

Mathematics
Higher level
Paper 2

Friday 5 May 2017 (morning)

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.
- A graphic display calculator is required 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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16EP07

Turn over

6. [Maximum mark: 5]

Given that $\log_{10} \left(\frac{1}{2\sqrt{2}}(p + 2q) \right) = \frac{1}{2}(\log_{10} p + \log_{10} q)$, $p > 0$, $q > 0$, find p in terms of q .

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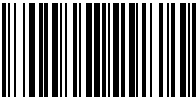
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16EP08

8. [Maximum mark: 6]

In a trial examination session a candidate at a school has to take 18 examination papers including the physics paper, the chemistry paper and the biology paper. No two of these three papers may be taken consecutively. There is no restriction on the order in which the other examination papers may be taken.

Find the number of different orders in which these 18 examination papers may be taken.

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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: 22]

The points A, B and C have the following position vectors with respect to an origin O.

$$\vec{OA} = 2\mathbf{i} + \mathbf{j} - 2\mathbf{k}$$

$$\vec{OB} = 2\mathbf{i} - \mathbf{j} + 2\mathbf{k}$$

$$\vec{OC} = \mathbf{i} + 3\mathbf{j} + 3\mathbf{k}$$

- (a) Find the vector equation of the line (BC). [3]
- (b) Determine whether or not the lines (OA) and (BC) intersect. [6]
- (c) Find the Cartesian equation of the plane Π_1 , which passes through C and is perpendicular to \vec{OA} . [3]
- (d) Show that the line (BC) lies in the plane Π_1 . [2]

The plane Π_2 contains the points O, A and B and the plane Π_3 contains the points O, A and C.

- (e) Verify that $2\mathbf{j} + \mathbf{k}$ is perpendicular to the plane Π_2 . [3]
- (f) Find a vector perpendicular to the plane Π_3 . [1]
- (g) Find the acute angle between the planes Π_2 and Π_3 . [4]



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10. [Maximum mark: 15]

A continuous random variable X has probability density function f given by

$$f(x) = \begin{cases} \frac{x^2}{a} + b, & 0 \leq x \leq 4 \\ 0 & \text{otherwise} \end{cases} \quad \text{where } a \text{ and } b \text{ are positive constants.}$$

It is given that $P(X \geq 2) = 0.75$.

- (a) Show that $a = 32$ and $b = \frac{1}{12}$. [5]
- (b) Find $E(X)$. [2]
- (c) Find $\text{Var}(X)$. [2]
- (d) Find the median of X . [3]

Eight independent observations of X are now taken and the random variable Y is the number of observations such that $X \geq 2$.

- (e) Find $E(Y)$. [2]
- (f) Find $P(Y \geq 3)$. [1]



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11. [Maximum mark: 13]

It is given that $f(x) = 3x^4 + ax^3 + bx^2 - 7x - 4$ where a and b are positive integers.

- (a) Given that $x^2 - 1$ is a factor of $f(x)$ find the value of a and the value of b . [4]
- (b) Factorize $f(x)$ into a product of linear factors. [3]
- (c) Sketch the graph of $y = f(x)$, labelling the maximum and minimum points and the x and y intercepts. [3]
- (d) Using your graph state the range of values of c for which $f(x) = c$ has exactly two distinct real roots. [3]
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16EP14

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16EP15

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16EP16