OCR
RECOGNISING ACHIEVEMENT

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.

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

Registered Charity 1066969
[Turn over

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 $0° \leqslant x \leqslant 360°$.

Solve the equation $\sin x = -0.2$ for $0° \leqslant x \leqslant 360°$. [4]

4

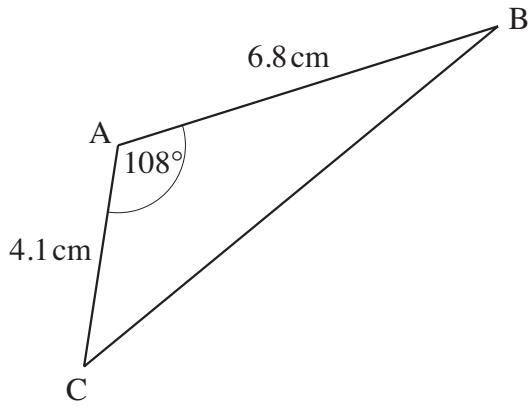

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Fig. 4

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]

7

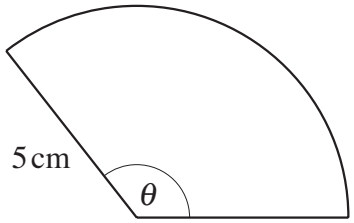

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Fig. 7

Fig. 7 shows a sector of a circle of radius 5 cm which has angle θ radians. The sector has area 30 cm^2.

(i) Find θ. [3]

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

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

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

[Turn over

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

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

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

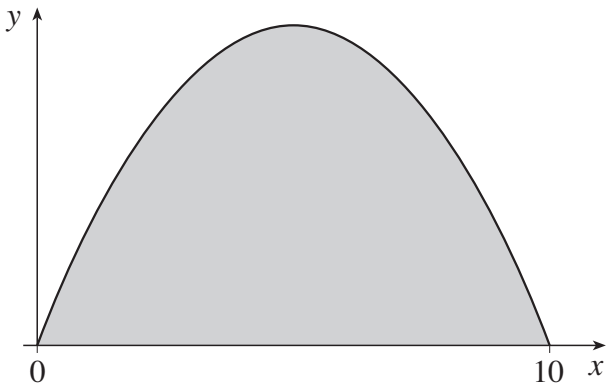

Figure 9.1

Using this model,

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

(*B*) explain why $100\int_0^{10} y\,\mathrm{d}x$ 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.

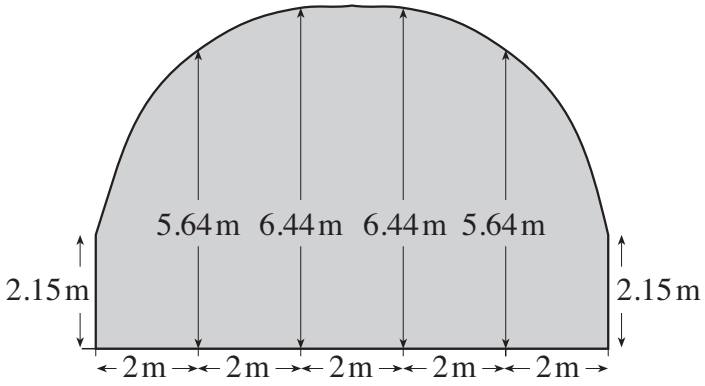

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Fig. 9.2

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 (°C)	68	53	42	36	31

The room temperature is 22 °C. The difference between the temperature of the drink and room temperature at time t minutes is z °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]

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