OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

MATHEMATICS (MEI) 4752

Concepts for Advanced Mathematics (C2)

Candidates answer on the Answer Booklet

OCR Supplied Materials:
- 8 page Answer Booklet
- Insert for Questions 5 and 12 (inserted)
- MEI Examination Formulae and Tables (MF2)

Other Materials Required:
None

Tuesday 13 January 2009
Morning

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the spaces provided on the Answer Booklet.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- There is an **insert** for use in Questions **5** and **12**.
- You are permitted to use a graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- 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**.
- This document consists of **8** pages. Any blank pages are indicated.

Section A (36 marks)

1 Find $\int \left(20x^4 + 6x^{-\frac{3}{2}}\right) dx$. **[4]**

2 Fig. 2 shows the coordinates at certain points on a curve.

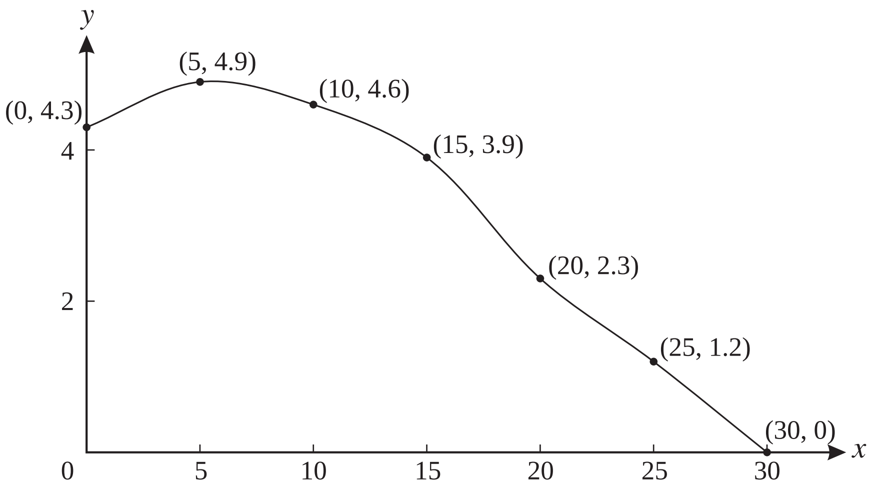

Fig. 2

Use the trapezium rule with 6 strips to calculate an estimate of the area of the region bounded by this curve and the axes. **[4]**

3 Find $\sum_{k=1}^{5} \frac{1}{1+k}$. **[2]**

4 Solve the equation $\sin 2x = -0.5$ for $0° < x < 180°$. **[3]**

5 **Answer this question on the insert provided.**

Fig. 5 shows the graph of $y = \mathrm{f}(x)$.

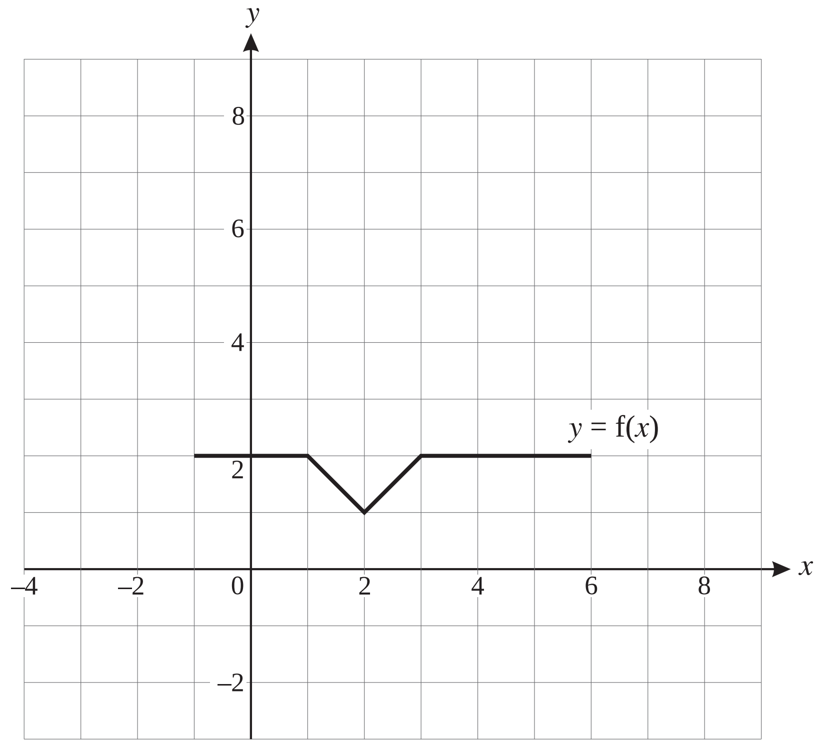

Fig. 5

On the insert, draw the graph of

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

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

6 An arithmetic progression has first term 7 and third term 12.

(i) Find the 20th term of this progression. **[2]**

(ii) Find the sum of the 21st to the 50th terms inclusive of this progression. **[3]**

7 Differentiate $4x^2 + \frac{1}{x}$ and hence find the x-coordinate of the stationary point of the curve $y = 4x^2 + \frac{1}{x}$. **[5]**

8 The terms of a sequence are given by

$$u_1 = 192,$$
$$u_{n+1} = -\tfrac{1}{2}u_n.$$

(i) Find the third term of this sequence and state what type of sequence it is. **[2]**

(ii) Show that the series $u_1 + u_2 + u_3 + \ldots$ converges and find its sum to infinity. **[3]**

9 **(i)** State the value of $\log_a a$. **[1]**

(ii) Express each of the following in terms of $\log_a x$.

(A) $\log_a x^3 + \log_a \sqrt{x}$ **[2]**

(B) $\log_a \dfrac{1}{x}$ **[1]**

Section B (36 marks)

10 Fig. 10 shows a sketch of the graph of $y = 7x - x^2 - 6$.

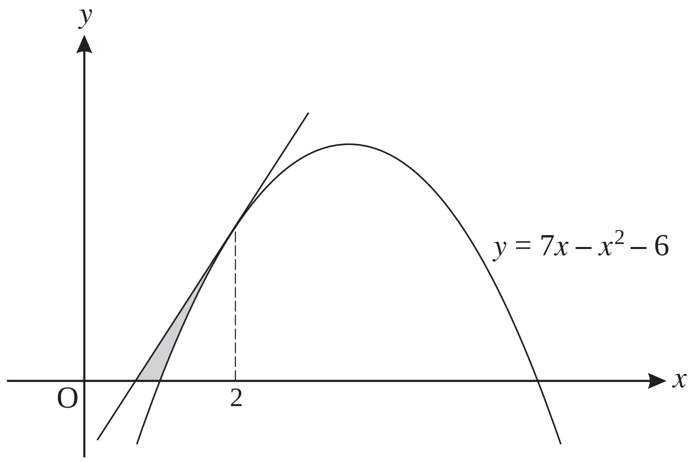

Fig. 10

(i) Find $\dfrac{dy}{dx}$ and hence find the equation of the tangent to the curve at the point on the curve where $x = 2$.

Show that this tangent crosses the x-axis where $x = \frac{2}{3}$. **[6]**

(ii) Show that the curve crosses the x-axis where $x = 1$ and find the x-coordinate of the other point of intersection of the curve with the x-axis. **[2]**

(iii) Find $\displaystyle\int_1^2 (7x - x^2 - 6)\,dx$.

Hence find the area of the region bounded by the curve, the tangent and the x-axis, shown shaded on Fig. 10. **[5]**

11 **(i)**

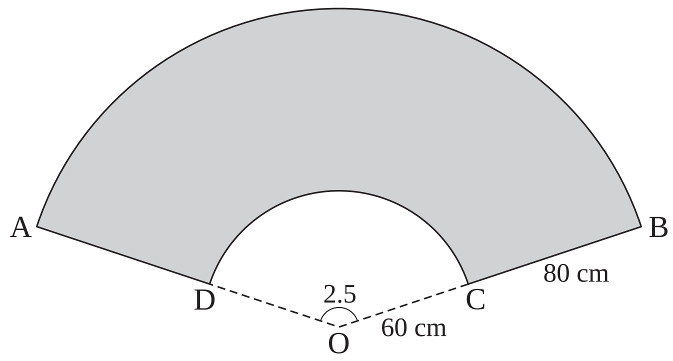

Fig. 11.1

Fig. 11.1 shows the surface ABCD of a TV presenter's desk. AB and CD are arcs of circles with centre O and sector angle 2.5 radians. OC = 60 cm and OB = 140 cm.

(*A*) Calculate the length of the arc CD. **[2]**

(*B*) Calculate the area of the surface ABCD of the desk. **[4]**

(ii) The TV presenter is at point P, shown in Fig. 11.2. A TV camera can move along the track EF, which is of length 3.5 m.

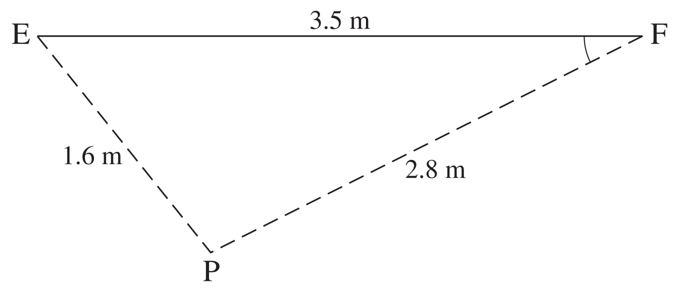

Fig. 11.2

When the camera is at E, the TV presenter is 1.6 m away. When the camera is at F, the TV presenter is 2.8 m away.

(*A*) Calculate, in degrees, the size of angle EFP. **[3]**

(*B*) Calculate the shortest possible distance between the camera and the TV presenter. **[2]**

[Question 12 is printed overleaf.]

12 Answer part (ii) of this question on the insert provided.

The proposal for a major building project was accepted, but actual construction was delayed. Each year a new estimate of the cost was made. The table shows the estimated cost, £y million, of the project t years after the project was first accepted.

Years after proposal accepted (t)	1	2	3	4	5
Cost (£y million)	250	300	360	440	530

The relationship between y and t is modelled by $y = ab^t$, where a and b are constants.

(i) Show that $y = ab^t$ may be written as

$$\log_{10} y = \log_{10} a + t \log_{10} b.$$ **[2]**

(ii) **On the insert**, complete the table and plot $\log_{10} y$ against t, drawing by eye a line of best fit. **[3]**

(iii) Use your graph and the results of part **(i)** to find the values of $\log_{10} a$ and $\log_{10} b$ and hence a and b. **[4]**

(iv) According to this model, what was the estimated cost of the project when it was first accepted? **[1]**

(v) Find the value of t given by this model when the estimated cost is £1000 million. Give your answer rounded to 1 decimal place. **[2]**