

**ADVANCED SUBSIDIARY GCE**

**MATHEMATICS (MEI)**

Concepts for Advanced Mathematics (C2)

**4752**

Candidates answer on the Answer Booklet

**OCR Supplied Materials:**

- 8 page Answer Booklet
- Insert for Question 12 (inserted)
- MEI Examination Formulae and Tables (MF2)

**Other Materials Required:**

None

**Friday 15 January 2010**  
**Afternoon**

**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 Question 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  $\int \left(x - \frac{3}{x^2}\right) dx$ . [3]

2 A sequence begins

1 3 5 3 1 3 5 3 1 3 ...

and continues in this pattern.

(i) Find the 55th term of this sequence, showing your method. [1]

(ii) Find the sum of the first 55 terms of the sequence. [2]

3 You are given that  $\sin \theta = \frac{\sqrt{2}}{3}$  and that  $\theta$  is an acute angle. Find the **exact** value of  $\tan \theta$ . [3]

4 A sector of a circle has area  $8.45 \text{ cm}^2$  and sector angle  $0.4$  radians. Calculate the radius of the sector. [3]

5

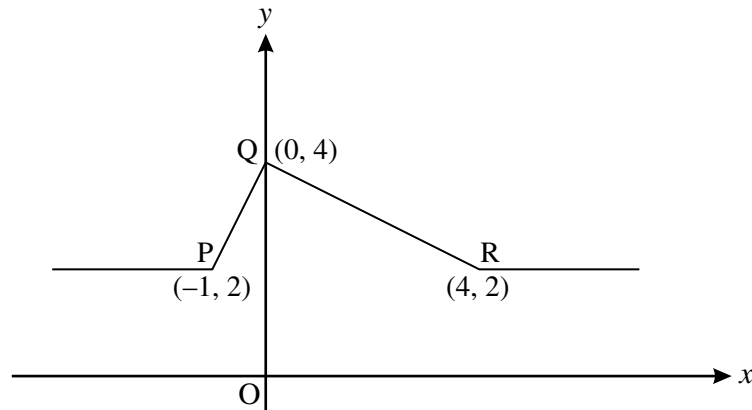


Fig. 5

Fig. 5 shows a sketch of the graph of  $y = f(x)$ . On separate diagrams, sketch the graphs of the following, showing clearly the coordinates of the points corresponding to P, Q and R.

(i)  $y = f(2x)$  [2]

(ii)  $y = \frac{1}{4}f(x)$  [2]

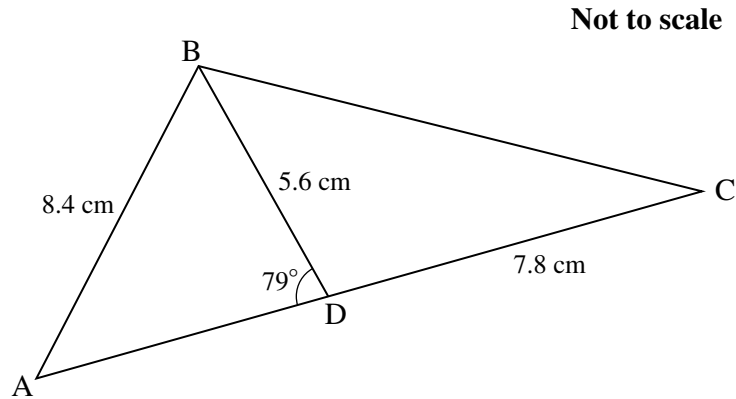
- 6 (i) Find the 51st term of the sequence given by

$$\begin{aligned} u_1 &= 5, \\ u_{n+1} &= u_n + 4. \end{aligned} \quad [3]$$

- (ii) Find the sum to infinity of the geometric progression which begins

$$5 \quad 2 \quad 0.8 \quad \dots \quad [2]$$

7



**Fig. 7**

Fig. 7 shows triangle ABC, with  $AB = 8.4$  cm. D is a point on AC such that angle  $ADB = 79^\circ$ ,  $BD = 5.6$  cm and  $CD = 7.8$  cm.

Calculate

- (i) angle BAD, [2]
- (ii) the length BC. [3]
- 8 Find the equation of the tangent to the curve  $y = 6\sqrt{x}$  at the point where  $x = 16$ . [5]
- 9 (i) Sketch the graph of  $y = 3^x$ . [2]
- (ii) Use logarithms to solve  $3^{2x+1} = 10$ , giving your answer correct to 2 decimal places. [3]

## Section B (36 marks)

- 10 (i) Differentiate  $x^3 - 3x^2 - 9x$ . Hence find the  $x$ -coordinates of the stationary points on the curve  $y = x^3 - 3x^2 - 9x$ , showing which is the maximum and which the minimum. [6]
- (ii) Find, in exact form, the coordinates of the points at which the curve crosses the  $x$ -axis. [3]
- (iii) Sketch the curve. [2]

- 11 Fig. 11 shows the cross-section of a school hall, with measurements of the height in metres taken at 1.5 m intervals from O.

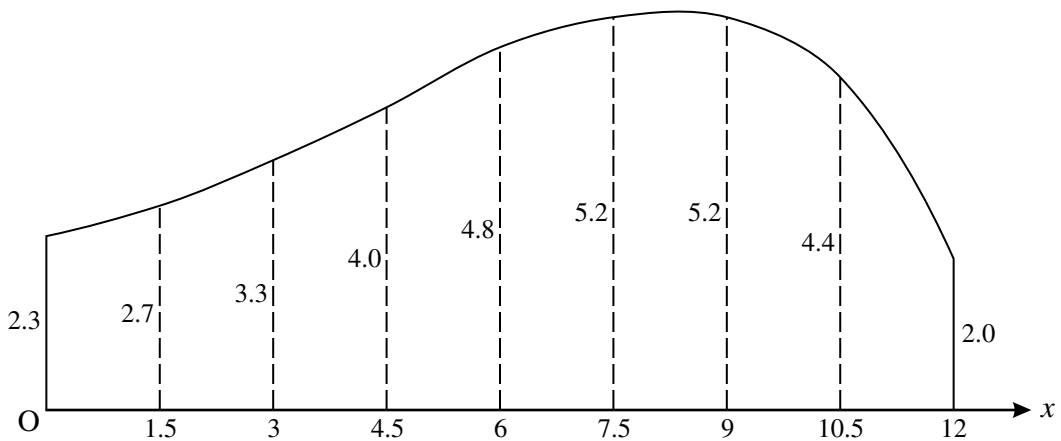


Fig. 11

- (i) Use the trapezium rule with 8 strips to calculate an estimate of the area of the cross-section. [4]
- (ii) Use 8 rectangles to calculate a lower bound for the area of the cross-section. [2]

The curve of the roof may be modelled by  $y = -0.013x^3 + 0.16x^2 - 0.082x + 2.4$ , where  $x$  metres is the horizontal distance from O across the hall, and  $y$  metres is the height.

- (iii) Use integration to find the area of the cross-section according to this model. [4]
- (iv) Comment on the accuracy of this model for the height of the hall when  $x = 7.5$ . [2]

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

Since 1945 the populations of many countries have been growing. The table shows the estimated population of 15- to 59-year-olds in Africa during the period 1955 to 2005.

Year	1955	1965	1975	1985	1995	2005
Population (millions)	131	161	209	277	372	492

Source: United Nations

Such estimates are used to model future population growth and world needs of resources. One model is  $P = a10^{bt}$ , where the population is  $P$  millions,  $t$  is the number of years after 1945 and  $a$  and  $b$  are constants.

- (i) Show that, using this model, the graph of  $\log_{10} P$  against  $t$  is a straight line of gradient  $b$ . State the intercept of this line on the vertical axis. [3]
- (ii) **On the insert**, complete the table, giving values correct to 2 decimal places, and plot the graph of  $\log_{10} P$  against  $t$ . Draw, by eye, a line of best fit on your graph. [3]
- (iii) Use your graph to find the equation for  $P$  in terms of  $t$ . [4]
- (iv) Use your results to estimate the population of 15- to 59-year-olds in Africa in 2050. Comment, with a reason, on the reliability of this estimate. [3]

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INSERT for Question 12

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Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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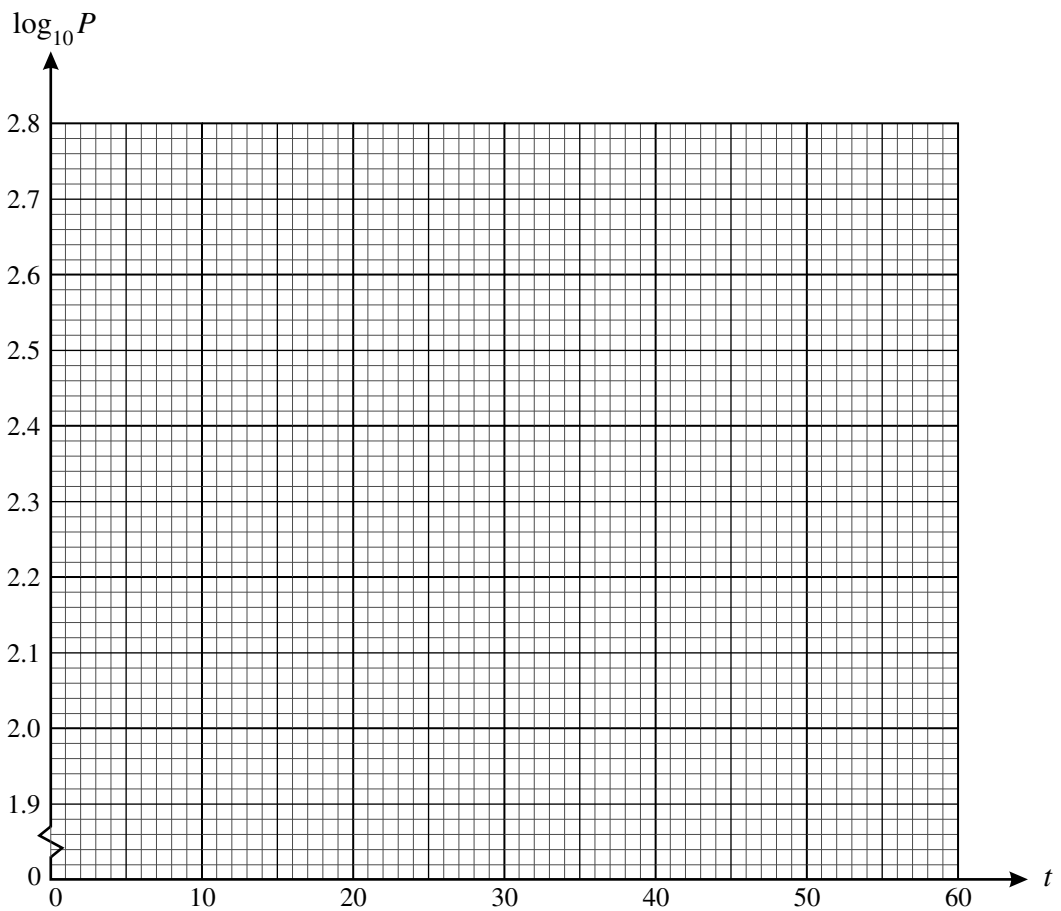
- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- This insert should be used to answer Question 12 part (ii).
- Write your answers to Question 12 part (ii) in the spaces provided in this insert, and **attach it to your Answer Booklet.**

**INFORMATION FOR CANDIDATES**

- This document consists of 2 pages. Any blank pages are indicated.

## 12 (ii)

Year	1955	1965	1975	1985	1995	2005
$t$	10	20	30	40	50	60
$P$	131	161	209	277	372	492
$\log_{10} P$	2.12	2.21				



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