Write your name here

Surname	Other names

Pearson Edexcel GCE

Centre Number	Candidate Number

Core Mathematics C2

Advanced Subsidiary

Wednesday 24 May 2017 – Morning
Time: 1 hour 30 minutes

Paper Reference
6664/01

You must have:
Mathematical Formulae and Statistical Tables (Pink)

Total Marks

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

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B). Coloured pencils and highlighter pens must not be used.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- When a calculator is used, the answer should be given to an appropriate degree of accuracy.

Information

- The total mark for this paper is 75.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

Pearson

Leave blank

1. Find the first 4 terms, in ascending powers of x, of the binomial expansion of

$$\left(3-\frac{1}{3}x\right)^5$$

giving each term in its simplest form.

(4)

1 , 5 , 10 , 10

$1(3)^5 + 5(3)^4\left(-\frac{1}{3}x\right) + 10(3)^3\left(-\frac{1}{3}x\right)^2 + 10(3)^2\left(-\frac{1}{3}x\right)^3$

$243 - 135x + 30x^2 - \frac{10}{3}x^3$

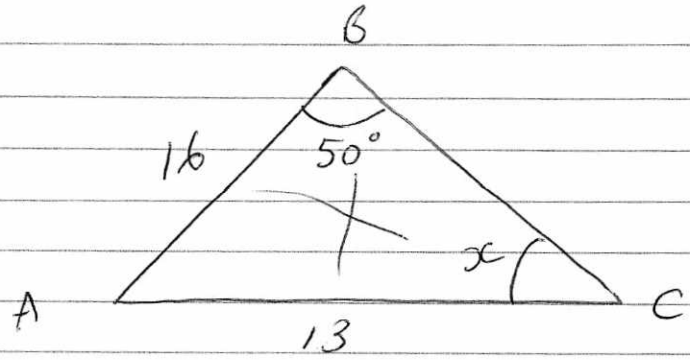
DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

Leave blank

2. In the triangle ABC, $AB = 16$ cm, $AC = 13$ cm, angle $ABC = 50°$ and angle $BCA = x°$

Find the two possible values for x, giving your answers to one decimal place.

(4)



$$\frac{\sin x}{16} = \frac{\sin 50}{13}$$

$$\sin x = \frac{\sin 50}{13} \times 16$$

$$= 0.94282393$$

$$x = \sin^{-1}(\text{Ans})$$

$$= \underline{\underline{70.5°}}, \ \underline{\underline{109.5°}}$$

[the second answer is 180 − Ans]

P 4 4 8 2 4 A 0 4 3 2

Leave blank

3. (a) $$y = 5^x + \log_2(x+1), \quad 0 \leqslant x \leqslant 2$$

Complete the table below, by giving the value of y when $x = 1$

x	0	0.5	1	1.5	2
y	1	2.821	6	12.502	26.585

(1)

(b) Use the trapezium rule, with all the values of y from the completed table, to find an approximate value for

$$\int_0^2 (5^x + \log_2(x+1))\,dx$$

giving your answer to 2 decimal places.

(4)

(c) Use your answer to part (b) to find an approximate value for

$$\int_0^2 (5 + 5^x + \log_2(x+1))\,dx$$

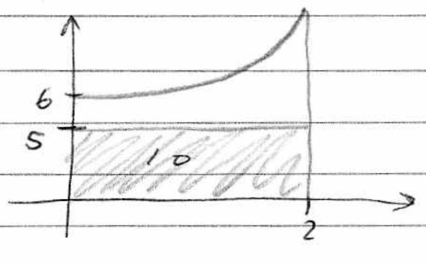
giving your answer to 2 decimal places.

(1)

b/ $0.5\left(\frac{1}{2} + 2.821 + 6 + 12.502 + \frac{26.585}{2}\right)$

$= 17.56$

c/ Moving graph up by 5 will create a rectangle. $5 \times 2 = 10$



$10 + 17.56 = 27.56$

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

Leave blank

4.

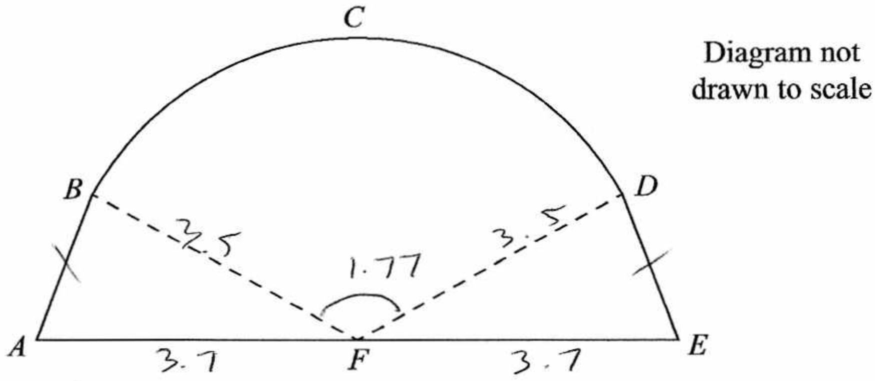


Figure 1

Figure 1 is a sketch representing the cross-section of a large tent *ABCDEF*.
AB and *DE* are line segments of equal length.
Angle *FAB* and angle *DEF* are equal.
F is the midpoint of the straight line *AE* and *FC* is perpendicular to *AE*.
BCD is an arc of a circle of radius 3.5 m with centre at *F*.
It is given that

$$AF = FE = 3.7\text{m}$$
$$BF = FD = 3.5\text{m}$$
$$\text{angle } BFD = 1.77 \text{ radians}$$

Find

(a) the length of the arc *BCD* in metres to 2 decimal places, **(2)**

(b) the area of the sector *FBCD* in m^2 to 2 decimal places, **(2)**

(c) the total area of the cross-section of the tent in m^2 to 2 decimal places. **(4)**

a/ Arc length $= r\theta$
$= 3.5(1.77)$
$= 6.20\text{m}(2\text{dp})$

b/ ~~Section A~~
Sector Area $= \frac{1}{2}\theta r^2$
$= \frac{1}{2}(1.77)(3.5)^2$
$= 10.84 \ m^2$

P 4 4 8 2 4 A 0 1 0 3 2

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

Leave blank

Question 4 continued

c/ $\hat{BFA} = \frac{\pi - 1.77}{2}$

$= \underline{0.686}$

Triangle area $= \frac{1}{2} ab \sin C$

$= \frac{1}{2}(3.7)(3.5)\sin(\text{"}0.686\text{"})$

$= 4.10 \text{ m}^2$

~~Two t~~

Total Area $= \text{"}10.84\text{"} + 2(\text{"}4.10\text{"})$

$= \underline{\underline{19.04 \text{ m}^2}}$

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

P 4 4 8 2 4 A 0 1 1 3 2

5. The circle C has equation

$$x^2 + y^2 - 10x + 6y + 30 = 0$$

Find

(a) the coordinates of the centre of C,

(2)

(b) the radius of C,

(2)

(c) the y coordinates of the points where the circle C crosses the line with equation $x = 4$, giving your answers as simplified surds.

(3)

Leave blank

a/ $x^2 - 10x + y^2 + 6y + 30 = 0$

$(x-5)^2 - 25 + (y+3)^2 - 9 + 30 = 0$

$(x-5)^2 + (y+3)^2 - 4 = 0$

$(x-5)^2 + (y+3)^2 = 4$

centre $(5, -3)$

b/ radius $= \sqrt{4}$

$= \underline{2}$

c/ $x = 4$

$(4-5)^2 + (y+3)^2 = 4$

$1 + (y+3)^2 = 4$

$(y+3)^2 = 3$

$y + 3 = \pm\sqrt{3}$

$y = -3 \pm \sqrt{3}$

$\underline{-3 + \sqrt{3}}$ and $\underline{-3 - \sqrt{3}}$

6. $$f(x) = -6x^3 - 7x^2 + 40x + 21$$

(a) Use the factor theorem to show that $(x + 3)$ is a factor of $f(x)$ **(2)**

(b) Factorise $f(x)$ completely. **(4)**

(c) Hence solve the equation

$$6(2^{3y}) + 7(2^{2y}) = 40(2^y) + 21$$

giving your answer to 2 decimal places. **(3)**

a/ $f(-3) = 0$

$-6(-3)^3 - 7(-3)^2 + 40(-3) + 21 = 0$

$\therefore$ It is a factor of $f(x)$

b/
$$\begin{array}{r|l} & -6x^2 + 11x + 7 \\ x+3 & -6x^3 - 7x^2 + 40x + 21 \\ & -6x^3 - 18x^2 \\ & 11x^2 + 40x + \cancel{21} \\ & 11x^2 + 33x \\ & 7x + 21 \\ & 7x + 21 \\ & 0 \end{array}$$

$(x+3)(-6x^2 + 11x + 7)$

$-(x+3)(6x^2 - 11x - 7)$

$\underline{-(x+3)(3x-7)(2x+1)}$

c/ $x = -3$ $\quad x = 7/3$ $\quad x = -1/2$

$2^y = -3$ $\quad 2^y = 7/3$ $\quad 2^y = -\frac{1}{2}$

$y = \log_2 -3$ $\quad y = \log_2 {}^{7/3}$ $\quad y = \log_2 {}^{-\frac{1}{2}}$

$\times$ $\quad \underline{y = 1.22}$ $\quad \times$

Leave blank

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

P44824A01632

Leave blank

7. (i) $2\log(x + a) = \log(16a^6)$, where a is a positive constant

Find x in terms of a, giving your answer in its simplest form.

(3)

(ii) $\log_3(9y + b) - \log_3(2y - b) = 2$, where b is a positive constant

Find y in terms of b, giving your answer in its simplest form.

(4)

i/ $2\log(x+a) = \log(16a^6)$

$\log(x+a)^2 = \log(16a^6)$

$(x+a)^2 = 16a^6$

$x+a = \sqrt{16a^6}$

$x+a = 4a^3$

$\underline{\underline{x = 4a^3 - a}}$

ii/ $\log_3(9y+b) - \log_3(2y-b) = 2$

$\log_3\left(\frac{9y+b}{2y-b}\right) = 2$

$\frac{9y+b}{2y-b} = 3^2$

$9y+b = 9(2y-b)$

$9y+b = 18y - 9b$

$10b = 9y$

$\underline{\underline{y = \frac{10}{9}b}}$

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Leave blank

8. (a) Show that the equation

$$\cos^2 x = 8\sin^2 x - 6\sin x$$

can be written in the form

$$(3\sin x - 1)^2 = 2$$

(3)

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

$$\cos^2 x = 8\sin^2 x - 6\sin x$$

giving your answers to 2 decimal places.

(5)

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

a) $1 - \sin^2 x = 8\sin^2 x - 6\sin x$

$1 = 9\sin^2 x - 6\sin x$

$0 = 9\sin^2 x - 6\sin x - 1$

$0 = (3\sin x - 1)^2 - 1 - 1$

$0 = (3\sin x - 1)^2 - 2$

$(3\sin x - 1)^2 = 2$

b/ $3\sin x - 1 = \pm\sqrt{2}$

$3\sin x = 1 \pm \sqrt{2}$

$\sin x = \dfrac{1 \pm \sqrt{2}}{3}$

$\sin^{-1}\left(\dfrac{1+\sqrt{2}}{3}\right)$ ~~sin⁻¹~~ $\sin^{-1}\left(\dfrac{1-\sqrt{2}}{3}\right)$

$= 53.58, 126.42$ $= -7.94, 187.94, 352.06$

$x = 53.58, 126.42, 187.94, 352.06$

P 4 4 8 2 4 A 0 2 2 3 2

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

Leave blank

9. The first three terms of a geometric sequence are

$$7k-5,\ 5k-7,\ 2k+10$$

where k is a constant.

(a) Show that $11k^2-130k+99=0$

(4)

Given that k is not an integer,

(b) show that $k=\dfrac{9}{11}$

(2)

For this value of k,

(c) (i) evaluate the fourth term of the sequence, giving your answer as an exact fraction,

(ii) evaluate the sum of the first ten terms of the sequence.

(6)

$$\frac{5k-7}{7k-5}=\frac{2k+10}{5k-7}$$

$$(5k-7)(5k-7)=(2k+10)(7k-5)$$

$$25k^2-35k-35k+49=14k^2-10k+70k-50$$

$$25k^2-70k+49=14k^2+60k-50$$

$$11k^2-130k+99=0$$

b/ $(11k-9)(k-11)=0$

$k=9/11 \qquad k=11$

k is not an integer $\therefore\ k=9/11$

c/ term 1 $=7\left(\frac{9}{11}\right)-5 = \frac{8}{11}$

term 2 $=5\left(\frac{9}{11}\right)-7 = \frac{-32}{11}$

term 3 $=2\left(\frac{9}{11}\right)+10 = \frac{128}{11}$

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Leave blank

Question 9 continued

$$r = \frac{-32}{11} \div \frac{8}{11}$$

$$= \underline{\underline{-4}}$$

$$\text{term } 4 = \frac{128}{11} \times -4$$

$$= \underline{\underline{-\frac{512}{11}}}$$

ii/ $$S_n = \frac{a(1-r^n)}{1-r}$$

$a = \frac{8}{11}$ $r = -4$ $n = 10$

$$S_{10} = \frac{\frac{8}{11}\left(1-(-4)^{10}\right)}{1-(-4)}$$

$$= \underline{\underline{-152520}}$$

Leave blank

10.

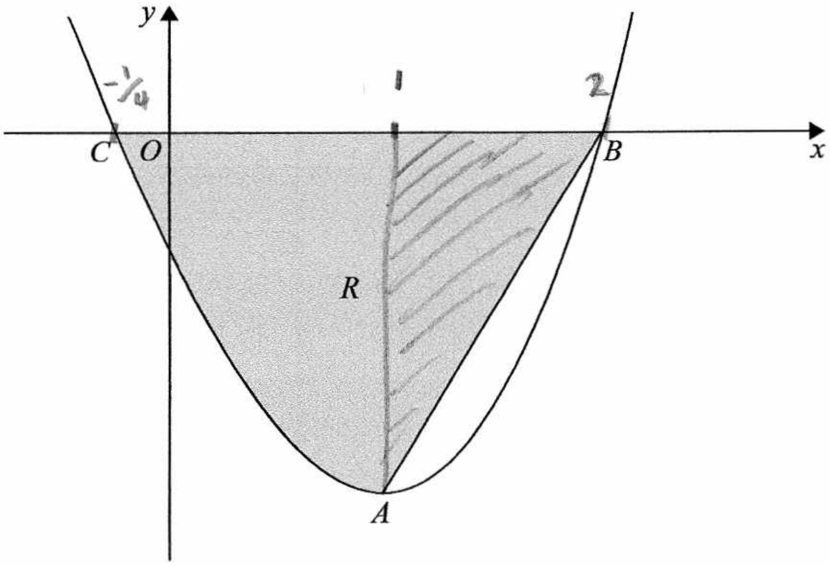


Figure 2

Figure 2 shows a sketch of part of the curve with equation

$$y = 4x^3 + 9x^2 - 30x - 8, \quad -0.5 \leqslant x \leqslant 2.2$$

The curve has a turning point at the point A.

(a) Using calculus, show that the x coordinate of A is 1

(3)

The curve crosses the x-axis at the points $B(2, 0)$ and $C\left(-\frac{1}{4}, 0\right)$

The finite region R, shown shaded in Figure 2, is bounded by the curve, the line AB, and the x-axis.

(b) Use integration to find the area of the finite region R, giving your answer to 2 decimal places.

(7)

a/ turning point where $\frac{dy}{dx} = 0$

$\frac{dy}{dx} = 12x^2 + 18x - 30$

$12x^2 + 18x - 30 = 0$

$6x^2 + 9x - 15 = 0$

$2x^2 + 3x - 5 = 0$

$(2x + 5)(x - 1)$

$x = -\frac{5}{2} \quad x = 1$

P 4 4 8 2 4 A 0 2 8 3 2

Question 10 continued

$-0.5 \leq x \leq 2.2 \quad \therefore \quad \underline{\underline{x = 1}}$

b/ $\displaystyle\int_{-\frac{1}{4}}^{1} 4x^3 + 9x^2 - 30x - 8 \; dx$

$\left[x^4 + 3x^3 - 15x^2 - 8x \right]_{-\frac{1}{4}}^{1}$

$\left[(1)^4 + 3(1)^3 - 15(1)^2 - 8(1)\right] - \left[\left(\frac{-1}{4}\right)^4 + 3\left(\frac{-1}{4}\right)^3 - 15\left(\frac{-1}{4}\right)^2 - 8\left(\frac{-1}{4}\right)\right]$

$(-19) - \left(\frac{261}{256}\right)$

$= -20.02$

$= \underline{\underline{20.02 \text{ units}^2}}$

when $x = 1 \quad y = 4(1)^3 + 9(1)^2 - 30(1) - 8$

$= -25$

Area of triangle $= \frac{1}{2}(1)(25)$

$= 12.5 \text{ units}^2$

Total Area $= 20.02 + 12.5$

$= \underline{\underline{32.52}} \text{ units}^2$

P 4 4 8 2 4 A 0 2 9 3 2