

# 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
- $1 \quad 3 \quad 5 \quad 3 \quad 1 \quad 3 \quad 5 \quad 3 \quad 1 \quad 3 \quad \dots$

and continues in this pattern.

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

[2]

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

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 cm<sup>2</sup> and sector angle 0.4 radians. Calculate the radius of the sector. [3]



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]
-/	) ) !(=!!)	L-1

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

5

3

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

$$u_1 = 5,$$
  
 $u_{n+1} = u_n + 4.$  [3]

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

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.

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]

[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]

[2]

- (iii) Sketch the curve.
- **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.



- (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]