Diploma Programme
Programme du diplôme
Programa del Diploma

Mathematics
Standard level
Paper 1

Wednesday 11 November 2015 (morning)

1 hour 30 minutes

Candidate session number

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 in the answer booklet provided. Fill in your session number on the front of the answer booklet, and attach it to this examination paper and your cover sheet using the tag provided.
- Unless otherwise stated in the question, all numerical answers should be given exactly or correct to three significant figures.
- A clean copy of the **mathematics SL formula booklet** is required for this paper.
- The maximum mark for this examination paper is **[90 marks]**.

8815–7301

Please **do not** write on this page.

Answers written on this page will not be marked.

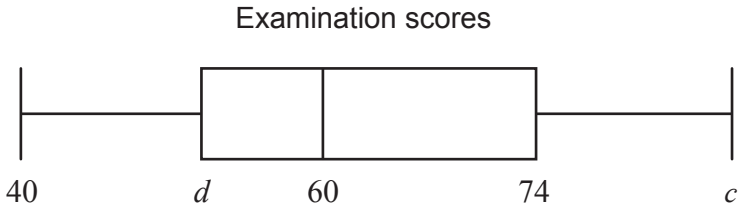
Full marks are not necessarily awarded for a correct answer with no working. Answers must be supported by working and/or explanations. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written working. You are therefore advised to show all working.

Section A

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

1. [Maximum mark: 5]

The following box-and-whisker plot represents the examination scores of a group of students.



(a) Write down the median score. [1]

The range of the scores is 47 marks, and the interquartile range is 22 marks.

(b) Find the value of

(i) c;

(ii) d. [4]

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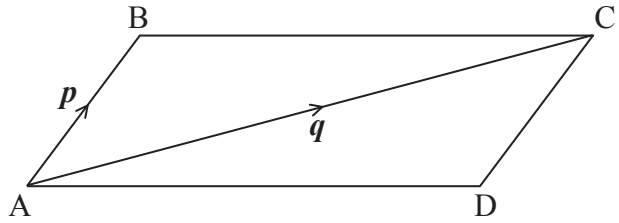
2. [Maximum mark: 7]

The following diagram shows the parallelogram ABCD.



Let $\overrightarrow{AB} = \boldsymbol{p}$ and $\overrightarrow{AC} = \boldsymbol{q}$. Find each of the following vectors in terms of $\boldsymbol{p}$ and/or $\boldsymbol{q}$.

(a) $\overrightarrow{CB}$ [2]

(b) $\overrightarrow{CD}$ [2]

(c) $\overrightarrow{DB}$ [3]

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3. [Maximum mark: 6]

Let $f'(x) = 6x^2 - 5$. Given that $f(2) = -3$, find $f(x)$.

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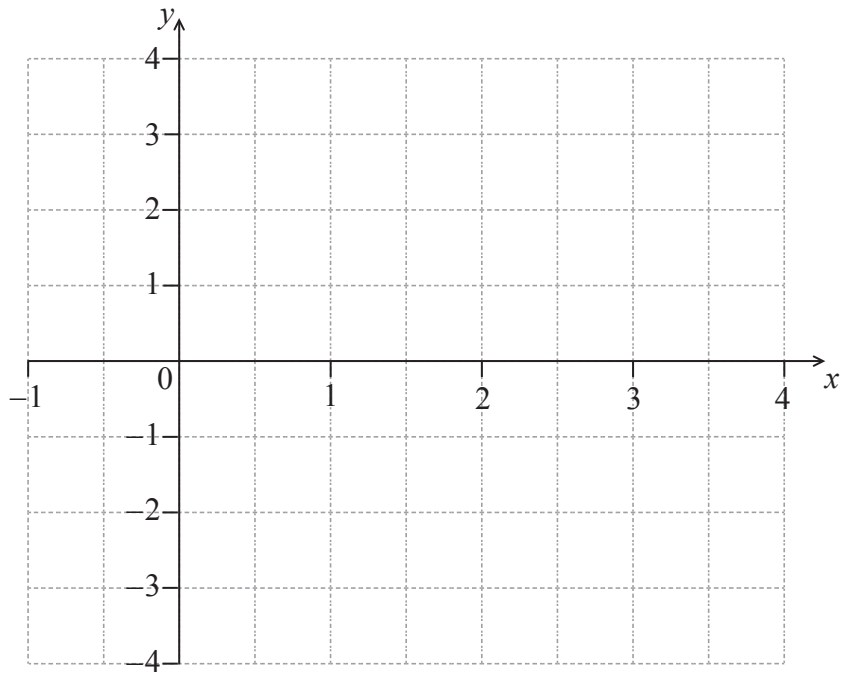
4. [Maximum mark: 7]

Let $f(x) = 3\sin(\pi x)$.

(a) Write down the amplitude of f. [1]

(b) Find the period of f. [2]

(c) On the following grid, sketch the graph of $y = f(x)$, for $0 \le x \le 3$. [4]



5. [Maximum mark: 6]

Let $f(x) = (x-5)^3$, for $x \in \mathbb{R}$.

(a) Find $f^{-1}(x)$. [3]

(b) Let g be a function so that $(f \circ g)(x) = 8x^6$. Find $g(x)$. [3]

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6. [Maximum mark: 7]

In the expansion of $(3x+1)^n$, the coefficient of the term in x^2 is $135n$, where $n \in \mathbb{Z}^+$. Find n.

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7. [Maximum mark: 6]

An arithmetic sequence has the first term $\ln a$ and a common difference $\ln 3$.
The 13th term in the sequence is $8\ln 9$. Find the value of a.

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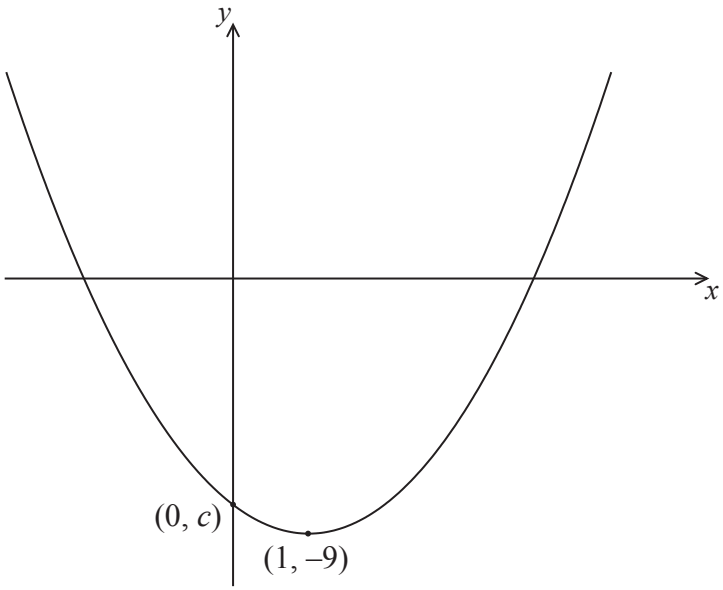
Section B

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

8. [Maximum mark: 16]

The following diagram shows part of the graph of a quadratic function f.



The vertex is at $(1, -9)$, and the graph crosses the y-axis at the point $(0, c)$.

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

(a) Write down the value of h and of k. [2]

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

Let $g(x) = -(x - 3)^2 + 1$. The graph of g is obtained by a reflection of the graph of f in the x-axis, followed by a translation of $\begin{pmatrix} p \\ q \end{pmatrix}$.

(c) Find the value of p and of q. [5]

(d) Find the x-coordinates of the points of intersection of the graphs of f and g. [7]

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9. [Maximum mark: 15]

A line L_1 passes through the points $\mathrm{A}(0, -3, 1)$ and $\mathrm{B}(-2, 5, 3)$.

(a) (i) Show that $\vec{\mathrm{AB}} = \begin{pmatrix} -2 \\ 8 \\ 2 \end{pmatrix}$.

(ii) Write down a vector equation for L_1. [3]

A line L_2 has equation $\boldsymbol{r} = \begin{pmatrix} -1 \\ 7 \\ -4 \end{pmatrix} + s\begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix}$. The lines L_1 and L_2 intersect at a point C.

(b) Show that the coordinates of C are $(-1, 1, 2)$. [5]

(c) A point D lies on line L_2 so that $\left|\vec{\mathrm{CD}}\right| = \sqrt{18}$ and $\vec{\mathrm{CA}} \bullet \vec{\mathrm{CD}} = -9$. Find $\mathrm{A\hat{C}D}$. [7]

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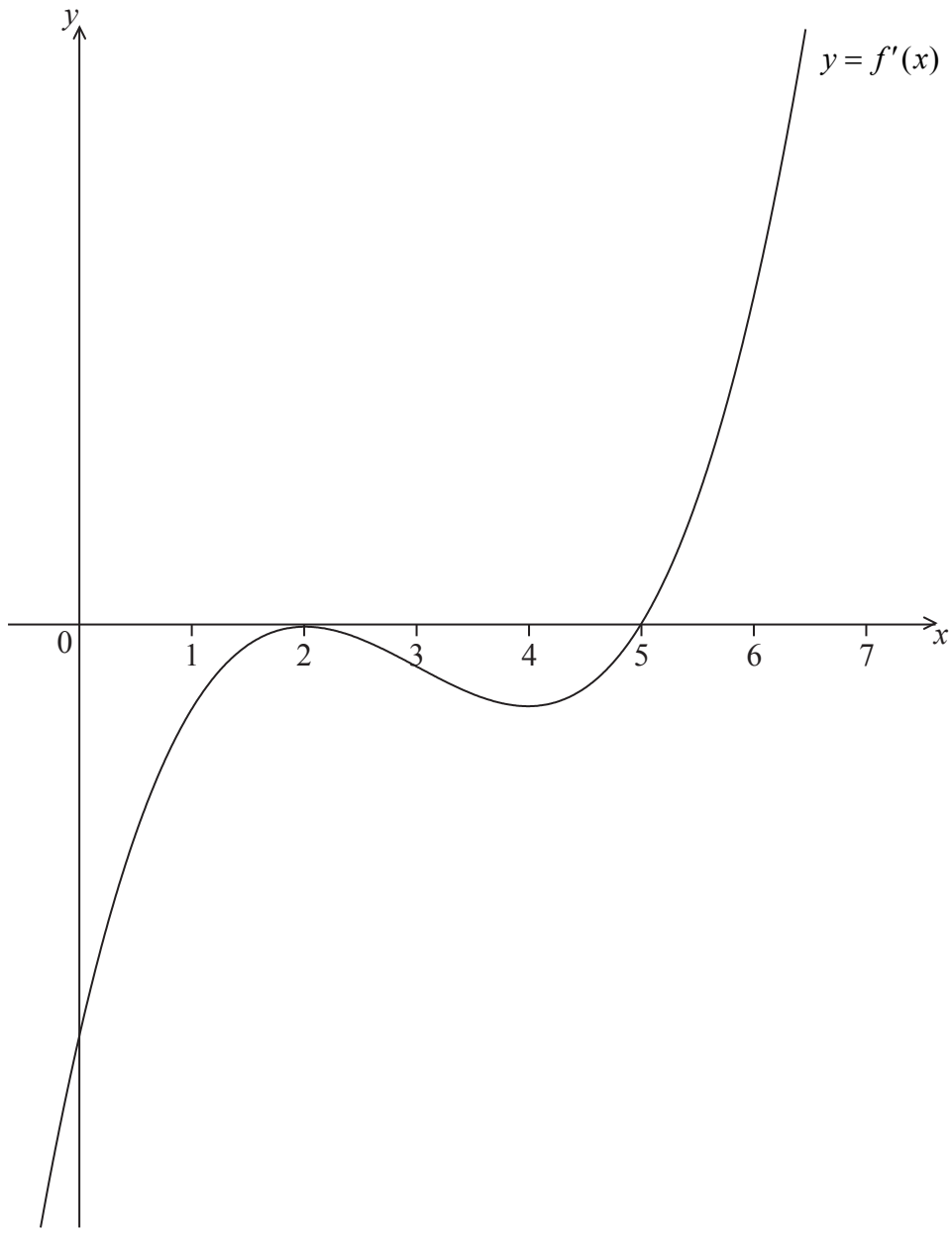
10. [Maximum mark: 15]

Let $y = f(x)$, for $-0.5 \le x \le 6.5$. The following diagram shows the graph of f', the derivative of f.



The graph of f' has a local maximum when $x = 2$, a local minimum when $x = 4$, and it crosses the x-axis at the point $(5, 0)$.

(a) Explain why the graph of f has a local minimum when $x = 5$. [2]

(b) Find the set of values of x for which the graph of f is concave down. [2]

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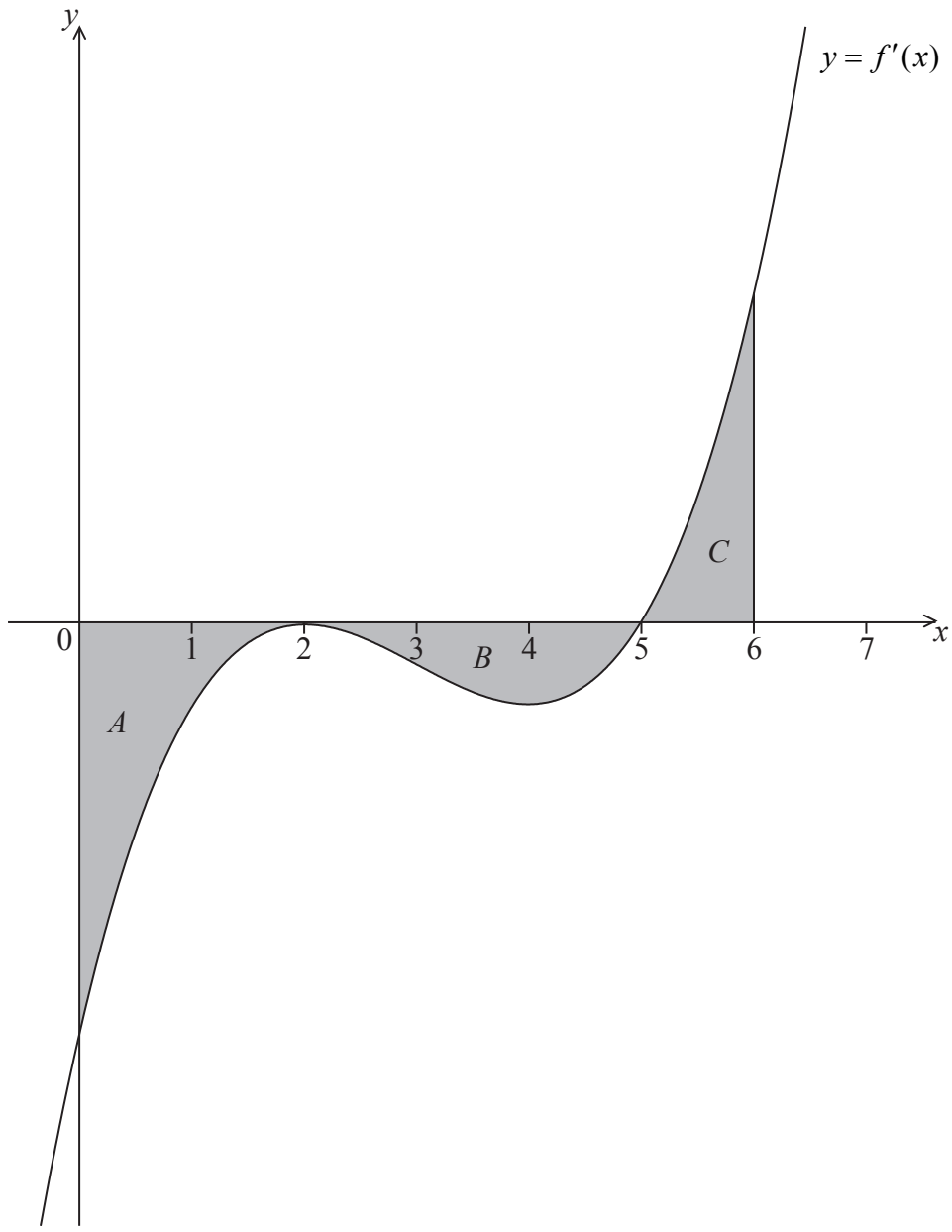
(Question 10 continued)

The following diagram shows the shaded regions A, B and C.



The regions are enclosed by the graph of f', the x-axis, the y-axis, and the line $x = 6$.
The area of region A is 12, the area of region B is 6.75 and the area of region C is 6.75.

(c) Given that $f(0) = 14$, find $f(6)$. [5]

(d) Let $g(x) = \left(f(x)\right)^2$. Given that $f'(6) = 16$, find the equation of the tangent to the graph of g at the point where $x = 6$. [6]

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