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)

Tuesday **6 JUNE 2006** Afternoon 1 hour 30 minutes

Additional materials:
8 page 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.
- Answer **all** the questions.
- 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 question paper consists of 4 printed pages and an insert.

HN/4

Section A (36 marks)

1 Write down the values of $\log_a a$ and $\log_a (a^3)$. [2]

2 The first term of a geometric series is 8. The sum to infinity of the series is 10.

Find the common ratio. [3]

3 θ is an acute angle and $\sin\theta = \frac{1}{4}$. Find the exact value of $\tan\theta$. [3]

4 Find $\int_1^2 \left(x^4 - \frac{3}{x^2} + 1\right) dx$, showing your working. [5]

5 The gradient of a curve is given by $\frac{dy}{dx} = 3 - x^2$. The curve passes through the point $(6, 1)$. Find the equation of the curve. [4]

6 A sequence is given by the following.

$$u_1 = 3$$
$$u_{n+1} = u_n + 5$$

(i) Write down the first 4 terms of this sequence. [1]

(ii) Find the sum of the 51st to the 100th terms, inclusive, of the sequence. [4]

7 **(i)** Sketch the graph of $y = \cos x$ for $0° \leqslant x \leqslant 360°$.

On the same axes, sketch the graph of $y = \cos 2x$ for $0° \leqslant x \leqslant 360°$. Label each graph clearly. [3]

(ii) Solve the equation $\cos 2x = 0.5$ for $0° \leqslant x \leqslant 360°$. [2]

8 Given that $y = 6x^3 + \sqrt{x} + 3$, find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$. [5]

9 Use logarithms to solve the equation $5^{3x} = 100$. Give your answer correct to 3 decimal places. [4]

Section B (36 marks)

10 **(i)**

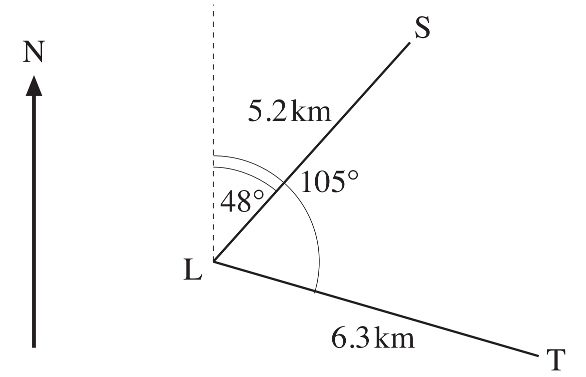

Fig. 10.1

At a certain time, ship S is 5.2 km from lighthouse L on a bearing of 048°. At the same time, ship T is 6.3 km from L on a bearing of 105°, as shown in Fig. 10.1.

For these positions, calculate

(*A*) the distance between ships S and T, [3]

(*B*) the bearing of S from T. [3]

(ii)

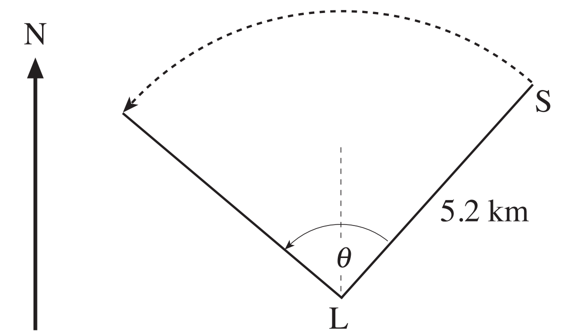

Fig. 10.2

Ship S then travels at $24\,\text{km}\,\text{h}^{-1}$ anticlockwise along the arc of a circle, keeping 5.2 km from the lighthouse L, as shown in Fig. 10.2.

Find, in radians, the angle θ that the line LS has turned through in 26 minutes.

Hence find, in degrees, the bearing of ship S from the lighthouse at this time. [5]

[Turn over

11 A cubic curve has equation $y = x^3 - 3x^2 + 1$.

(i) Use calculus to find the coordinates of the turning points on this curve. Determine the nature of these turning points. [5]

(ii) Show that the tangent to the curve at the point where $x = -1$ has gradient 9.

Find the coordinates of the other point, P, on the curve at which the tangent has gradient 9 and find the equation of the normal to the curve at P.

Show that the area of the triangle bounded by the normal at P and the x- and y-axes is 8 square units. [8]

12 **Answer the whole of this question on the insert provided.**

A colony of bats is increasing. The population, P, is modelled by $P = a \times 10^{bt}$, where t is the time in years after 2000.

(i) Show that, according to this model, the graph of $\log_{10} P$ against t should be a straight line of gradient b. State, in terms of a, the intercept on the vertical axis. [3]

(ii) The table gives the data for the population from 2001 to 2005.

Year	2001	2002	2003	2004	2005
t	1	2	3	4	5
P	7900	8800	10000	11300	12800

Complete the table of values on the insert, and plot $\log_{10} P$ against t. Draw a line of best fit for the data. [3]

(iii) Use your graph to find the equation for P in terms of t. [4]

(iv) Predict the population in 2008 according to this model. [2]