

**Friday 17 May 2013 – Morning**

**AS GCE MATHEMATICS (MEI)**

**4752/01 Concepts for Advanced Mathematics (C2)**

**QUESTION PAPER**

Candidates answer on the Printed Answer Book.

**OCR supplied materials:**

- Printed Answer Book 4752/01
- MEI Examination Formulae and Tables (MF2)

**Other materials required:**

- Scientific or graphical calculator

**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. HB 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.

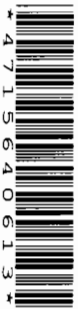
**INFORMATION FOR CANDIDATES**

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 **16** 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 recycled. Please contact OCR Copyright should you wish to re-use this document.



## Section A (36 marks)

1 Find  $\frac{dy}{dx}$  when

(i)  $y = 2x^{-5}$ , [2]

(ii)  $y = \sqrt[3]{x}$ . [3]

2 The  $n$ th term of a sequence,  $u_n$ , is given by

$$u_n = 12 - \frac{1}{2}n.$$

(i) Write down the values of  $u_1$ ,  $u_2$  and  $u_3$ . State what type of sequence this is. [2]

(ii) Find  $\sum_{n=1}^{30} u_n$ . [3]

3 The gradient of a curve is given by  $\frac{dy}{dx} = \frac{18}{x^3} + 2$ . The curve passes through the point (3, 6). Find the equation of the curve. [5]

4 (i) Starting with an equilateral triangle, prove that  $\cos 30^\circ = \frac{\sqrt{3}}{2}$ . [2]

(ii) Solve the equation  $2 \sin \theta = -1$  for  $0 \leq \theta \leq 2\pi$ , giving your answers in terms of  $\pi$ . [3]

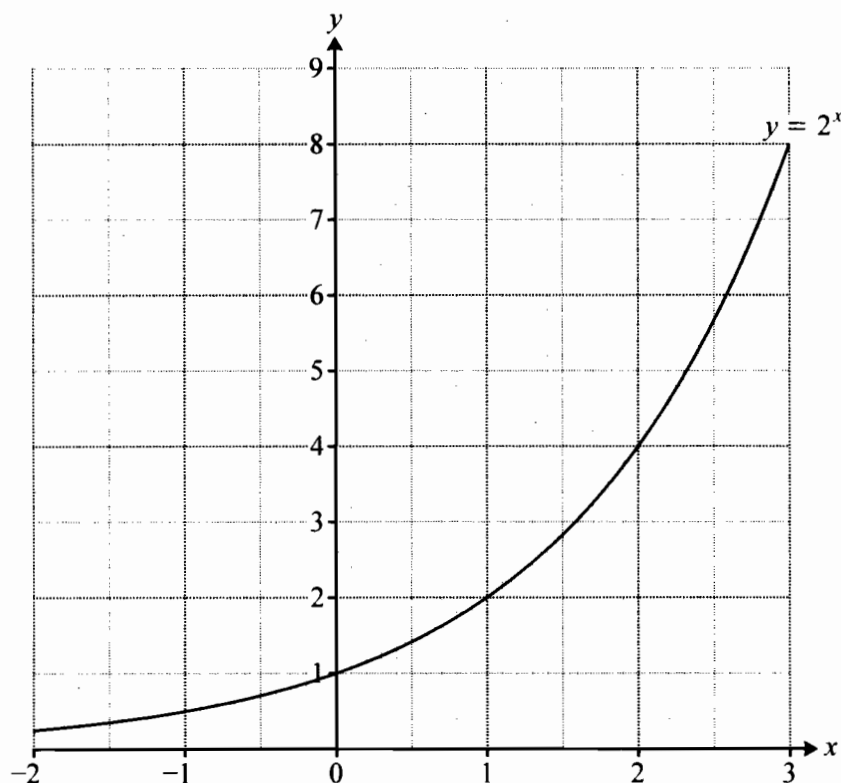


Fig. 5

Fig. 5 shows the graph of  $y = 2^x$ .

- (i) On the copy of Fig. 5, draw by eye a tangent to the curve at the point where  $x = 2$ . Hence find an estimate of the gradient of  $y = 2^x$  when  $x = 2$ . [3]
- (ii) Calculate the  $y$ -values on the curve when  $x = 1.8$  and  $x = 2.2$ . Hence calculate another approximation to the gradient of  $y = 2^x$  when  $x = 2$ . [2]

6  $S$  is the sum to infinity of a geometric progression with first term  $a$  and common ratio  $r$ .

- (i) Another geometric progression has first term  $2a$  and common ratio  $r$ . Express the sum to infinity of this progression in terms of  $S$ . [1]
- (ii) A third geometric progression has first term  $a$  and common ratio  $r^2$ . Express, in its simplest form, the sum to infinity of this progression in terms of  $S$  and  $r$ . [2]

- 7 Fig. 7 shows a curve and the coordinates of some points on it.

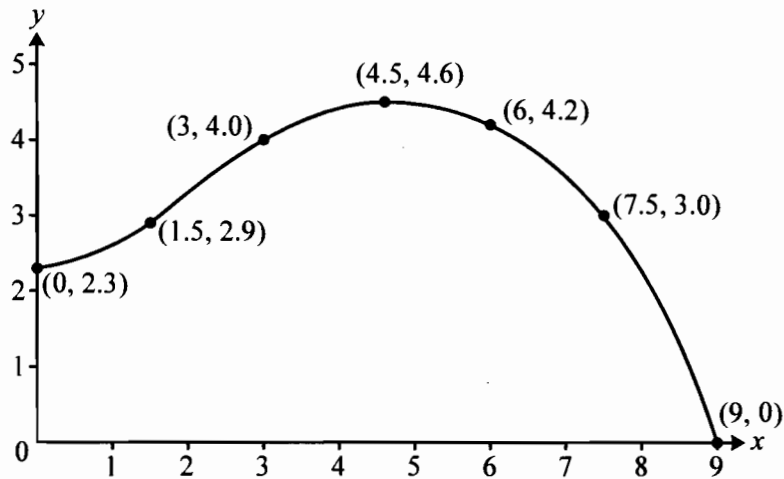


Fig. 7

Use the trapezium rule with 6 strips to estimate the area of the region bounded by the curve and the positive  $x$ - and  $y$ -axes. [4]

- 8 Fig. 8 shows the graph of  $y = g(x)$ .

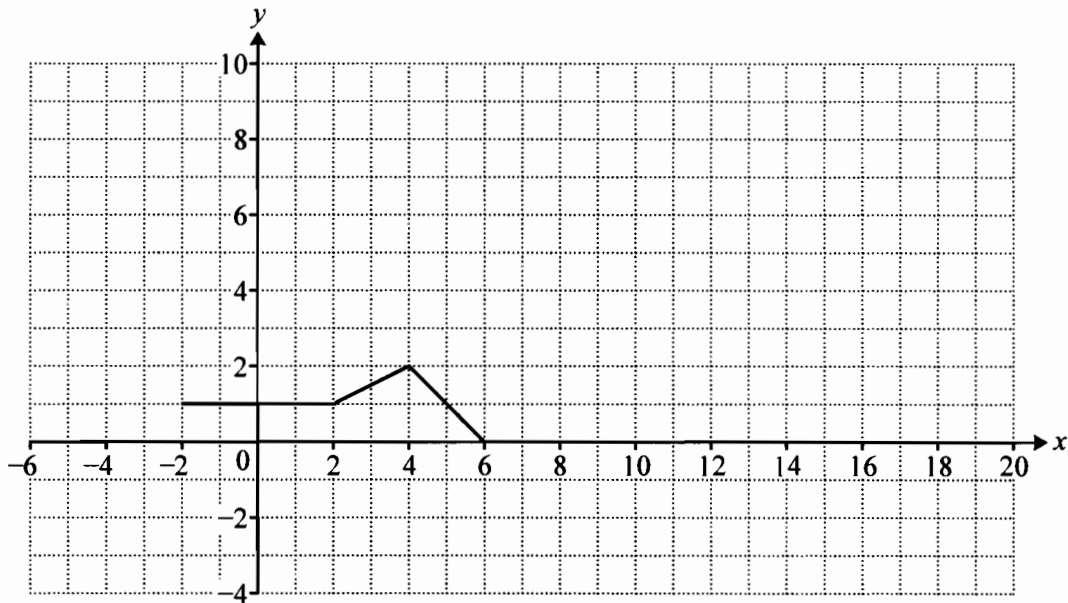


Fig. 8

Draw the graph of

(i)  $y = g(2x)$ ,

[2]

(ii)  $y = 3g(x)$ .

[2]

## Section B (36 marks)

- 9 Fig. 9 shows a sketch of the curve  $y = x^3 - 3x^2 - 22x + 24$  and the line  $y = 6x + 24$ .

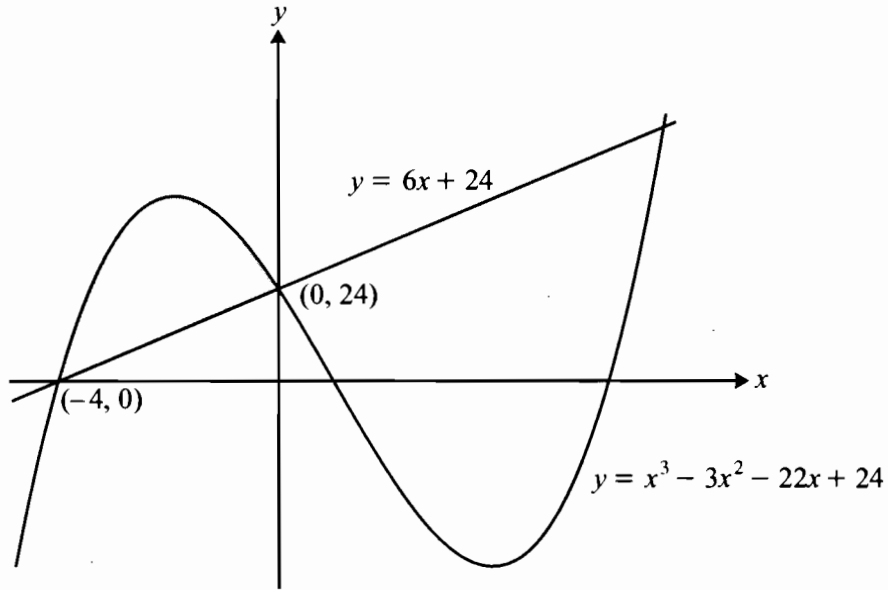


Fig. 9

- (i) Differentiate  $y = x^3 - 3x^2 - 22x + 24$  and hence find the  $x$ -coordinates of the turning points of the curve. Give your answers to 2 decimal places. [4]
- (ii) You are given that the line and the curve intersect when  $x = 0$  and when  $x = -4$ . Find algebraically the  $x$ -coordinate of the other point of intersection. [3]
- (iii) Use calculus to find the area of the region bounded by the curve and the line  $y = 6x + 24$  for  $-4 \leq x \leq 0$ , shown shaded on Fig. 9. [4]

10 Fig. 10.1 shows Jean's back garden. This is a quadrilateral ABCD with dimensions as shown.

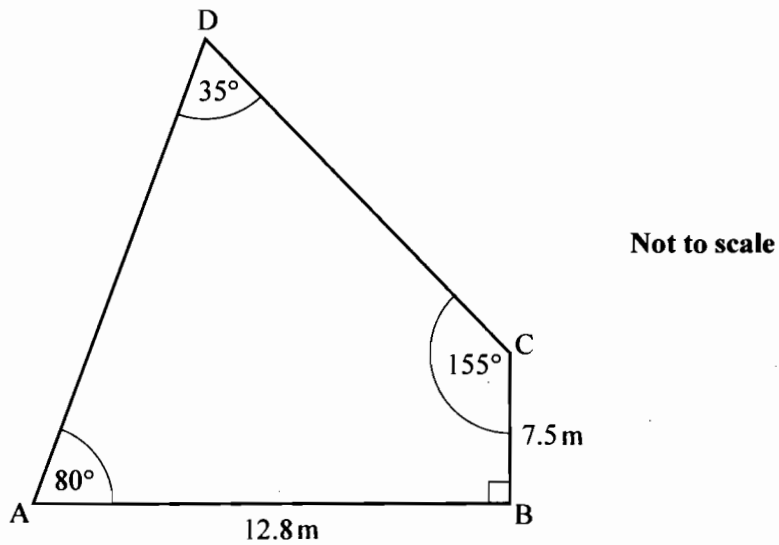


Fig. 10.1

(i) (A) Calculate AC and angle ACB. Hence calculate AD. [6]

(B) Calculate the area of the garden. [3]

(ii) The shape of the fence panels used in the garden is shown in Fig. 10.2. EH is the arc of a sector of a circle with centre at the midpoint, M, of side FG, and sector angle 1.1 radians, as shown.  $FG = 1.8$  m.

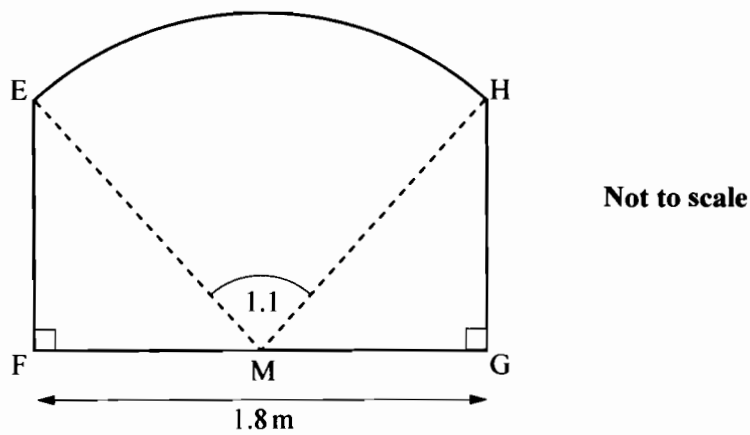


Fig. 10.2

Calculate the area of one of these fence panels. [5]

11 A hot drink when first made has a temperature which is  $65^{\circ}\text{C}$  higher than room temperature. The temperature difference,  $d^{\circ}\text{C}$ , between the drink and its surroundings decreases by 1.7% each minute.

(i) Show that 3 minutes after the drink is made,  $d = 61.7$  to 3 significant figures. [2]

(ii) Write down an expression for the value of  $d$  at time  $n$  minutes after the drink is made, where  $n$  is an integer. [1]

(iii) Show that when  $d < 3$ ,  $n$  must satisfy the inequality

$$n > \frac{\log_{10} 3 - \log_{10} 65}{\log_{10} 0.983}.$$

Hence find the least integer value of  $n$  for which  $d < 3$ . [4]

(iv) The temperature difference at any time  $t$  minutes after the drink is made can also be expressed as  $d = 65 \times 10^{-kt}$ , for some constant  $k$ . Use the value of  $d$  for 1 minute after the drink is made to calculate the value of  $k$ . Hence find the temperature difference 25.3 minutes after the drink is made. [4]