



MATHEMATICS
STANDARD LEVEL
PAPER 1

Friday 7 November 2008 (afternoon)

1 hour 30 minutes

Candidate session number

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INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- You are not permitted access to any calculator for this paper.
- Section A: answer all of Section A in the spaces provided.
- Section B: answer all of Section B on the answer sheets provided. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the number of sheets used in the appropriate box on your cover sheet.
- Unless otherwise stated in the question, all numerical answers must be given exactly or correct to three significant figures.

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Full marks are not necessarily awarded for a correct answer with no working. Answers must be supported by working and/or explanations. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written working. You are therefore advised to show all working.

SECTION A

Answer **all** the questions in the spaces provided. Working may be continued below the lines, if necessary.

1. [Maximum mark: 5]

Consider the infinite geometric sequence $3, 3(0.9), 3(0.9)^2, 3(0.9)^3, \dots$

(a) Write down the 10th term of the sequence. Do not simplify your answer. [1 mark]

(b) Find the sum of the infinite sequence. [4 marks]

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2. [Maximum mark: 6]

A particle is moving with a constant velocity along line L . Its initial position is $A(6, -2, 10)$. After one second the particle has moved to $B(9, -6, 15)$.

(a) (i) Find the velocity vector, \vec{AB} .

(ii) Find the speed of the particle. [4 marks]

(b) Write down an equation of the line L . [2 marks]

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3. [Maximum mark: 7]

Let $A = \begin{pmatrix} 1 & -2 \\ 3 & p \end{pmatrix}$ and $B = \begin{pmatrix} -2 & 1 \\ q & \frac{1}{2} \end{pmatrix}$.

(a) Find AB in terms of p and q . [2 marks]

(b) Matrix B is the inverse of matrix A . Find the value of p and of q . [5 marks]

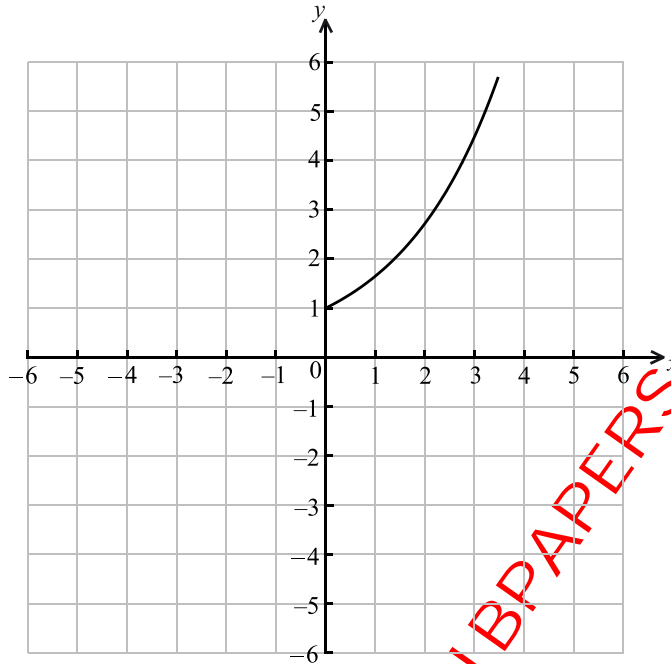
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4. [Maximum mark: 7]

Let f be the function given by $f(x) = e^{0.5x}$, $0 \leq x \leq 3.5$. The diagram shows the graph of f .



- (a) On the same diagram, sketch the graph of f^{-1} . [3 marks]
- (b) Write down the range of f^{-1} . [1 mark]
- (c) Find $f^{-1}(x)$. [3 marks]

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5. [Maximum mark: 6]

Let A and B be independent events, where $P(A) = 0.6$ and $P(B) = x$.

(a) Write down an expression for $P(A \cap B)$. [1 mark]

(b) Given that $P(A \cup B) = 0.8$,

(i) find x ;

(ii) find $P(A \cap B)$. [4 marks]

(c) Hence, explain why A and B are **not** mutually exclusive. [1 mark]

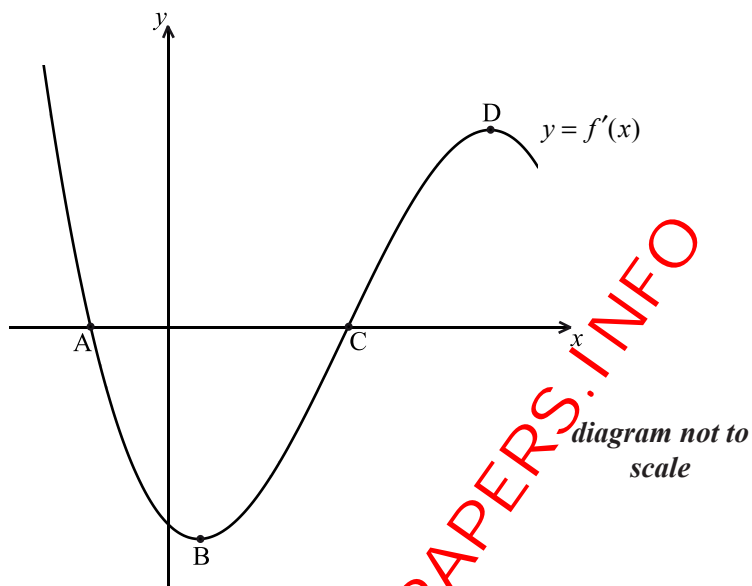
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6. [Maximum mark: 7]

The diagram shows part of the graph of $y = f'(x)$. The x -intercepts are at points A and C. There is a minimum at B, and a maximum at D.



- (a) (i) Write down the value of $f'(x)$ at C. [3 marks]
- (ii) **Hence**, show that C corresponds to a minimum on the graph of f , i.e. it has the same x -coordinate. [1 mark]
- (b) Which of the points A, B, D corresponds to a maximum on the graph of f ? [3 marks]
- (c) Show that B corresponds to a point of inflexion on the graph of f . [1 mark]

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7. [Maximum mark: 7]

Let $f(x) = \sin^3 x + \cos^3 x \tan x$, $\frac{\pi}{2} < x < \pi$.

(a) Show that $f(x) = \sin x$.

[2 marks]

(b) Let $\sin x = \frac{2}{3}$. Show that $f(2x) = -\frac{4\sqrt{5}}{9}$.

[5 marks]

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SECTION B

Answer **all** the questions on the answer sheets provided. Please start each question on a new page.

8. [Maximum mark: 13]

Two standard six-sided dice are tossed. A diagram representing the sample space is shown below.

		Score on second die					
		1	2	3	4	5	6
Score on first die	1	•	•	•	•	•	•
	2	•	•	•	•	•	•
	3	•	•	•	•	•	•
	4	•	•	•	•	•	•
	5	•	•	•	•	•	•
	6	•	•	•	•	•	•

Let X be the sum of the scores on the two dice.

(a) Find

(i) $P(X = 6)$;

(ii) $P(X > 6)$;

(iii) $P(X = 7 | X > 5)$

[6 marks]

(b) Elena plays a game where she tosses two dice.

If the sum is 6, she wins 3 points.

If the sum is greater than 6, she wins 1 point.

If the sum is less than 6, she **loses** k points.

Find the value of k for which Elena's expected number of points is zero.

[7 marks]



9. [Maximum mark: 16]

The acceleration, $a \text{ ms}^{-2}$, of a particle at time t seconds is given by $a = 2t + \cos t$.

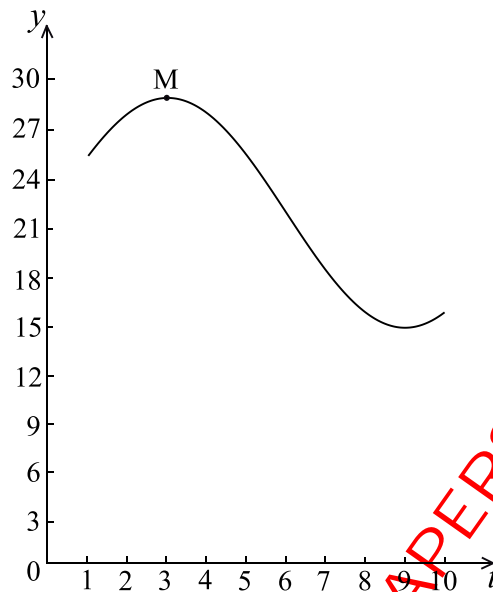
- (a) Find the acceleration of the particle at $t = 0$. [2 marks]
- (b) Find the velocity, v , at time t , given that the initial velocity of the particle is 2 ms^{-1} . [5 marks]
- (c) Find $\int_0^3 v dt$, giving your answer in the form $p - q \cos 3$. [7 marks]
- (d) What information does the answer to part (c) give about the motion of the particle? [2 marks]

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10. [Maximum mark: 16]

Let $f(t) = a \cos b(t - c) + d$, $t \geq 0$. Part of the graph of $y = f(t)$ is given below.



When $t = 3$, there is a maximum value of 29, at M.

When $t = 9$, there is a minimum value of 15.

(a) (i) Find the value of a .

(ii) Show that $b = \frac{\pi}{6}$.

(iii) Find the value of d .

(iv) Write down a value for c .

[7 marks]

The transformation P is given by a horizontal stretch of a scale factor of $\frac{1}{2}$, followed by a translation of $\begin{pmatrix} 3 \\ -10 \end{pmatrix}$.

(b) Let M' be the image of M under P . Find the coordinates of M' .

[2 marks]

The graph of g is the image of the graph of f under P .

(c) Find $g(t)$ in the form $g(t) = 7 \cos B(t - C) + D$.

[4 marks]

(d) Give a full geometric description of the transformation that maps the graph of g to the graph of f .

[3 marks]

