Paper Reference(s)

9801/01

Edexcel

Mathematics

Advanced Extension Award

Thursday 25 June 2015 – Morning

Time: 3 hours

Materials required for examination	**Items included with question papers**
Answer book (AB16)	Nil
Graph paper (ASG2)	
Mathematical Formulae (Pink)	

Candidates may NOT use a calculator in answering this paper.

Instructions to Candidates

In the boxes on the answer book provided, write the name of the examining body (Edexcel), your centre number, candidate number, the paper title (Mathematics), the paper reference (9801), your surname, initials and signature.
Check that you have the correct question paper.
Answers should be given in as simple a form as possible. e.g. $\frac{2\pi}{3}$, $\sqrt{6}$, $3\sqrt{2}$.

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 7 questions in this question paper.
The total mark for this paper is 100, of which 7 marks are for style, clarity and presentation.
There are 8 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 not gain full credit.

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PEARSON

1. (a) Sketch the graph of the curve with equation

$$y = \left|\ln(2x + 5)\right| \qquad x > -\frac{5}{2}$$

On your sketch you should clearly state the equations of any asymptotes and mark the coordinates of points where the curve meets the coordinate axes.

(3)

(b) Solve the equation $\left|\ln(2x + 5)\right| = \ln 9$

(3)

(Total 6 marks)

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2. (a) Show that $(x + 1)$ is a factor of $2x^3 + 3x^2 - 1$

(1)

(b) Solve the equation

$$\sqrt{x^2 + 2x + 5} = x + \sqrt{2x + 3}$$

(8)

(Total 9 marks)

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3. Solve for $0 < x < 360°$

$$\cot 2x - \tan 78° = \frac{(\sec x)(\sec 78°)}{2}$$

where x is not an integer multiple of $90°$

(Total 9 marks)

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4. (a) Find the binomial series expansion for $(4+y)^{\frac{1}{2}}$ in ascending powers of y up to and including the term in y^3. Simplify the coefficient of each term.

(3)

(b) Hence show that the binomial series expansion for $(4+5x+x^2)^{\frac{1}{2}}$ in ascending powers of x up to and including the term in x^3 is

$$2+\frac{5x}{4}-\frac{9x^2}{64}+\frac{45x^3}{512}$$

(3)

(c) Show that the binomial series expansion of $(4+5x+x^2)^{\frac{1}{2}}$ will converge for $-\frac{1}{2}\leqslant x\leqslant\frac{1}{2}$

(6)

(d) Use the result in part (b) to estimate

$$\int_{-\frac{1}{2}}^{\frac{1}{2}}\sqrt{4+5x+x^2}\,\mathrm{d}x$$

Give your answer as a single fraction.

(3)

(Total 15 marks)

5.

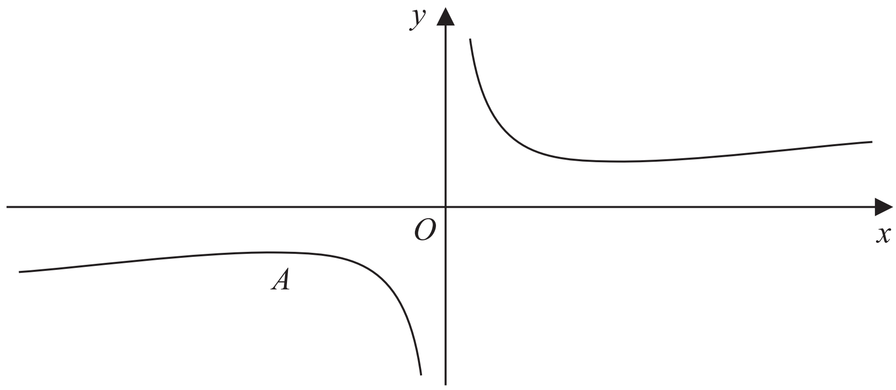

Figure 1

Figure 1 shows a sketch of the curve with equation $y = \mathrm{f}(x)$ where

$$\mathrm{f}(x) = \frac{x^2 + 16}{3x} \qquad x \neq 0$$

The curve has a maximum at the point A with coordinates (a, b).

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

(4)

The function g is defined as

$$\mathrm{g} : x \mapsto \frac{x^2 + 16}{3x} \qquad a \leqslant x < 0$$

where a is the value found in part (a).

(b) Write down the range of g.

(1)

(c) On the same axes sketch $y = \mathrm{g}(x)$ and $y = \mathrm{g}^{-1}(x)$.

(3)

(d) Find an expression for $\mathrm{g}^{-1}(x)$ and state the domain of g^{-1}

(5)

(e) Solve the equation $\mathrm{g}(x) = \mathrm{g}^{-1}(x)$.

(3)

(Total 16 marks)

6. The lines L_1 and L_2 have vector equations

$$L_1 : \ \mathbf{r} = \begin{pmatrix} 1 \\ 10 \\ -3 \end{pmatrix} + \lambda \begin{pmatrix} 2 \\ -5 \\ 4 \end{pmatrix}$$

$$L_2 : \ \mathbf{r} = \begin{pmatrix} -1 \\ 2 \\ 3 \end{pmatrix} + \mu \begin{pmatrix} 1 \\ 2 \\ 2 \end{pmatrix}$$

(a) Show that L_1 and L_2 are perpendicular.

(2)

(b) Show that L_1 and L_2 are skew lines.

(3)

The point A with position vector $-\mathbf{i} + 2\mathbf{j} + 3\mathbf{k}$ lies on L_2 and the point X lies on L_1 such that $\overrightarrow{AX}$ is perpendicular to L_1

(c) Find the position vector of X.

(5)

(d) Find $|\overrightarrow{AX}|$

(2)

The point B (distinct from A) also lies on L_2 and $|\overrightarrow{BX}| = |\overrightarrow{AX}|$

(e) Find the position vector of B.

(5)

(f) Find the cosine of angle AXB.

(2)

(Total 19 marks)

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7. (a) Use the substitution $x = \sec\theta$ to show that

$$\int_{\sqrt{2}}^{2} \frac{1}{(x^2 - 1)^{\frac{3}{2}}}\, dx = \frac{\sqrt{6} - 2}{\sqrt{3}}$$

(5)

(b) Use integration by parts to show that

$$\int \text{cosec}\theta \cot^2\theta \, d\theta = \frac{1}{2}\left[\ln\left|\text{cosec}\theta + \cot\theta\right| - \text{cosec}\theta \cot\theta\right] + c$$

(6)

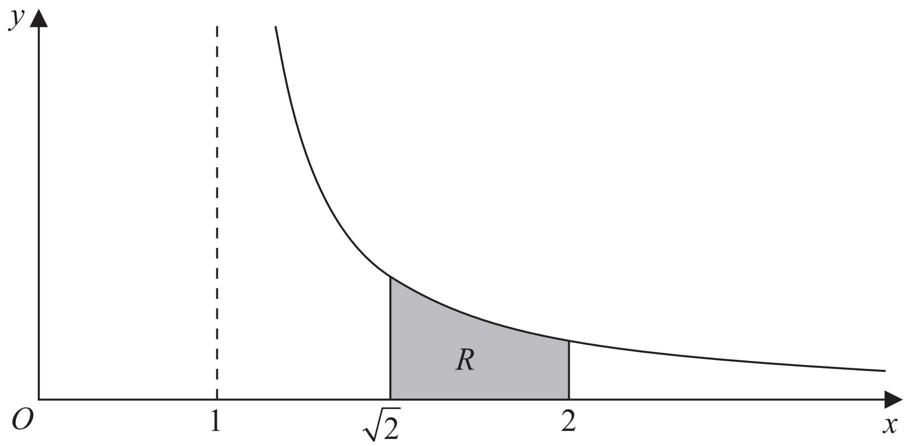

Figure 2

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

The region R, shown shaded in Figure 2, is bounded by the curve, the x-axis and the lines $x = \sqrt{2}$ and $x = 2$

The region R is rotated through 2π radians about the x-axis.

(c) Show that the volume of the solid formed is

$$\pi\left[\frac{3}{8}\ln\left(\frac{1 + \sqrt{2}}{\sqrt{3}}\right) + \frac{7}{36} - \frac{\sqrt{2}}{8}\right]$$

(8)

(Total 19 marks)

FOR STYLE, CLARITY AND PRESENTATION: 7 MARKS

TOTAL FOR PAPER: 100 MARKS

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