OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

MATHEMATICS (MEI)

4752

Concepts for Advanced Mathematics (C2)

Candidates answer on the Answer Booklet

OCR Supplied Materials:
- 8 page Answer Booklet
- Insert for Question 10 (inserted)
- MEI Examination Formulae and Tables (MF2)

Other Materials Required:
None

Friday 22 May 2009
Morning

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 **10**.
- 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 **4** pages. Any blank pages are indicated.

Section A (36 marks)

1 Use an isosceles right-angled triangle to show that $\cos 45° = \frac{1}{\sqrt{2}}$. **[2]**

2 Find $\int_1^2 (12x^5 + 5)\,dx$. **[4]**

3 **(i)** Find $\sum_{k=3}^{8} (k^2 - 1)$. **[2]**

(ii) State whether the sequence with kth term $k^2 - 1$ is convergent or divergent, giving a reason for your answer. **[1]**

4 A sector of a circle of radius 18.0 cm has arc length 43.2 cm.

(i) Find in radians the angle of the sector. **[2]**

(ii) Find this angle in degrees, giving your answer to the nearest degree. **[2]**

5 **(i)** On the same axes, sketch the graphs of $y = \cos x$ and $y = \cos 2x$ for values of x from 0 to 2π. **[3]**

(ii) Describe the transformation which maps the graph of $y = \cos x$ onto the graph of $y = 3\cos x$. **[2]**

6 Use calculus to find the x-coordinates of the turning points of the curve $y = x^3 - 6x^2 - 15x$.

Hence find the set of values of x for which $x^3 - 6x^2 - 15x$ is an increasing function. **[5]**

7 Show that the equation $4\cos^2\theta = 4 - \sin\theta$ may be written in the form

$$4\sin^2\theta - \sin\theta = 0.$$

Hence solve the equation $4\cos^2\theta = 4 - \sin\theta$ for $0° \leqslant \theta \leqslant 180°$. **[5]**

8 The gradient of a curve is $3\sqrt{x} - 5$. The curve passes through the point (4, 6). Find the equation of the curve. **[5]**

9 Simplify

(i) $10 - 3\log_a a$, **[1]**

(ii) $\dfrac{\log_{10} a^5 + \log_{10}\sqrt{a}}{\log_{10} a}$. **[2]**

Section B (36 marks)

10 Answer part (i) of this question on the insert provided.

Ash trees grow quickly for the first years of their life, then more slowly. This table shows the height of a tree at various ages.

Age (t years)	4	7	10	15	20	40
Height (h m)	4	9	12	17	19	26

The height, h m, of an ash tree when it is t years old may be modelled by an equation of the form

$$h = a \log_{10} t + b.$$

(i) **On the insert**, complete the table and plot h against $\log_{10} t$, drawing by eye a line of best fit. **[3]**

(ii) Use your graph to find an equation for h in terms of $\log_{10} t$ for this model. **[3]**

(iii) Find the height of the tree at age 100 years, as predicted by this model. **[1]**

(iv) Find the age of the tree when it reaches a height of 29 m, according to this model. **[3]**

(v) Comment on the suitability of the model when the tree is very young. **[2]**

11 (i) In a 'Make Ten' quiz game, contestants get £10 for answering the first question correctly, then a further £20 for the second question, then a further £30 for the third, and so on, until they get a question wrong and are out of the game.

(*A*) Haroon answers six questions correctly. Show that he receives a total of £210. **[1]**

(*B*) State, in a simple form, a formula for the total amount received by a contestant who answers n questions correctly.

Hence find the value of n for a contestant who receives £10 350 from this game. **[4]**

(ii) In a 'Double Your Money' quiz game, contestants get £5 for answering the first question correctly, then a further £10 for the second question, then a further £20 for the third, and so on doubling the amount for each question until they get a question wrong and are out of the game.

(*A*) Gary received £75 from the game. How many questions did he get right? **[1]**

(*B*) Bethan answered 9 questions correctly. How much did she receive from the game? **[2]**

(*C*) State a formula for the total amount received by a contestant who answers n questions correctly.

Hence find the value of n for a contestant in this game who receives £2 621 435. **[4]**

[Question 12 is printed overleaf.]

12 **(i)** Calculate the gradient of the chord joining the points on the curve $y = x^2 - 7$ for which $x = 3$ and $x = 3.1$. **[2]**

(ii) Given that $f(x) = x^2 - 7$, find and simplify $\dfrac{f(3+h) - f(3)}{h}$. **[3]**

(iii) Use your result in part **(ii)** to find the gradient of $y = x^2 - 7$ at the point where $x = 3$, showing your reasoning. **[2]**

(iv) Find the equation of the tangent to the curve $y = x^2 - 7$ at the point where $x = 3$. **[2]**

(v) This tangent crosses the x-axis at the point P. The curve crosses the positive x-axis at the point Q. Find the distance PQ, giving your answer correct to 3 decimal places. **[3]**