

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary General Certificate of Education  
Advanced General Certificate of Education

MEI STRUCTURED MATHEMATICS

4752

Concepts for Advanced Mathematics (C2)

Wednesday 12 JANUARY 2005 Afternoon 1 hour 30 minutes

Additional materials:

Answer booklet

Graph paper

MEI Examination Formulae and Tables (MF2)

**TIME** 1 hour 30 minutes

**INSTRUCTIONS TO CANDIDATES**

- Write your name, centre number and candidate number in the spaces provided on the answer booklet.
- There is an **insert** for use in Question 11.
- Answer **all** the questions.
- You are permitted to use a graphical calculator in this paper.

**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.
- Final answers should be given to a degree of accuracy appropriate to the context.
- The total number of marks for this paper is 72.

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This question paper consists of 5 printed pages, 3 blank pages and an insert.

**ERRATUM NOTICE**

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**Advanced Subsidiary GCE**

**MEI STRUCTURED MATHEMATICS**

**4752**

Concepts for Advanced Mathematics (C2)

Wednesday

**12 JANUARY 2005**

Afternoon

1 hour 30 minutes

**To be opened immediately**

**For the attention of the Examination Officer and Head of Mathematics**

For the January session of examinations, all yellow examination papers beginning 47.. should have the new yellow formulae booklet MF2.  
All white papers beginning 26.. should have the blue formulae booklet MF12.

There has been an error when sending out the formulae booklets for C2 (4752) and D1 (4771). The 'legacy' formulae booklet (MF12) has been sent.

For the C2 (4752) examination on Wed 12<sup>th</sup> January 05, candidates may use the MF2 they used in the C1 (4751) examination.

For the D1 (4771) examination on Fri 14<sup>th</sup> January 05, the legacy formulae booklet MF12 can be used. This will not disadvantage candidates.

Any enquiry about this notice should be referred to the Information Bureau on 01223 553 998 or [helpdesk@ocr.org.uk](mailto:helpdesk@ocr.org.uk)

## Section A (36 marks)

1 Find  $\frac{dy}{dx}$  when  $y = x^6 + \sqrt{x}$ . [3]

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

3 Sketch the graph of  $y = \sin x$  for  $0^\circ \leq x \leq 360^\circ$ .

Solve the equation  $\sin x = -0.2$  for  $0^\circ \leq x \leq 360^\circ$ . [4]

4

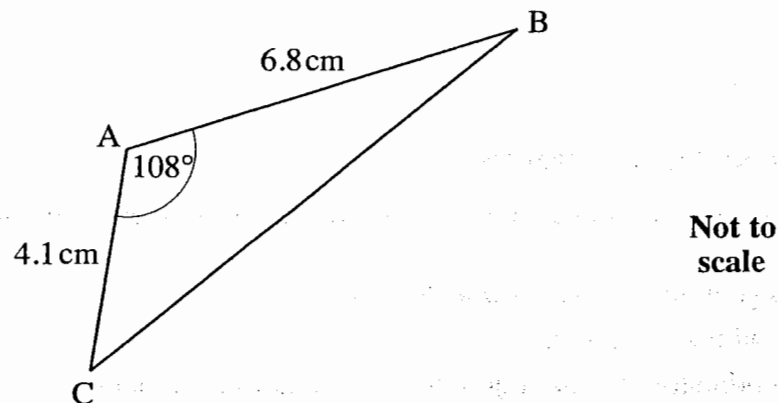


Fig. 4

For triangle ABC shown in Fig. 4, calculate

(i) the length of BC, [3]

(ii) the area of triangle ABC. [2]

5 The first three terms of a geometric progression are 4, 2, 1.

Find the twentieth term, expressing your answer as a power of 2.

Find also the sum to infinity of this progression. [5]

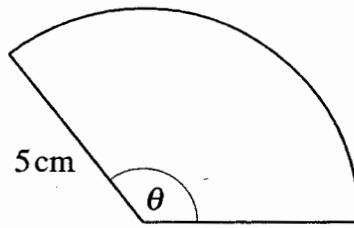
6 A sequence is given by

$$a_1 = 4,$$

$$a_{r+1} = a_r + 3.$$

Write down the first 4 terms of this sequence.

Find the sum of the first 100 terms of the sequence. [5]



Not to  
scale

Fig. 7

Fig. 7 shows a sector of a circle of radius 5 cm which has angle  $\theta$  radians. The sector has area  $30 \text{ cm}^2$ .

(i) Find  $\theta$ . [3]

(ii) Hence find the perimeter of the sector. [2]

8 (i) Solve the equation  $10^x = 316$ . [2]

(ii) Simplify  $\log_a(a^2) - 4\log_a\left(\frac{1}{a}\right)$ . [3]

## Section B (36 marks)

- 9 (i) A tunnel is 100 m long. Its cross-section, shown in Fig. 9.1, is modelled by the curve

$$y = \frac{1}{4}(10x - x^2),$$

where  $x$  and  $y$  are horizontal and vertical distances in metres.

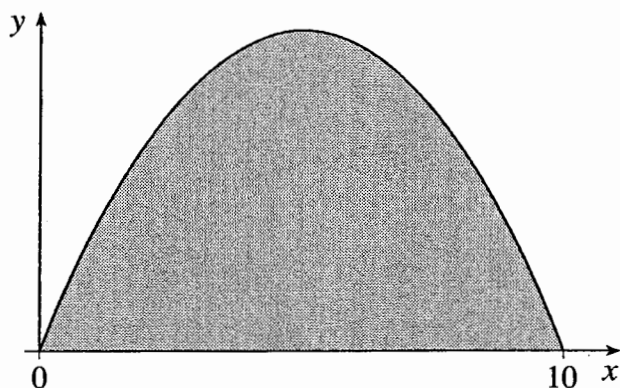


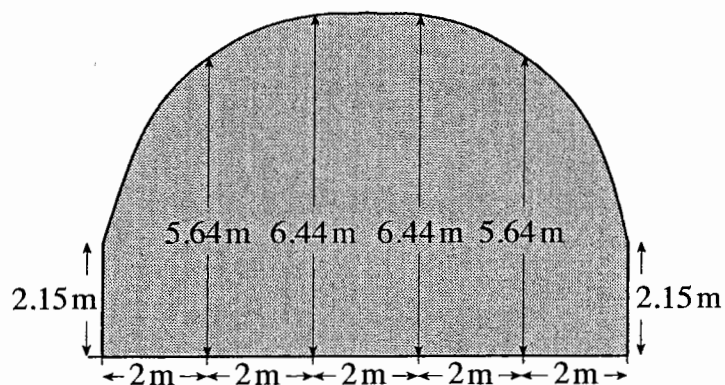
Figure 9.1

Using this model,

- (A) find the greatest height of the tunnel, [2]

- (B) explain why  $100 \int_0^{10} y \, dx$  gives the volume, in cubic metres, of earth removed to make the tunnel. Calculate this volume. [5]

- (ii) The roof of the tunnel is re-shaped to allow for larger vehicles. Fig. 9.2 shows the new cross-section.



Not to scale

Fig. 9.2

Use the trapezium rule with 5 strips to estimate the new cross-sectional area.

- Hence estimate the volume of earth removed when the tunnel is re-shaped. [5]

10 A curve has equation  $y = x^3 - 6x^2 + 12$ .

(i) Use calculus to find the coordinates of the turning points of this curve. Determine also the nature of these turning points. [7]

(ii) Find, in the form  $y = mx + c$ , the equation of the normal to the curve at the point  $(2, -4)$ . [4]

11 Answer part (iii) of this question on the insert provided.

A hot drink is made and left to cool. The table shows its temperature at ten-minute intervals after it is made.

Time (minutes)	10	20	30	40	50
Temperature ( $^{\circ}\text{C}$ )	68	53	42	36	31

The room temperature is  $22^{\circ}\text{C}$ . The difference between the temperature of the drink and room temperature at time  $t$  minutes is  $z^{\circ}\text{C}$ . The relationship between  $z$  and  $t$  is modelled by

$$z = z_0 10^{-kt},$$

where  $z_0$  and  $k$  are positive constants.

(i) Give a physical interpretation for the constant  $z_0$ . [2]

(ii) Show that  $\log_{10} z = -kt + \log_{10} z_0$ . [2]

(iii) On the insert, complete the table and draw the graph of  $\log_{10} z$  against  $t$ .

Use your graph to estimate the values of  $k$  and  $z_0$ .

Hence estimate the temperature of the drink 70 minutes after it is made. [9]