate value for $\int_2^3 \frac{5}{3x^2 - 2}\,dx$.

(4)

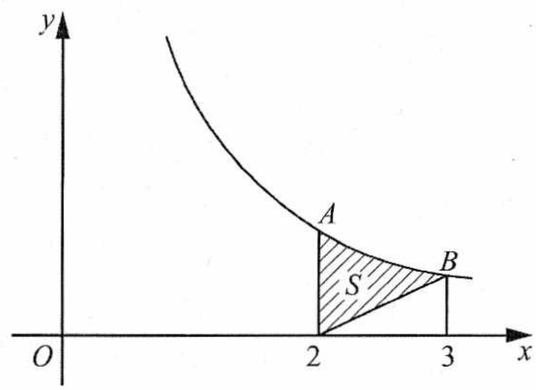


Figure 2

Figure 2 shows a sketch of part of the curve with equation $y = \frac{5}{3x^2 - 2}$, $x > 1$.

At the points A and B on the curve, $x = 2$ and $x = 3$ respectively.

The region S is bounded by the curve, the straight line through B and (2, 0), and the line through A parallel to the y-axis. The region S is shown shaded in Figure 2.

(c) Use your answer to part (b) to find an approximate value for the area of S.

(3)

b/ $0.25\left(\frac{0.5}{2} + 0.38 + 0.30 + 0.24 + \frac{0.2}{2}\right)$

$= 0.3175$ units^2

c/ Area of triangle $= \frac{1}{2}(1)(0.2)$

$= 0.1$

$0.3175 - 0.1 = 0.2175$ units^2

Leave blank

7. (a) Show that the equation

$$3\sin^2 x + 7\sin x = \cos^2 x - 4$$

can be written in the form

$$4\sin^2 x + 7\sin x + 3 = 0$$

(2)

(b) Hence solve, for $0 \leqslant x < 360°$,

$$3\sin^2 x + 7\sin x = \cos^2 x - 4$$

giving your answers to 1 decimal place where appropriate.

(5)

$\sin^2 x + \cos^2 x = 1$

$\cos^2 x = 1 - \sin^2 x$

a/ $3\sin^2 x + 7\sin x = (1 - \sin^2 x) - 4$

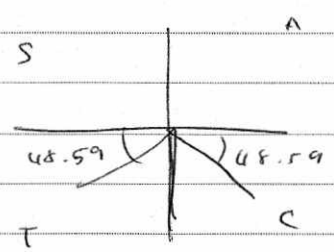
$3\sin^2 x + 7\sin x = -\sin^2 x - 3$

$4\sin^2 x + 7\sin x + 3 = 0$

b/ $(4\sin x + 3)(\sin x + 1) = 0$

$\sin x = -3/4 \qquad \sin x = -1$

$x = -48.59 \qquad x = -90$



$x = 228.6°,\ 270°,\ 311.4°$

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8. (a) Sketch the graph of $y = 7^x$, $x \in \mathbb{R}$, showing the coordinates of any points at which the graph crosses the axes.

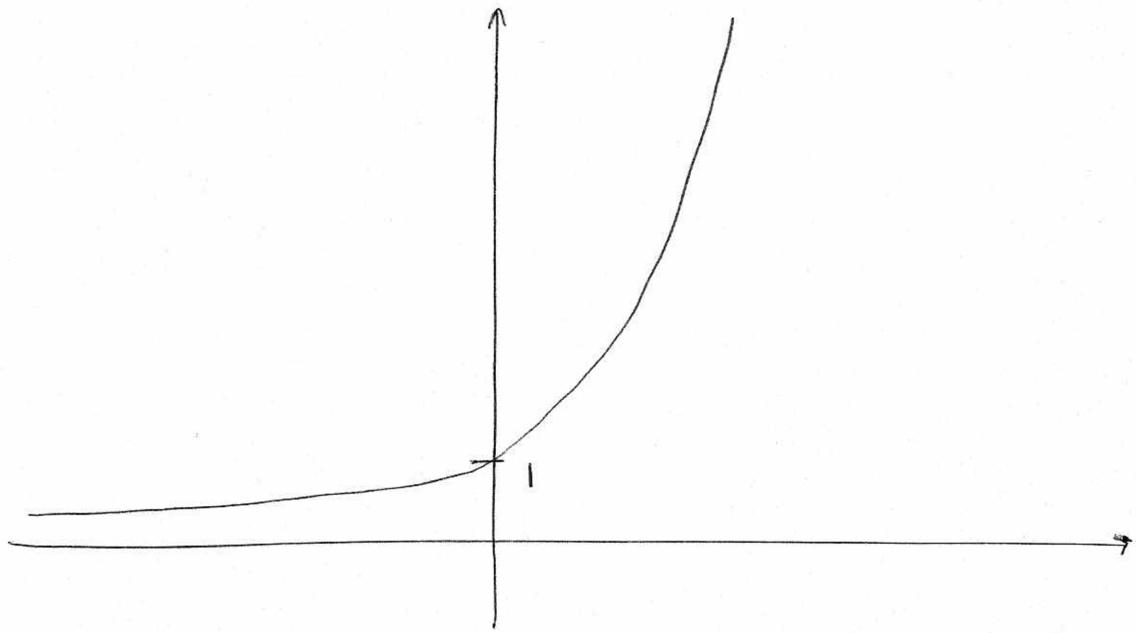
(2)

(b) Solve the equation

$$7^{2x} - 4(7^x) + 3 = 0$$

giving your answers to 2 decimal places where appropriate.

(6)



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Question 8 continued

b/ $7^{2x} - 4(7^{x}) + 3 = 0$

$(7^{x} - 3)(7^{x} - 1) = 0$

$7^{x} = 3 \qquad 7^{x} = 1$

$x = \log_7 3 \qquad \underline{\underline{x = 0}}$

$\underline{\underline{x = 0.56}}$ 2dp

Leave blank

9. The points A and B have coordinates $(-2, 11)$ and $(8, 1)$ respectively.

Given that AB is a diameter of the circle C,

(a) show that the centre of C has coordinates $(3, 6)$,

(1)

(b) find an equation for C.

(4)

(c) Verify that the point $(10, 7)$ lies on C.

(1)

(d) Find an equation of the tangent to C at the point $(10, 7)$, giving your answer in the form $y = mx + c$, where m and c are constants.

(4)

a/ centre or circle is the diameter's midpoint

$\left(\frac{-2+8}{2}, \frac{11+1}{2}\right)$

$(3, 6)$

b/ $(x-3)^2 + (y-6)^2 = r^2$ $\quad \overset{x\ \ y}{(8, 1)}$

$(8-3)^2 + (1-6)^2 = r^2$

$(5)^2 + (-5)^2 = r^2$

$50 = r^2$

$r = \sqrt{50}$

$\underline{(x-3)^2 + (y-6)^2 = 50}$

c/ $\overset{x\ \ y}{(10, 7)}$

$(10-3)^2 + (7-6)^2 = 50$

$49 + 1 = 50$

$\underline{50 = 50}$

$\therefore (10, 7)$ lies on C.

Leave blank

Question 9 continued

d/ centre $\overset{x_1\ y_1}{(3,6)}$ $\overset{x_2\ y_2}{(10,7)}$

$m = \dfrac{y_2 - y_1}{x_2 - x_1}$

$= \dfrac{7-6}{10-3} = \dfrac{1}{7}$

tangent at (10,7) is perpendicular to radius.

$\therefore\ m = -7$

$y = -7x + c$ $\overset{x\ \ y}{(10,7)}$

$7 = -7(10) + c$

$7 = -70 + c$

$77 = c$

$\underline{y = -7x + 77}$

Leave blank

10. The volume V cm^3 of a box, of height x cm, is given by

$$V = 4x(5-x)^2, \quad 0 < x < 5$$

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

(4)

(b) Hence find the maximum volume of the box.

(4)

(c) Use calculus to justify that the volume that you found in part (b) is a maximum.

(2)

a/ $V = 4x(5-x)^2$

$= 4x(5-x)(5-x)$

$= 4x(25-5x-5x+x^2)$

$= 4x(25-10x+x^2)$

$= 100x - 40x^2 + 4x^3$

$\frac{dv}{dx} = 100 - 80x + 12x^2$

b/ Maximum value is where $\frac{dv}{dx} = 0$

$100 - 80x + 12x^2 = 0$

$25 - 20x + 3x^2 = 0$

$3x^2 - 20x + 25 = 0$

$(3x-5)(x-5) = 0$

$x = 5/3 \quad x = 5$

$0 < x < 5 \quad \therefore \quad x = 5/3.$

$V = 4(5/3)(5 - 5/3)^2$

$= 74.074$ cm^3

$= 74.1$ cm^3 (3sf)

c/ $\frac{d^2V}{dx^2} = -80 + 24x$

$= -80 + 24(5/3)$

$= -40$

$\frac{d^2v}{dx^2}$ is negative $\therefore$ it is a Maximum