RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE **4752/01**

MATHEMATICS (MEI)

Concepts for Advanced Mathematics (C2)

WEDNESDAY 9 JANUARY 2008 Afternoon

Time: 1 hour 30 minutes

Additional materials: Answer Booklet (8 pages)
MEI Examination Formulae and Tables (MF2)

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the spaces provided on the answer booklet.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- 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.
- The total number of marks for this paper is 72.
- 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.

This document consists of **6** printed pages and **2** blank pages.

Section A (36 marks)

1 Differentiate $10x^4 + 12$. [2]

2 A sequence begins

1 2 3 4 5 1 2 3 4 5 1 . . .

and continues in this pattern.

(i) Find the 48th term of this sequence. [1]

(ii) Find the sum of the first 48 terms of this sequence. [2]

3 You are given that $\tan\theta = \frac{1}{2}$ and the angle θ is acute. Show, without using a calculator, that $\cos^2\theta = \frac{4}{5}$. [3]

4

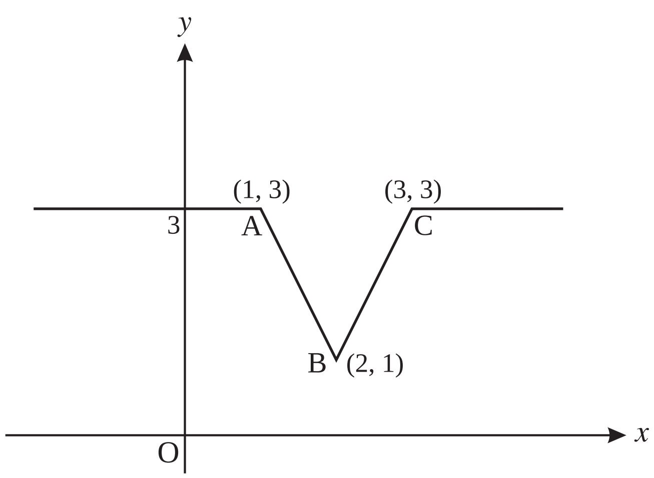

Fig. 4

Fig. 4 shows a sketch of the graph of $y = \mathrm{f}(x)$. On separate diagrams, sketch the graphs of the following, showing clearly the coordinates of the points corresponding to A, B and C.

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

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

5 Find $\int (12x^5 + \sqrt[3]{x} + 7)\,\mathrm{d}x$. [5]

6 **(i)** Sketch the graph of $y = \sin\theta$ for $0 \leqslant \theta \leqslant 2\pi$. [2]

(ii) Solve the equation $2\sin\theta = -1$ for $0 \leqslant \theta \leqslant 2\pi$. Give your answers in the form $k\pi$. [3]

7 **(i)** Find $\sum_{k=2}^{5} 2^k$. [2]

(ii) Find the value of n for which $2^n = \frac{1}{64}$. [1]

(iii) Sketch the curve with equation $y = 2^x$. [2]

8 The second term of a geometric progression is 18 and the fourth term is 2. The common ratio is positive. Find the sum to infinity of this progression. [5]

9 You are given that $\log_{10} y = 3x + 2$.

(i) Find the value of x when $y = 500$, giving your answer correct to 2 decimal places. [1]

(ii) Find the value of y when $x = -1$. [1]

(iii) Express $\log_{10}(y^4)$ in terms of x. [1]

(iv) Find an expression for y in terms of x. [1]

Section B (36 marks)

10

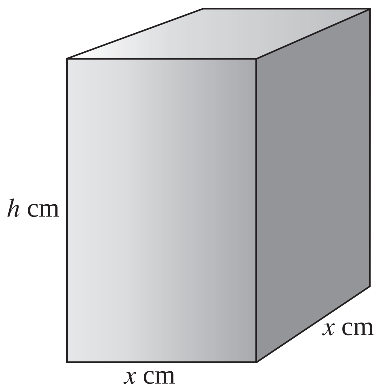

Fig. 10

Fig. 10 shows a solid cuboid with square base of side x cm and height h cm. Its volume is 120 cm^3.

(i) Find h in terms of x. Hence show that the surface area, A cm^2, of the cuboid is given by $A = 2x^2 + \dfrac{480}{x}$. [3]

(ii) Find $\dfrac{dA}{dx}$ and $\dfrac{d^2A}{dx^2}$. [4]

(iii) Hence find the value of x which gives the minimum surface area. Find also the value of the surface area in this case. [5]

11 **(i)** The course for a yacht race is a triangle, as shown in Fig. 11.1. The yachts start at A, then travel to B, then to C and finally back to A.

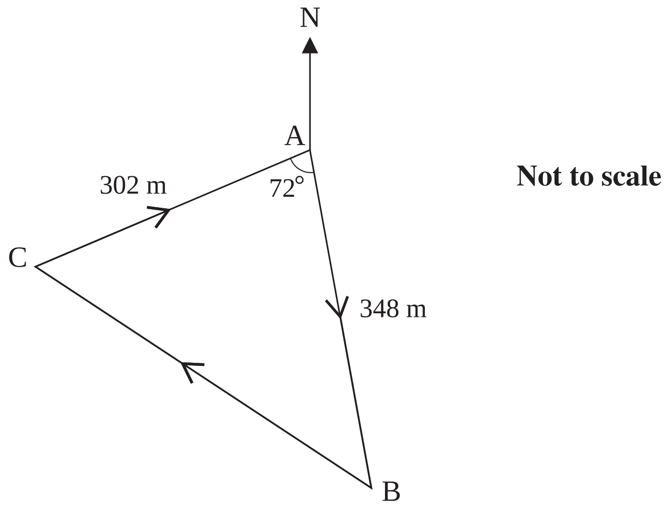

Fig. 11.1

(*A*) Calculate the total length of the course for this race. [4]

(*B*) Given that the bearing of the first stage, AB, is 175°, calculate the bearing of the second stage, BC. [4]

(ii) Fig. 11.2 shows the course of another yacht race. The course follows the arc of a circle from P to Q, then a straight line back to P. The circle has radius 120 m and centre O; angle POQ = 136°.

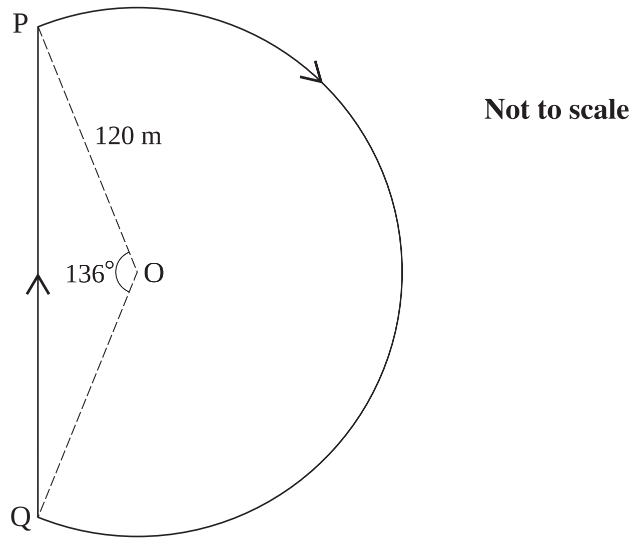

Fig. 11.2

Calculate the total length of the course for this race. [4]

12 **(i)**

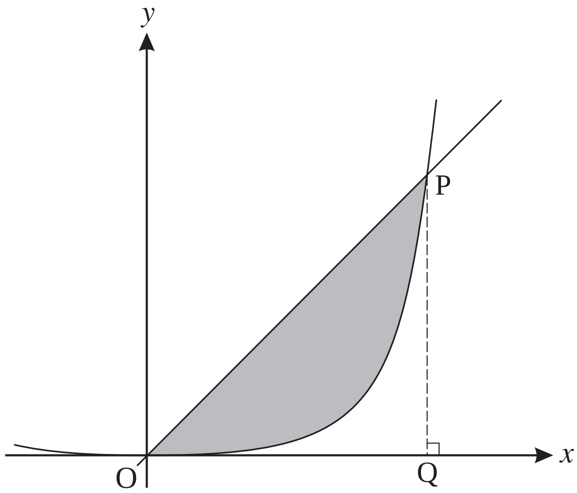

Fig. 12

Fig. 12 shows part of the curve $y = x^4$ and the line $y = 8x$, which intersect at the origin and the point P.

(A) Find the coordinates of P, and show that the area of triangle OPQ is 16 square units. [3]

(B) Find the area of the region bounded by the line and the curve. [3]

(ii) You are given that $\mathrm{f}(x) = x^4$.

(A) Complete this identity for $\mathrm{f}(x + h)$.

$$\mathrm{f}(x+h) = (x+h)^4 = x^4 + 4x^3h + \ \ldots$$ [2]

(B) Simplify $\dfrac{\mathrm{f}(x+h) - \mathrm{f}(x)}{h}$. [2]

(C) Find $\lim\limits_{h \to 0} \dfrac{\mathrm{f}(x+h) - \mathrm{f}(x)}{h}$. [1]

(D) State what this limit represents. [1]

