

**Mathematics**
Standard level
Paper 1

Monday 13 November 2017 (afternoon)

Candidate session number

1 hour 30 minutes

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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 SL formula booklet** is required for this paper.
- The maximum mark for this examination paper is **[90 marks]**.



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

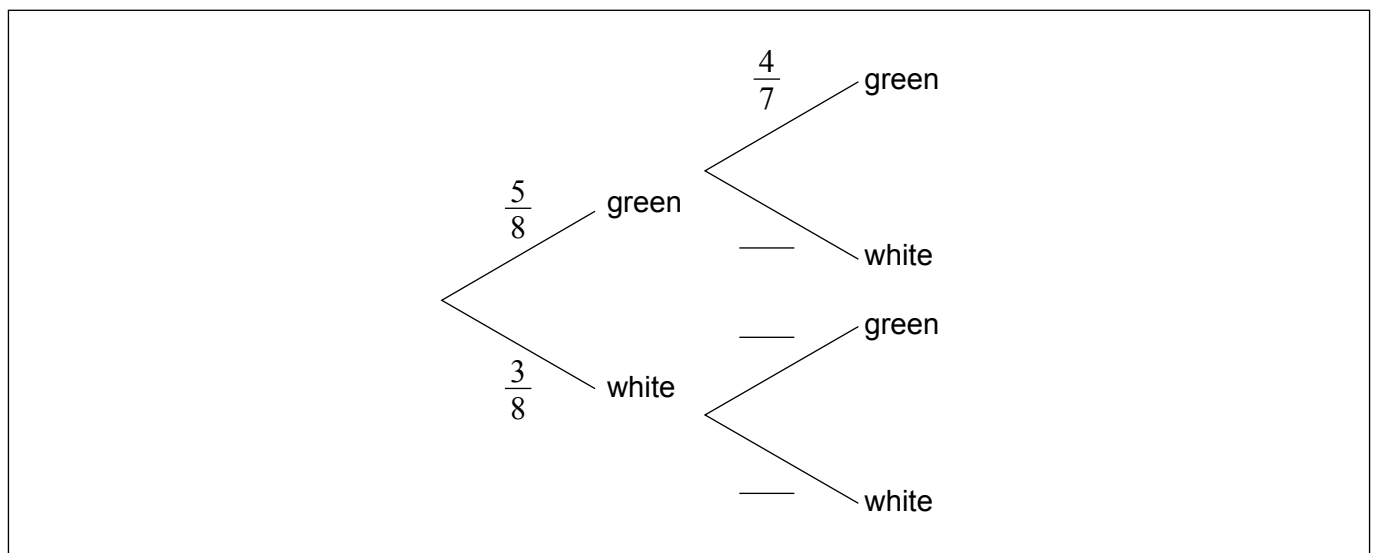
Answer **all** questions. Answers must be written within the answer boxes provided. Working may be continued below the lines if necessary.

1. [Maximum mark: 6]

A bag contains 5 green balls and 3 white balls. Two balls are selected at random without replacement.

(a) Complete the following tree diagram.

[3]



(b) Find the probability that exactly one of the selected balls is green.

[3]

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2. [Maximum mark: 6]

In an arithmetic sequence, the first term is 8 and the second term is 5.

- (a) Find the common difference. [2]
- (b) Find the tenth term. [2]
- (c) Find the sum of the first ten terms. [2]

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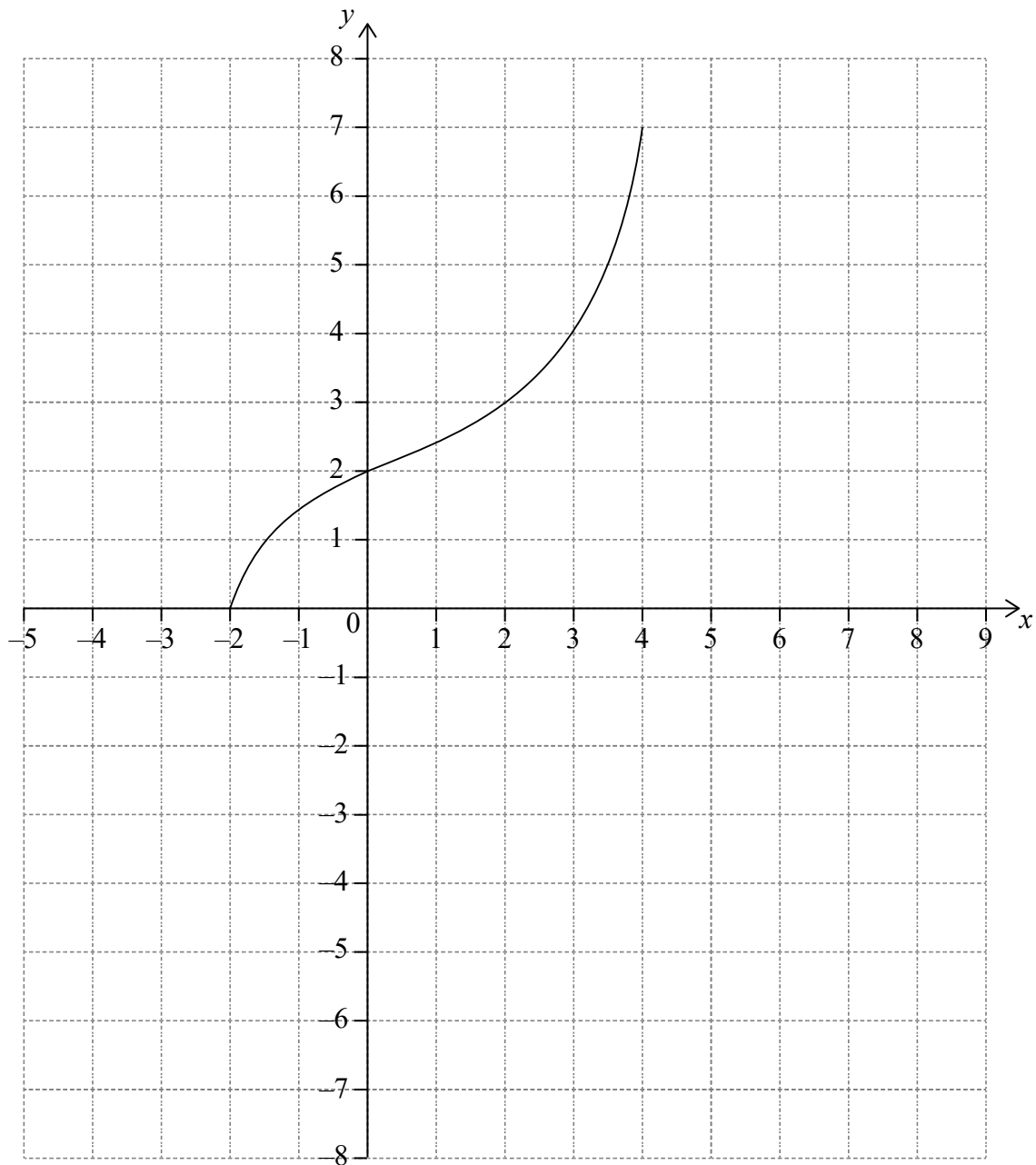
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3. [Maximum mark: 6]

The following diagram shows the graph of a function f , with domain $-2 \leq x \leq 4$.



The points $(-2, 0)$ and $(4, 7)$ lie on the graph of f .

(This question continues on the following page)



(Question 3 continued)

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

(b) Write down

(i) $f(2)$;

(ii) $f^{-1}(2)$. [2]

(c) On the grid opposite, sketch the graph of f^{-1} . [3]

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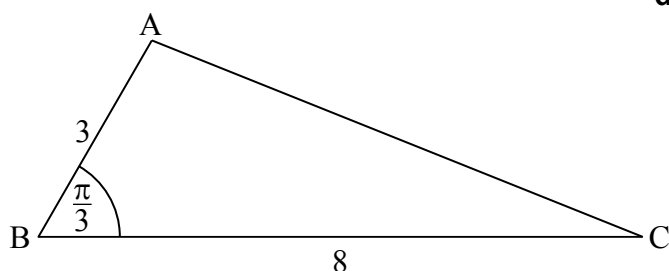
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4. [Maximum mark: 7]

The following diagram shows triangle ABC , with $AB = 3$ cm, $BC = 8$ cm, and $\angle ABC = \frac{\pi}{3}$.

diagram not to scale

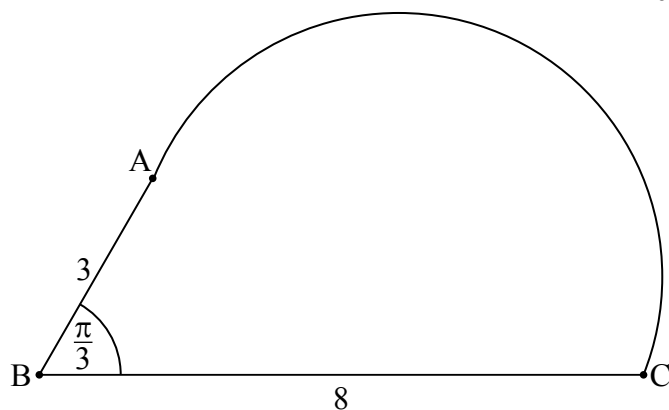


(a) Show that $AC = 7$ cm.

[4]

(b) The shape in the following diagram is formed by adding a semicircle with diameter $[AC]$ to the triangle.

diagram not to scale



Find the exact perimeter of this shape.

[3]

(This question continues on the following page)



(Question 4 continued)

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5. [Maximum mark: 6]

Let $f(x) = 1 + e^{-x}$ and $g(x) = 2x + b$, for $x \in \mathbb{R}$, where b is a constant.

(a) Find $(g \circ f)(x)$. [2]

(b) Given that $\lim_{x \rightarrow +\infty} (g \circ f)(x) = -3$, find the value of b . [4]

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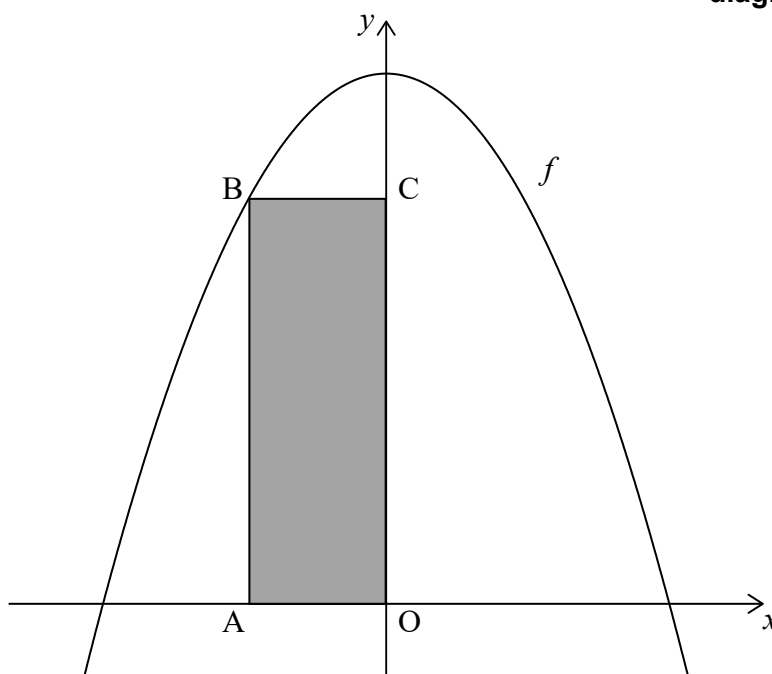
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6. [Maximum mark: 7]

Let $f(x) = 15 - x^2$, for $x \in \mathbb{R}$. The following diagram shows part of the graph of f and the rectangle OABC, where A is on the negative x -axis, B is on the graph of f , and C is on the y -axis.

diagram not to scale



Find the x -coordinate of A that gives the maximum area of OABC.

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7. [Maximum mark: 7]

Consider $f(x) = \log_k(6x - 3x^2)$, for $0 < x < 2$, where $k > 0$.
The equation $f(x) = 2$ has exactly one solution. Find the value of k .

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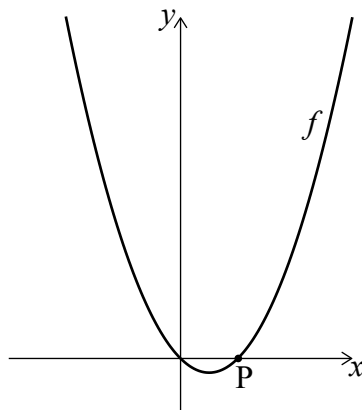
Section B

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

8. [Maximum mark: 16]

Let $f(x) = x^2 - x$, for $x \in \mathbb{R}$. The following diagram shows part of the graph of f .

diagram not to scale



The graph of f crosses the x -axis at the origin and at the point $P(1, 0)$.

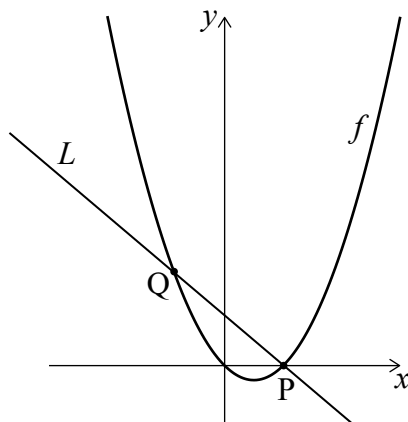
(a) Show that $f'(1) = 1$. [3]

The line L is the normal to the graph of f at P .

(b) Find the equation of L in the form $y = ax + b$. [3]

The line L intersects the graph of f at another point Q , as shown in the following diagram.

diagram not to scale



(c) Find the x -coordinate of Q . [4]

(d) Find the area of the region enclosed by the graph of f and the line L . [6]



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9. [Maximum mark: 15]

A line L passes through points $A(-3, 4, 2)$ and $B(-1, 3, 3)$.

(a) (i) Show that $\vec{AB} = \begin{pmatrix} 2 \\ -1 \\ 1 \end{pmatrix}$.

(ii) Find a vector equation for L .

[3]

The line L also passes through the point $C(3, 1, p)$.

(b) Find the value of p .

[5]

(c) The point D has coordinates $(q^2, 0, q)$. Given that $\vec{DC}$ is perpendicular to L , find the possible values of q .

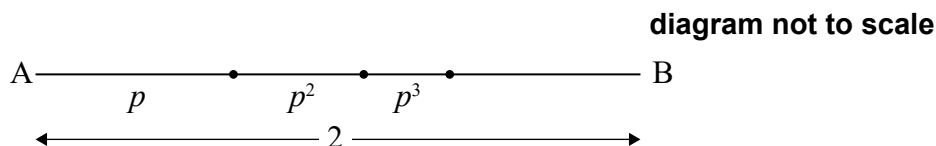
[7]



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10. [Maximum mark: 14]

- (a) The following diagram shows $[AB]$, with length 2 cm. The line is divided into an infinite number of line segments. The diagram shows the first three segments.

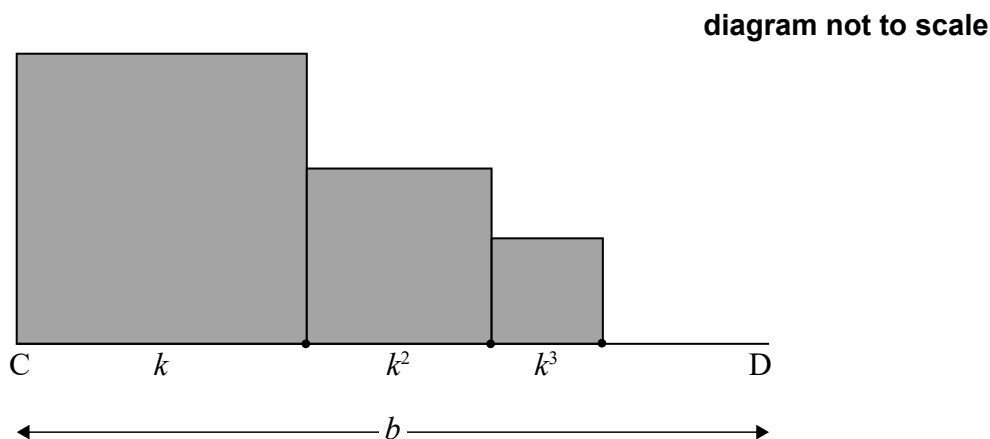


The length of the line segments are p cm, p^2 cm, p^3 cm, $\dots$, where $0 < p < 1$.

Show that $p = \frac{2}{3}$.

[5]

- (b) The following diagram shows $[CD]$, with length b cm, where $b > 1$. Squares with side lengths k cm, k^2 cm, k^3 cm, $\dots$, where $0 < k < 1$, are drawn along $[CD]$. This process is carried on indefinitely. The diagram shows the first three squares.



The **total** sum of the areas of all the squares is $\frac{9}{16}$. Find the value of b .

[9]



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