



88117301



**MATHEMATICS**  
**STANDARD LEVEL**  
**PAPER 1**

Candidate session number

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Wednesday 2 November 2011 (afternoon)

Examination code

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1 hour 30 minutes

**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 questions in the boxes provided.
- Section B: answer all questions 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 should be given exactly or correct to three significant figures.



0112

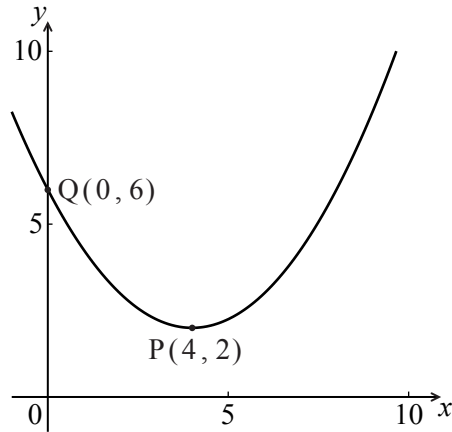
Full marks are not necessarily awarded for a correct answer with no working. Answers must be supported by working and/or explanations. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written working. You are therefore advised to show all working.

**SECTION A**

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

1. [Maximum mark: 6]

Let  $f$  be a quadratic function. Part of the graph of  $f$  is shown below.



The vertex is at  $P(4, 2)$  and the  $y$ -intercept is at  $Q(0, 6)$ .

(a) Write down the equation of the axis of symmetry. [1 mark]

The function  $f$  can be written in the form  $f(x) = a(x - h)^2 + k$ .

(b) Write down the value of  $h$  and of  $k$ . [2 marks]

(c) Find  $a$ . [3 marks]

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2. [Maximum mark: 5]

Let  $\mathbf{P} = \begin{pmatrix} 3 & 1 \\ 5 & 2 \end{pmatrix}$  and  $\mathbf{Q} = \begin{pmatrix} 4 & -2 \\ -10 & 6 \end{pmatrix}$ .

(a) Find  $\mathbf{PQ}$ . [3 marks]

(b) Hence, or otherwise, write down  $\mathbf{P}^{-1}$ . [2 marks]

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3. [Maximum mark: 6]

A box contains six red marbles and two blue marbles. Anna selects a marble from the box. She replaces the marble and then selects a second marble.

- (a) Write down the probability that the first marble Anna selects is red. [1 mark]
- (b) Find the probability that Anna selects two red marbles. [2 marks]
- (c) Find the probability that one marble is red and one marble is blue. [3 marks]

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4. [Maximum mark: 6]

Let  $f'(x) = 3x^2 + 2$ . Given that  $f(2) = 5$ , find  $f(x)$ .

A large rectangular box containing 12 horizontal dotted lines for writing the solution.



5. [Maximum mark: 6]

The random variable  $X$  has the following probability distribution.

$x$	1	2	3
$P(X = x)$	$s$	0.3	$q$

Given that  $E(X) = 1.7$ , find  $q$ .

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7. [Maximum mark: 8]

Let  $f(x) = \frac{1}{2}x^2 + kx + 8$ , where  $k \in \mathbb{Z}$ .

(a) Find the values of  $k$  such that  $f(x) = 0$  has two equal roots. [4 marks]

(b) Each value of  $k$  is equally likely for  $-5 \leq k \leq 5$ . Find the probability that  $f(x) = 0$  has no roots. [4 marks]

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

### SECTION B

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

8. [Maximum mark: 18]

The line  $L_1$  passes through the points  $P(2, 4, 8)$  and  $Q(4, 5, 4)$ .

(a) (i) Find  $\vec{PQ}$ .

(ii) Hence write down a vector equation for  $L_1$  in the form  $\mathbf{r} = \mathbf{a} + s\mathbf{b}$ . [4 marks]

The line  $L_2$  is perpendicular to  $L_1$ , and parallel to  $\begin{pmatrix} 3p \\ 2p \\ 4 \end{pmatrix}$ , where  $p \in \mathbb{Z}$ .

(b) (i) Find the value of  $p$ .

(ii) Given that  $L_2$  passes through  $R(10, 6, -40)$ , write down a vector equation for  $L_2$ . [7 marks]

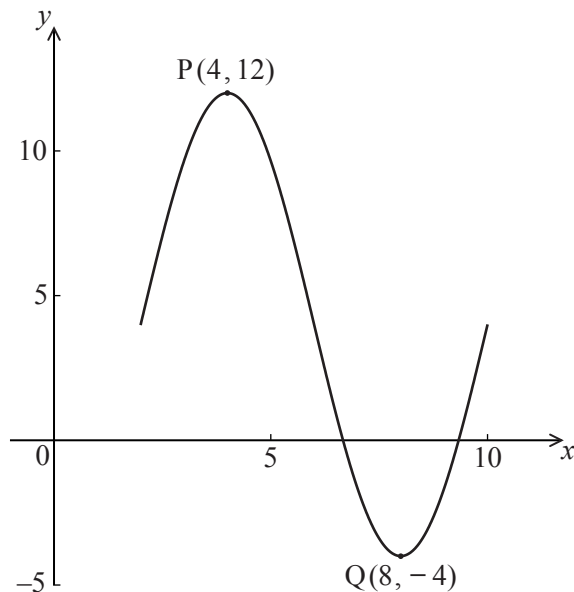
(c) The lines  $L_1$  and  $L_2$  intersect at the point  $A$ . Find the  $x$ -coordinate of  $A$ . [7 marks]



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

9. [Maximum mark: 14]

The following diagram shows the graph of  $f(x) = a \sin(b(x-c)) + d$ , for  $2 \leq x \leq 10$ .



There is a maximum point at  $P(4, 12)$  and a minimum point at  $Q(8, -4)$ .

- (a) Use the graph to write down the value of
  - (i)  $a$ ;
  - (ii)  $c$ ;
  - (iii)  $d$ . [3 marks]
- (b) Show that  $b = \frac{\pi}{4}$ . [2 marks]
- (c) Find  $f'(x)$ . [3 marks]
- (d) At a point R, the gradient is  $-2\pi$ . Find the  $x$ -coordinate of R. [6 marks]



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

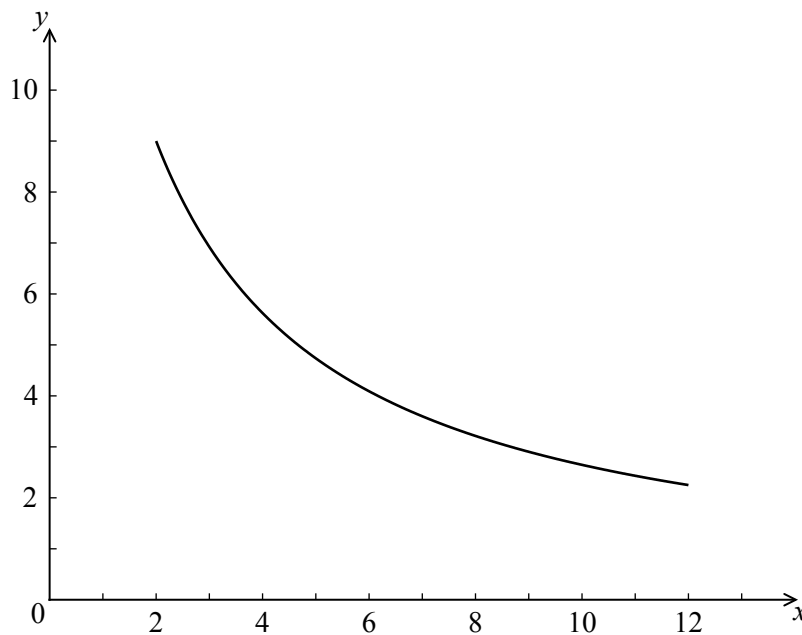
10. [Maximum mark: 13]

Let  $f(x) = \frac{1}{4}x^2 + 2$ . The line  $L$  is the tangent to the curve of  $f$  at  $(4, 6)$ .

(a) Find the equation of  $L$ .

[4 marks]

Let  $g(x) = \frac{90}{3x+4}$ , for  $2 \leq x \leq 12$ . The following diagram shows the graph of  $g$ .



(b) Find the area of the region enclosed by the curve of  $g$ , the  $x$ -axis, and the lines  $x = 2$  and  $x = 12$ . Give your answer in the form  $a \ln b$ , where  $a, b \in \mathbb{Z}$ .

[6 marks]

(c) The graph of  $g$  is reflected in the  $x$ -axis to give the graph of  $h$ . The area of the region enclosed by the lines  $L$ ,  $x = 2$ ,  $x = 12$  and the  $x$ -axis is  $120 \text{ cm}^2$ .

Find the area enclosed by the lines  $L$ ,  $x = 2$ ,  $x = 12$  and the graph of  $h$ .

[3 marks]



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Answers written on this page will  
not be marked.



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