OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

MATHEMATICS (MEI) 4752

Concepts for Advanced Mathematics (C2)

QUESTION PAPER

Candidates answer on the printed answer book.

OCR supplied materials:
- Printed answer book 4752
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Friday 14 January 2011
Afternoon

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

These instructions are the same on the printed answer book and the question paper.

- The question paper will be found in the centre of the printed answer book.
- Write your name, centre number and candidate number in the spaces provided on the printed answer book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the printed answer book.** Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

This information is the same on the printed answer book and the question paper.

- The number of marks is given in brackets **[ ]** at the end of each question or part question on the question paper.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **72**.
- The printed answer book consists of **12** pages. The question paper consists of **8** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

- Do not send this question paper for marking; it should be retained in the centre or destroyed.

Section A (36 marks)

1 Calculate $\sum_{r=3}^{6} \frac{12}{r}$. **[2]**

2 Find $\int \left(3x^5 + 2x^{-\frac{1}{2}}\right) \mathrm{d}x$. **[4]**

3 At a place where a river is 7.5 m wide, its depth is measured every 1.5 m across the river. The table shows the results.

Distance across river (m)	0	1.5	3	4.5	6	7.5
Depth of river (m)	0.6	2.3	3.1	2.8	1.8	0.7

Use the trapezium rule with 5 strips to estimate the area of cross-section of the river. **[3]**

4 The curve $y = \mathrm{f}(x)$ has a minimum point at (3, 5).

State the coordinates of the corresponding minimum point on the graph of

(i) $y = 3\mathrm{f}(x)$, **[2]**

(ii) $y = \mathrm{f}(2x)$. **[2]**

5 The second term of a geometric sequence is 6 and the fifth term is –48.

Find the tenth term of the sequence.

Find also, in simplified form, an expression for the sum of the first n terms of this sequence. **[5]**

6 The third term of an arithmetic progression is 24. The tenth term is 3.

Find the first term and the common difference.

Find also the sum of the 21st to 50th terms inclusive. **[5]**

7 Simplify

(i) $\log_{10} x^5 + 3\log_{10} x^4$, **[2]**

(ii) $\log_a 1 - \log_a a^b$. **[2]**

8 Showing your method clearly, solve the equation

$$5\sin^2\theta = 5 + \cos\theta \qquad \text{for } 0° \leqslant \theta \leqslant 360°.$$ **[5]**

9 Charles has a slice of cake; its cross-section is a sector of a circle, as shown in Fig. 9. The radius is r cm and the sector angle is $\frac{\pi}{6}$ radians.

He wants to give half of the slice to Jan. He makes a cut across the sector as shown.

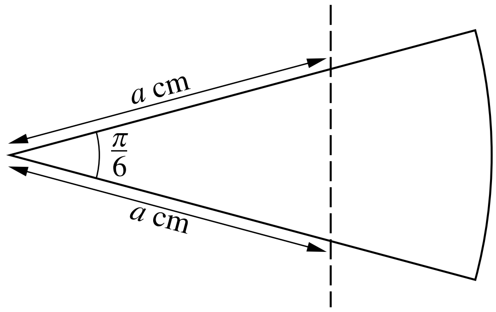

Fig. 9

Show that when they each have half the slice, $a = r\sqrt{\frac{\pi}{6}}$. **[4]**

Section B (36 marks)

10

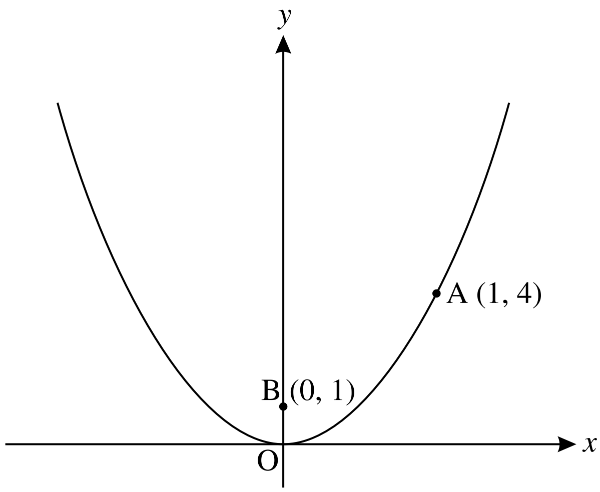

Fig. 10

A is the point with coordinates (1, 4) on the curve $y = 4x^2$. B is the point with coordinates (0, 1), as shown in Fig. 10.

(i) The line through A and B intersects the curve again at the point C. Show that the coordinates of C are $\left(-\frac{1}{4}, \frac{1}{4}\right)$. **[4]**

(ii) Use calculus to find the equation of the tangent to the curve at A and verify that the equation of the tangent at C is $y = -2x - \frac{1}{4}$. **[6]**

(iii) The two tangents intersect at the point D. Find the y-coordinate of D. **[2]**

11

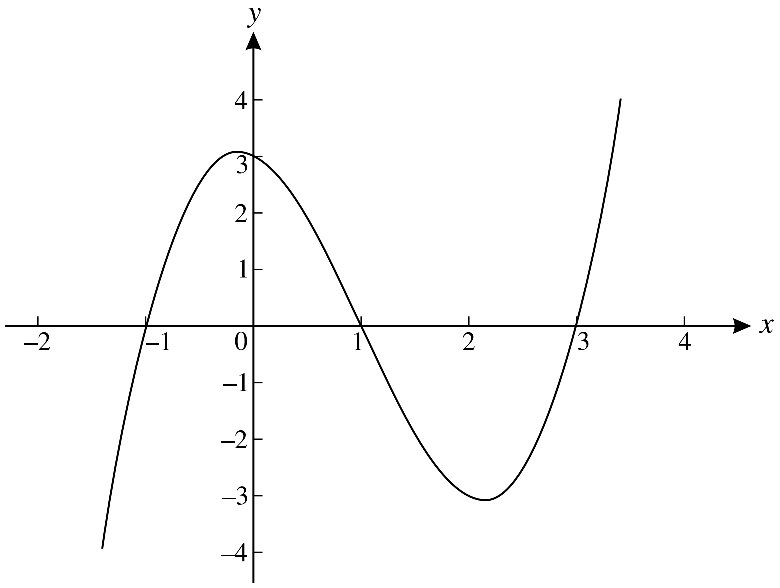

Fig. 11

Fig. 11 shows the curve $y = x^3 - 3x^2 - x + 3$.

(i) Use calculus to find $\int_1^3 (x^3 - 3x^2 - x + 3)\,dx$ and state what this represents. **[6]**

(ii) Find the x-coordinates of the turning points of the curve $y = x^3 - 3x^2 - x + 3$, giving your answers in surd form. Hence state the set of values of x for which $y = x^3 - 3x^2 - x + 3$ is a decreasing function. **[5]**

12 The table shows the size of a population of house sparrows from 1980 to 2005.

Year	1980	1985	1990	1995	2000	2005
Population	25 000	22 000	18 750	16 250	13 500	12 000

The 'red alert' category for birds is used when a population has decreased by at least 50% in the previous 25 years.

(i) Show that the information for this population is consistent with the house sparrow being on red alert in 2005. **[1]**

The size of the population may be modelled by a function of the form $P = a \times 10^{-kt}$, where P is the population, t is the number of years after 1980, and a and k are constants.

(ii) Write the equation $P = a \times 10^{-kt}$ in logarithmic form using base 10, giving your answer as simply as possible. **[2]**

(iii) Complete the table and draw the graph of $\log_{10} P$ against t, drawing a line of best fit by eye. **[3]**

(iv) Use your graph to find the values of a and k and hence the equation for P in terms of t. **[4]**

(v) Find the size of the population in 2015 as predicted by this model.

Would the house sparrow still be on red alert? Give a reason for your answer. **[3]**