

**Mathematics**  
**Standard level**  
**Paper 1**

Tuesday 10 May 2016 (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 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]**.



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]

Let  $f(x) = 8x + 3$  and  $g(x) = 4x$ , for  $x \in \mathbb{R}$ .

(a) Write down  $g(2)$ . [1]

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

(c) Find  $f^{-1}(x)$ . [2]

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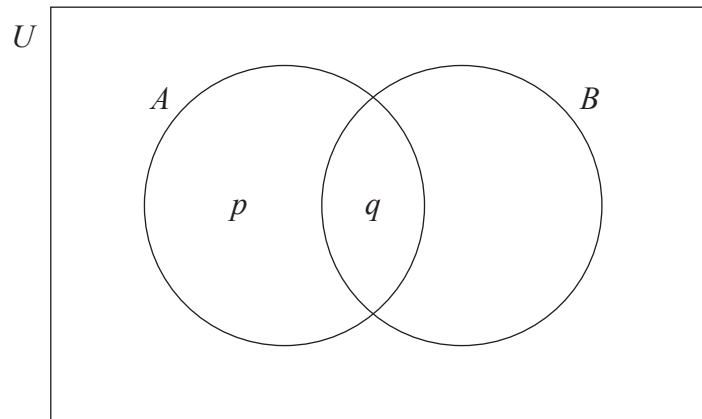
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2. [Maximum mark: 6]

The following Venn diagram shows the events  $A$  and  $B$ , where  $P(A) = 0.4$ ,  $P(A \cup B) = 0.8$  and  $P(A \cap B) = 0.1$ . The values  $p$  and  $q$  are probabilities.



(a) (i) Write down the value of  $q$ .

(ii) Find the value of  $p$ .

[3]

(b) Find  $P(B)$ .

[3]

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3. [Maximum mark: 7]

Let  $f(x) = 3\sin\left(\frac{\pi}{2}x\right)$ , for  $0 \leq x \leq 4$ .

(a) (i) Write down the amplitude of  $f$ .

(ii) Find the period of  $f$ .

[3]

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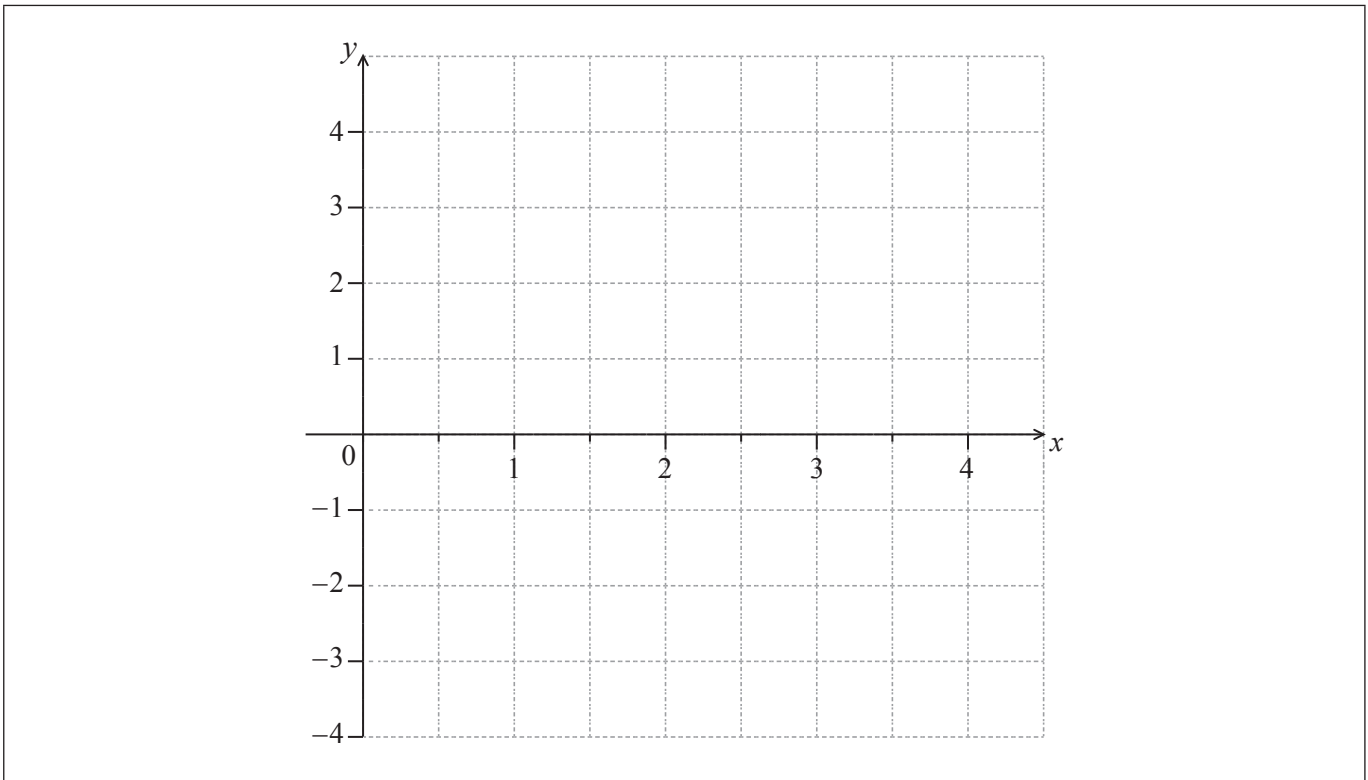
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(b) On the following grid sketch the graph of  $f$ .

[4]



4. [Maximum mark: 6]

Consider the following sequence of figures.

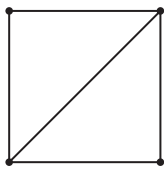


Figure 1

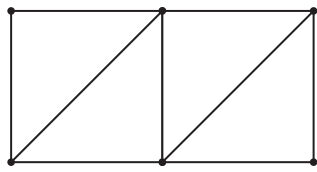


Figure 2

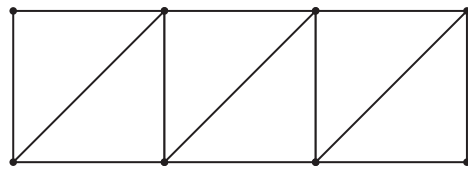


Figure 3

Figure 1 contains 5 line segments.

- (a) Given that Figure  $n$  contains 801 line segments, show that  $n = 200$ . [3]
- (b) Find the total number of line segments in the first 200 figures. [3]

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5. [Maximum mark: 6]

Consider  $f(x) = x^2 + qx + r$ . The graph of  $f$  has a minimum value when  $x = -1.5$ .  
The distance between the two zeros of  $f$  is 9.

(a) Show that the two zeros are 3 and  $-6$ . [2]

(b) Find the value of  $q$  and of  $r$ . [4]

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6. [Maximum mark: 7]

The following diagram shows triangle ABC. The point D lies on [BC] so that [AD] bisects  $\hat{BAC}$ .

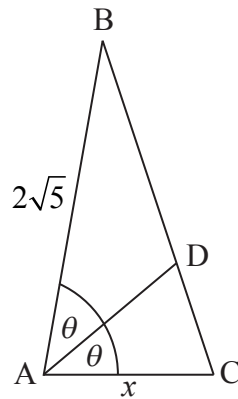


diagram not to scale

$$AB = 2\sqrt{5} \text{ cm}, AC = x \text{ cm}, \text{ and } \hat{DAC} = \theta, \text{ where } \sin \theta = \frac{2}{3}$$

The area of triangle ABC is  $5 \text{ cm}^2$ . Find the value of  $x$ .

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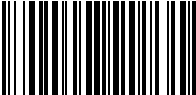




7. [Maximum mark: 8]

Let  $f(x) = 3 \tan^4 x + 2k$  and  $g(x) = -\tan^4 x + 8k \tan^2 x + k$ , for  $0 \leq x \leq 1$ , where  $\mathbb{N}$ .  
The graphs of  $f$  and  $g$  intersect at exactly one point. 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.

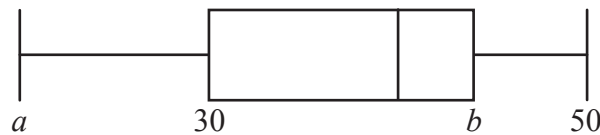
8. [Maximum mark: 15]

A school collects cans for recycling to raise money. Sam's class has 20 students. The number of cans collected by each student in Sam's class is shown in the following stem and leaf diagram.

Stem	Leaf	Key: 3 1 represents 31 cans
2	0, 1, 4, 9, 9	
3	1, 7, 7, 7, 8, 8	
4	1, 2, 2, 3, 5, 6, 7, 8	
5	0	

(a) Find the median number of cans collected. [2]

The following box-and-whisker plot also displays the number of cans collected by students in Sam's class.



(b) (i) Write down the value of  $a$ .  
 (ii) The interquartile range is 14. Find the value of  $b$ . [3]

(c) Sam's class collected 745 cans. They want an average of 40 cans per student. How many more cans need to be collected to achieve this target? [3]

There are 80 students in the school.

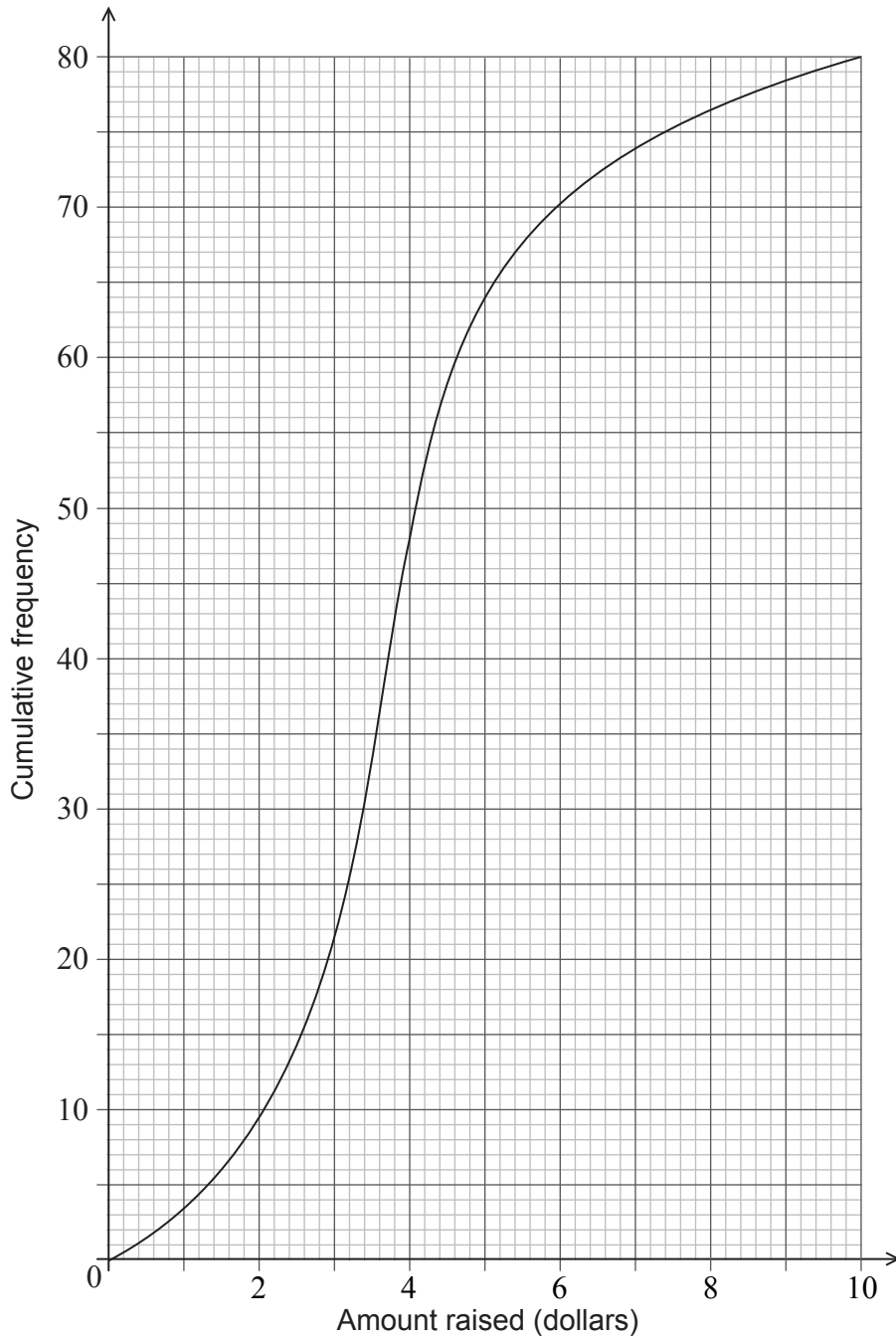
(d) The students raise \$0.10 for each recycled can.  
 (i) Find the largest amount raised by a student in Sam's class.  
 (ii) The following cumulative frequency curve shows the amounts in dollars raised by all the students in the school. Find the percentage of students in the school who raised more money than anyone in Sam's class. [5]

(This question continues on the following page)



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**(Question 8 continued)**



(e) The mean number of cans collected is 39.4. The standard deviation is 18.5. Each student then collects 2 more cans.

- (i) Write down the new mean.
- (ii) Write down the new standard deviation.

[2]



12EP11

Turn over

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9. [Maximum mark: 15]

Let  $f'(x) = \frac{6-2x}{6x-x^2}$ , for  $0 < x < 6$ .

The graph of  $f$  has a maximum point at P.

(a) Find the  $x$ -coordinate of P. [3]

The  $y$ -coordinate of P is  $\ln 27$ .

(b) Find  $f(x)$ , expressing your answer as a single logarithm. [8]

(c) The graph of  $f$  is transformed by a vertical stretch with scale factor  $\frac{1}{\ln 3}$ . The image of P under this transformation has coordinates  $(a, b)$ .

Find the value of  $a$  and of  $b$ , where  $a, b \in \mathbb{N}$ . [4]

10. [Maximum mark: 15]

Let  $f(x) = \sqrt{4x+5}$ , for  $x \geq -1.25$ .

(a) Find  $f'(1)$ . [4]

Consider another function  $g$ . Let R be a point on the graph of  $g$ . The  $x$ -coordinate of R is 1. The equation of the tangent to the graph at R is  $y = 3x + 6$ .

(b) Write down  $g'(1)$ . [2]

(c) Find  $g(1)$ . [2]

(d) Let  $h(x) = f(x) \times g(x)$ . Find the equation of the tangent to the graph of  $h$  at the point where  $x = 1$ . [7]

