



MATHEMATICS
STANDARD LEVEL
PAPER 2

Friday 5 November 2010 (morning)

Candidate session number

1 hour 30 minutes

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INSTRUCTIONS TO CANDIDATES

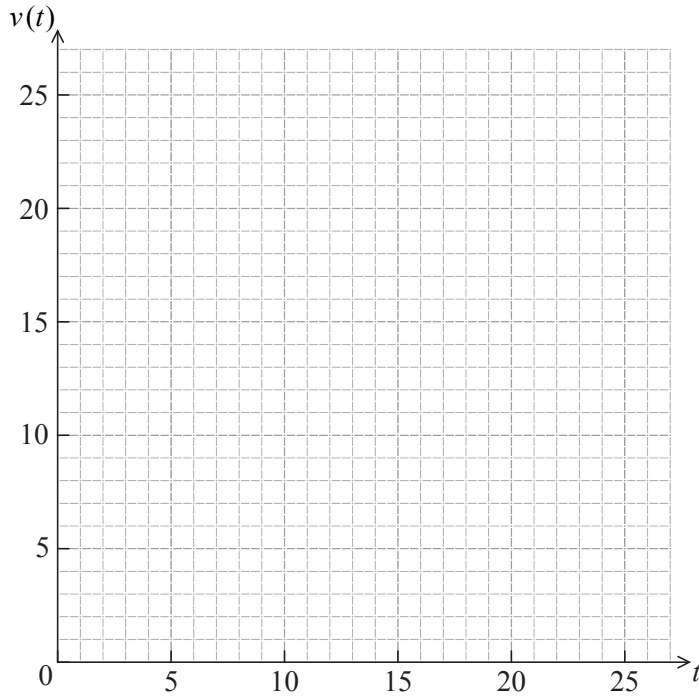
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- A graphic display calculator is required for this paper.
- Section A: answer all of Section A in the spaces provided.
- Section B: answer all of Section B on the answer sheets provided. Write 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.



2. [Maximum mark: 7]

The velocity $v \text{ ms}^{-1}$ of an object after t seconds is given by $v(t) = 15\sqrt{t} - 3t$, for $0 \leq t \leq 25$.

(a) On the grid below, sketch the graph of v , clearly indicating the maximum point. [3 marks]



Let d be the distance travelled in the first nine seconds.

(b) (i) Write down an expression for d .

(ii) Hence, write down the value of d . [4 marks]

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3. [Maximum mark: 6]

The n^{th} term of an arithmetic sequence is given by $u_n = 5 + 2n$.

(a) Write down the common difference. [1 mark]

(b) (i) Given that the n^{th} term of this sequence is 115, find the value of n .

(ii) For this value of n , find the sum of the sequence. [5 marks]

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4. [Maximum mark: 7]

Let $\mathbf{v} = \begin{pmatrix} 2 \\ -3 \\ 6 \end{pmatrix}$ and $\mathbf{w} = \begin{pmatrix} k \\ -2 \\ 4 \end{pmatrix}$, for $k > 0$. The angle between \mathbf{v} and \mathbf{w} is $\frac{\pi}{3}$.

Find the value of k .

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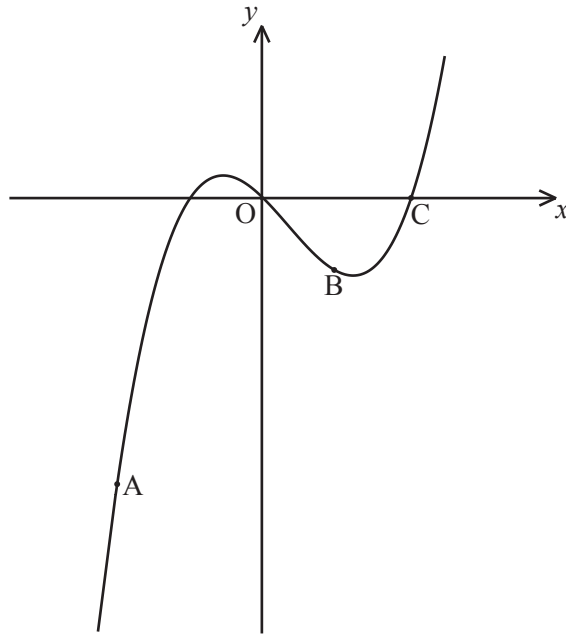
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5. [Maximum mark: 7]

Consider the function $f(x) = px^3 + qx^2 + rx$. Part of the graph of f is shown below.



The graph passes through the origin O and the points A(-2, -8), B(1, -2) and C(2, 0).

(a) Find three linear equations in p , q and r . [4 marks]

(b) Hence find the value of p , of q and of r . [3 marks]

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7. [Maximum mark: 5]

Let $f'(x) = -24x^3 + 9x^2 + 3x + 1$.

(a) There are two points of inflexion on the graph of f . Write down the x -coordinates of these points. [3 marks]

(b) Let $g(x) = f''(x)$. Explain why the graph of g has no points of inflexion. [2 marks]

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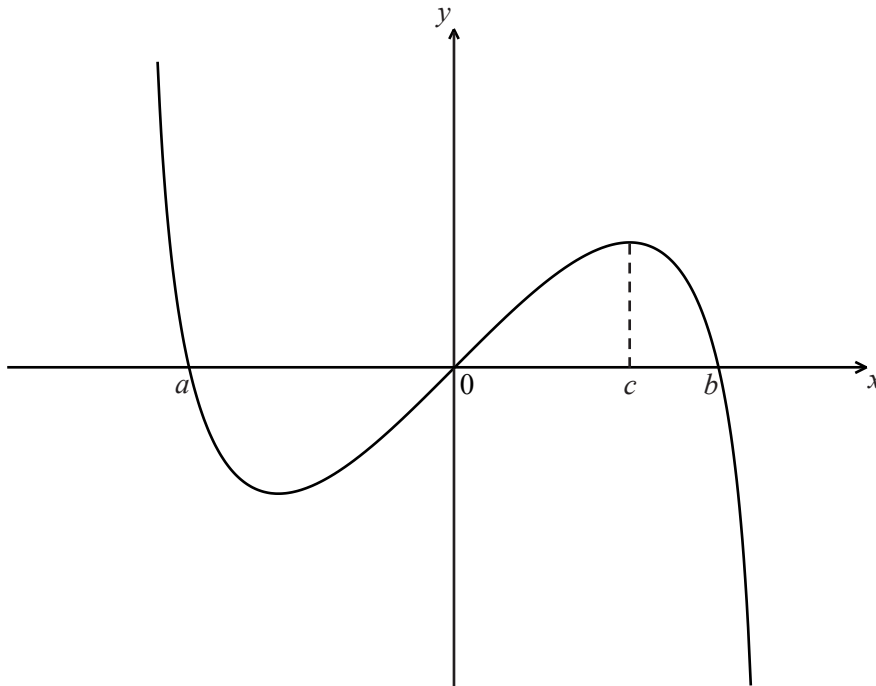
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SECTION B

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

8. [Maximum mark: 12]

Let $f(x) = x \ln(4 - x^2)$, for $-2 < x < 2$. The graph of f is shown below.



The graph of f crosses the x -axis at $x = a$, $x = 0$ and $x = b$.

(a) Find the value of a and of b . [3 marks]

The graph of f has a maximum value when $x = c$.

(b) Find the value of c . [2 marks]

(c) The region under the graph of f from $x = 0$ to $x = c$ is rotated 360° about the x -axis. Find the volume of the solid formed. [3 marks]

(d) Let R be the region enclosed by the curve, the x -axis and the line $x = c$, between $x = a$ and $x = c$.

Find the area of R . [4 marks]



Do **NOT** write solutions on this page. Any working on this page will **NOT** be marked.

9. [Maximum mark: 17]

A test has five questions. To pass the test, at least three of the questions must be answered correctly.

The probability that Mark answers a question correctly is $\frac{1}{5}$. Let X be the number of questions that Mark answers correctly.

(a) (i) Find $E(X)$.

(ii) Find the probability that Mark passes the test.

[6 marks]

Bill also takes the test. Let Y be the number of questions that Bill answers correctly. The following table is the probability distribution for Y .

y	0	1	2	3	4	5
$P(Y = y)$	0.67	0.05	$a + 2b$	$a - b$	$2a + b$	0.04

(b) (i) Show that $4a + 2b = 0.24$.

(ii) Given that $E(Y) = 1$, find a and b .

[8 marks]

(c) Find which student is more likely to pass the test.

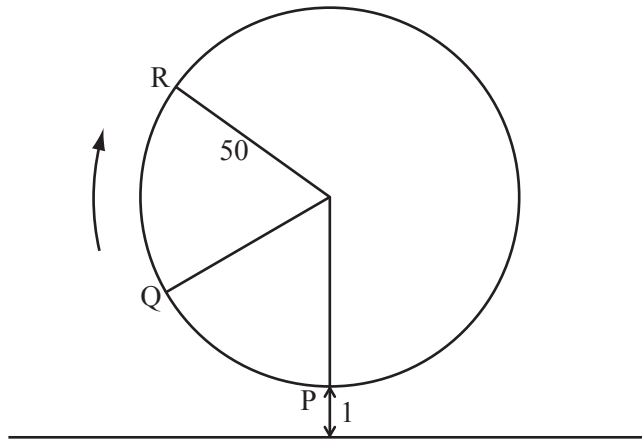
[3 marks]



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10. [Maximum mark: 16]

The following diagram represents a large Ferris wheel at an amusement park. The points P, Q and R represent different positions of a seat on the wheel.



The wheel has a radius of 50 metres and rotates clockwise at a rate of one revolution every 30 minutes.

A seat starts at the lowest point P, when its height is one metre above the ground.

- (a) Find the height of a seat above the ground after 15 minutes. [2 marks]
- (b) After six minutes, the seat is at point Q. Find its height above the ground at Q. [5 marks]

The height of the seat above ground after t minutes can be modelled by the function $h(t) = 50 \sin(b(t-c)) + 51$.

- (c) Find the value of b and of c . [6 marks]
- (d) Hence find the value of t the first time the seat is 96 m above the ground. [3 marks]

