



**Mathematics
Higher level
Paper 1**

Thursday 4 May 2017 (afternoon)

Candidate session number

2 hours

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Instructions to candidates

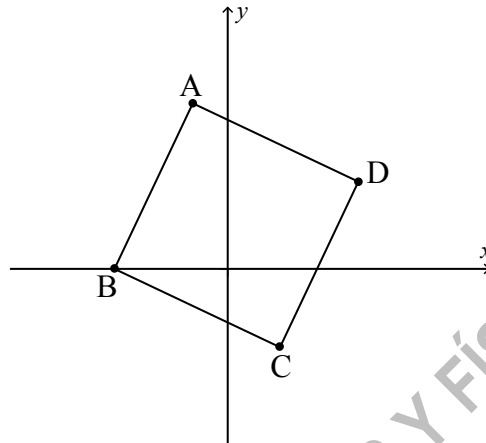
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- You are not permitted access to any calculator for this paper.
- Section A: answer all questions. Answers must be written within the answer boxes provided.
- Section B: answer all questions 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 HL and further mathematics HL formula booklet** is required for this paper.
- The maximum mark for this examination paper is **[100 marks]**.

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5. [Maximum mark: 4]

In the following Argand diagram the point A represents the complex number $-1 + 4i$ and the point B represents the complex number $-3 + 0i$. The shape of ABCD is a square. Determine the complex numbers represented by the points C and D.



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12EP06

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Section B

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

9. [Maximum mark: 17]

Consider the function f defined by $f(x) = x^2 - a^2$, $x \in \mathbb{R}$ where a is a positive constant.

(a) Showing any x and y intercepts, any maximum or minimum points and any asymptotes, sketch the following curves on separate axes.

(i) $y = f(x)$;

(ii) $y = \frac{1}{f(x)}$;

(iii) $y = \left| \frac{1}{f(x)} \right|$.

[8]

(b) Find $\int f(x) \cos x \, dx$.

[5]

The function g is defined by $g(x) = x\sqrt{f(x)}$ for $|x| > a$.

(c) By finding $g'(x)$ explain why g is an increasing function.

[4]



Do **not** write solutions on this page.

10. [Maximum mark: 11]

A window is made in the shape of a rectangle with a semicircle of radius r metres on top, as shown in the diagram. The perimeter of the window is a constant P metres.



- (a) (i) Find the area of the window in terms of P and r .
- (ii) Find the width of the window in terms of P when the area is a maximum, justifying that this is a maximum. [9]
- (b) Show that in this case the height of the rectangle is equal to the radius of the semicircle. [2]



12EP11

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11. [Maximum mark: 22]

(a) Solve $2 \sin(x + 60^\circ) = \cos(x + 30^\circ)$, $0^\circ \leq x \leq 180^\circ$. [5]

(b) Show that $\sin 105^\circ + \cos 105^\circ = \frac{1}{\sqrt{2}}$. [3]

(c) Let $z = 1 - \cos 2\theta - i \sin 2\theta$, $z \in \mathbb{C}$, $0 \leq \theta \leq \pi$.

(i) Find the modulus and argument of z in terms of θ . Express each answer in its simplest form.

(ii) Hence find the cube roots of z in modulus-argument form. [14]

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