

22147204

**MATHEMATICS  
HIGHER LEVEL  
PAPER 2**

Candidate session number

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Wednesday 14 May 2014 (morning)

Examination code

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.
- A graphic display calculator is required 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 HL and Further Mathematics HL formula booklet** is required for this paper.
- The maximum mark for this examination paper is [120 marks].



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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. In particular, solutions found from a graphic display calculator should be supported by suitable working. For example, if graphs are used to find a solution, you should sketch these as part of your answer. 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: 4]

One root of the equation  $x^2 + ax + b = 0$  is  $2 + 3i$  where  $a, b \in \mathbb{R}$ . Find the value of  $a$  and the value of  $b$ .

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3. [Maximum mark: 4]

Find the number of ways in which seven different toys can be given to three children, if the youngest is to receive three toys and the others receive two toys each.

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8. [Maximum mark: 8]

(a) Find the term in  $x^5$  in the expansion of  $(3x + A)(2x + B)^6$ . [4]

Mina and Norbert each have a fair cubical die with faces labelled 1, 2, 3, 4, 5 and 6; they throw it to decide if they are going to eat a cookie.

Mina throws her die just once and she eats a cookie if she throws a four, a five or a six. Norbert throws his die six times and each time eats a cookie if he throws a five or a six.

(b) Calculate the probability that five cookies are eaten. [4]

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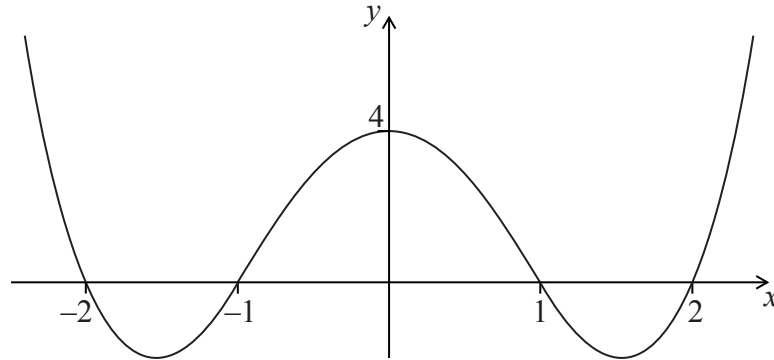


Do **NOT** write solutions on this page.

12. [Maximum mark: 18]

Let  $f(x) = |x| - 1$ .

(a) The graph of  $y = g(x)$  is drawn below.



- (i) Find the value of  $(f \circ g)(1)$ .
  - (ii) Find the value of  $(f \circ g \circ g)(1)$ .
  - (iii) Sketch the graph of  $y = (f \circ g)(x)$ . [5]
- (b)
- (i) Sketch the graph of  $y = f(x)$ .
  - (ii) State the zeros of  $f$ . [3]
- (c)
- (i) Sketch the graph of  $y = (f \circ f)(x)$ .
  - (ii) State the zeros of  $f \circ f$ . [3]

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

(Question 12 continued)

(d) Given that we can denote  $\underbrace{f \circ f \circ f \circ \dots \circ f}_{n \text{ times}}$  as  $f^n$ ,

(i) find the zeros of  $f^3$ ;

(ii) find the zeros of  $f^4$ ;

(iii) deduce the zeros of  $f^8$ .

[3]

(e) The zeros of  $f^{2n}$  are  $a_1, a_2, a_3, \dots, a_N$ .

(i) State the relation between  $n$  and  $N$ ;

(ii) Find, and simplify, an expression for  $\sum_{r=1}^N |a_r|$  in terms of  $n$ .

[4]

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