Paper Reference(s)
9801/01

Edexcel

Mathematics

Advanced Extension Award

Wednesday 30 June 2010 – 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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Turn over

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1. (a) Solve the equation

$$\sqrt{(3x+16)} = 3 + \sqrt{(x+1)}$$

(5)

(b) Solve the equation

$$\log_3 (x-7) - \tfrac{1}{2}\log_3 x = 1 - \log_3 2$$

(7)

(Total 12 marks)

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2. The sum of the first p terms of an arithmetic series is q and the sum of the first q terms of the same arithmetic series is p, where p and q are positive integers and $p \neq q$.

Giving simplified answers in terms of p and q, find

(a) the common difference of the terms in this series,

(5)

(b) the first term of the series,

(3)

(c) the sum of the first $(p+q)$ terms of the series.

(3)

(Total 11 marks)

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3. The curve C has equation

$$x^2 + y^2 + fxy = g^2,$$

where f and g are constants and $g \neq 0$.

(a) Find an expression in terms of α, β and f for the gradient of C at the point (α, β).

(4)

Given that $f < 2$ and $f \neq -2$ and that the gradient of C at the point (α, β) is 1,

(b) show that $\alpha = -\beta = \dfrac{\pm g}{\sqrt{(2-f)}}$.

(4)

Given that $f = -2$,

(c) sketch C.

(3)

(Total 11 marks)

4.

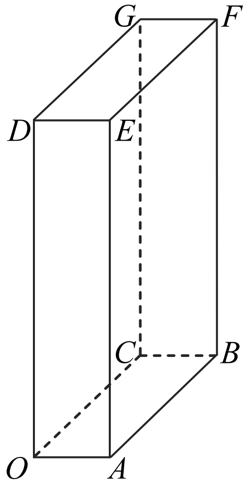

Figure 1

Figure 1 shows a cuboid *OABCDEFG*, where *O* is the origin, *A* has position vector $5\mathbf{i}$, *C* has position vector $10\mathbf{j}$ and *D* has position vector $20\mathbf{k}$.

(a) Find the cosine of angle *CAF*.

(4)

Given that the point *X* lies on *AC* and that *FX* is perpendicular to *AC*,

(b) find the position vector of point *X* and the distance *FX*.

(7)

The line l_1 passes through *O* and through the midpoint of the face *ABFE*. The line l_2 passes through *A* and through the midpoint of the edge *FG*.

(c) Show that l_1 and l_2 intersect and find the coordinates of the point of intersection.

(5)

(Total 16 marks)

5.

$$I = \int \frac{1}{(x-1)\sqrt{(x^2-1)}}\,\mathrm{d}x, \qquad x > 1$$

(a) Use the substitution $x = 1 + u^{-1}$ to show that

$$I = -\left(\frac{x+1}{x-1}\right)^{\frac{1}{2}} + c.$$

(7)

(b) Hence show that

$$\int_{\sec\alpha}^{\sec\beta} \frac{1}{(x-1)\sqrt{(x^2-1)}}\,\mathrm{d}x = \cot\left(\frac{\alpha}{2}\right) - \cot\left(\frac{\beta}{2}\right), \qquad 0 < \alpha < \beta < \tfrac{\pi}{2}$$

(5)

(Total 12 marks)

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6. (a) Given that $x^4 + y^4 = 1$, prove that $x^2 + y^2$ is a maximum when $x = \pm y$, and find the maximum and minimum values of $x^2 + y^2$.

(7)

(b) On the same diagram, sketch the curves C_1 and C_2 with equations $x^4 + y^4 = 1$ and $x^2 + y^2 = 1$ respectively.

(2)

(c) Write down the equation of the circle C_3, centre the origin, which touches the curve C_1 at the points where $x = \pm y$.

(1)

(Total 10 marks)

7.

$$f(x) = [1 + \cos(x + \tfrac{\pi}{4})][1 + \sin(x + \tfrac{\pi}{4})], \qquad 0 \leqslant x \leqslant 2\pi$$

(a) Show that $f(x)$ may be written in the form

$$f(x) = (\tfrac{1}{\sqrt{2}} + \cos x)^2, \qquad 0 \leqslant x \leqslant 2\pi$$

(5)

(b) Find the range of the function $f(x)$.

(2)

The graph of $y = f(x)$ is shown in Figure 2.

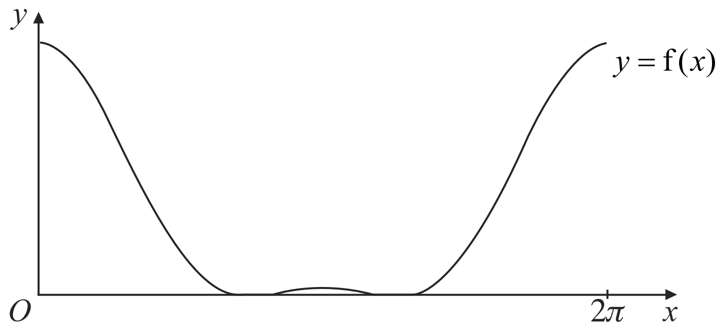

Figure 2

(c) Find the coordinates of all the maximum and minimum points on this curve.

(6)

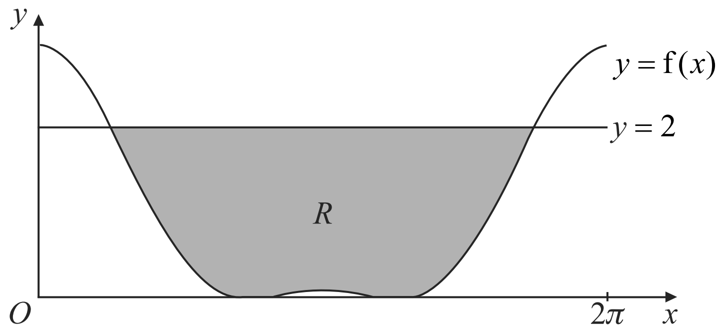

Figure 3

The region R, bounded by $y = 2$ and $y = f(x)$, is shown shaded in Figure 3.

(d) Find the area of R.

(8)

(Total 21 marks)

FOR STYLE, CLARITY AND PRESENTATION: 7 MARKS

TOTAL FOR PAPER: 100 MARKS

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