

Mathematics

Standard level

Paper 1

Thursday 4 May 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]**.



Please **do not** write on this page.

Answers written on this page
will not be marked.



2. [Maximum mark: 7]

The vectors $\mathbf{a} = \begin{pmatrix} 4 \\ 2 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} k+3 \\ k \end{pmatrix}$ are perpendicular to each other.

(a) Find the value of k . [4]

(b) Given that $\mathbf{c} = \mathbf{a} + 2\mathbf{b}$, find \mathbf{c} . [3]

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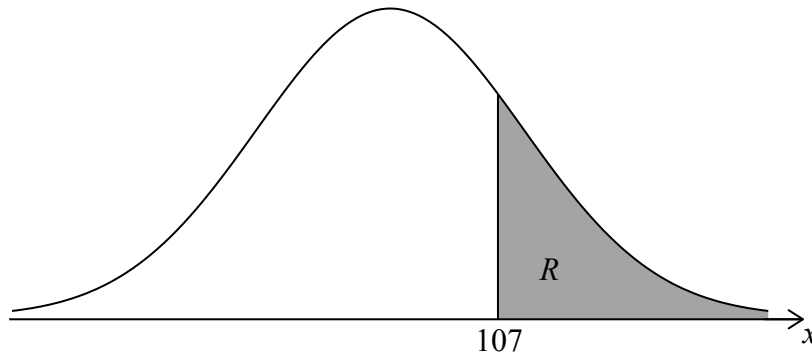
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3. [Maximum mark: 6]

The random variable X is normally distributed with a mean of 100. The following diagram shows the normal curve for X .



Let R be the shaded region under the curve, to the right of 107. The area of R is 0.24.

- (a) Write down $P(X > 107)$. [1]
- (b) Find $P(100 < X < 107)$. [3]
- (c) Find $P(93 < X < 107)$. [2]

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4. [Maximum mark: 6]

The following figures consist of rows and columns of squares. The figures form a continuing pattern.

Figure 1 has two rows and one column. Figure 2 has three rows and two columns.

Figure 1



Figure 2

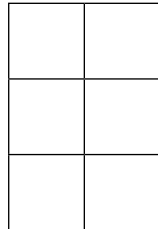


Figure 3

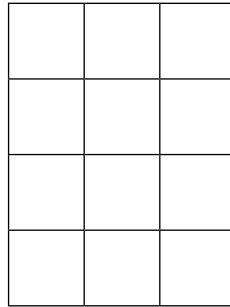


Figure 4

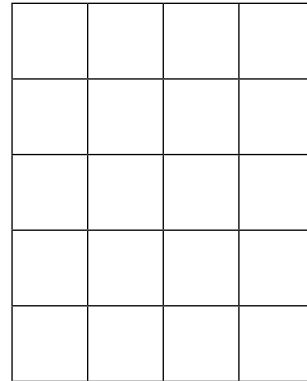


Figure 5 has p rows and q columns.

(a) Write down the value of

(i) p ;

(ii) q .

[2]

Each small square has an area of 1 cm^2 . Let A_n be the total area of Figure n . The following table gives the first five values of A_n .

n	1	2	3	4	5
$A_n (\text{cm}^2)$	2	6	12	20	k

(b) Find the value of k .

[2]

(c) Find an expression for A_n in terms of n .

[2]

(This question continues on the following page)



5. [Maximum mark: 6]

Let $f'(x) = \frac{3x^2}{(x^3+1)^5}$. Given that $f(0) = 1$, find $f(x)$.

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6. [Maximum mark: 5]

The values of the functions f and g and their derivatives for $x = 1$ and $x = 8$ are shown in the following table.

x	$f(x)$	$f'(x)$	$g(x)$	$g'(x)$
1	2	4	9	-3
8	4	-3	2	5

Let $h(x) = f(x)g(x)$.

(a) Find $h(1)$. [2]

(b) Find $h'(8)$. [3]

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7. [Maximum mark: 7]

Solve $\log_2(2 \sin x) + \log_2(\cos x) = -1$, for $2\pi < x < \frac{5\pi}{2}$.

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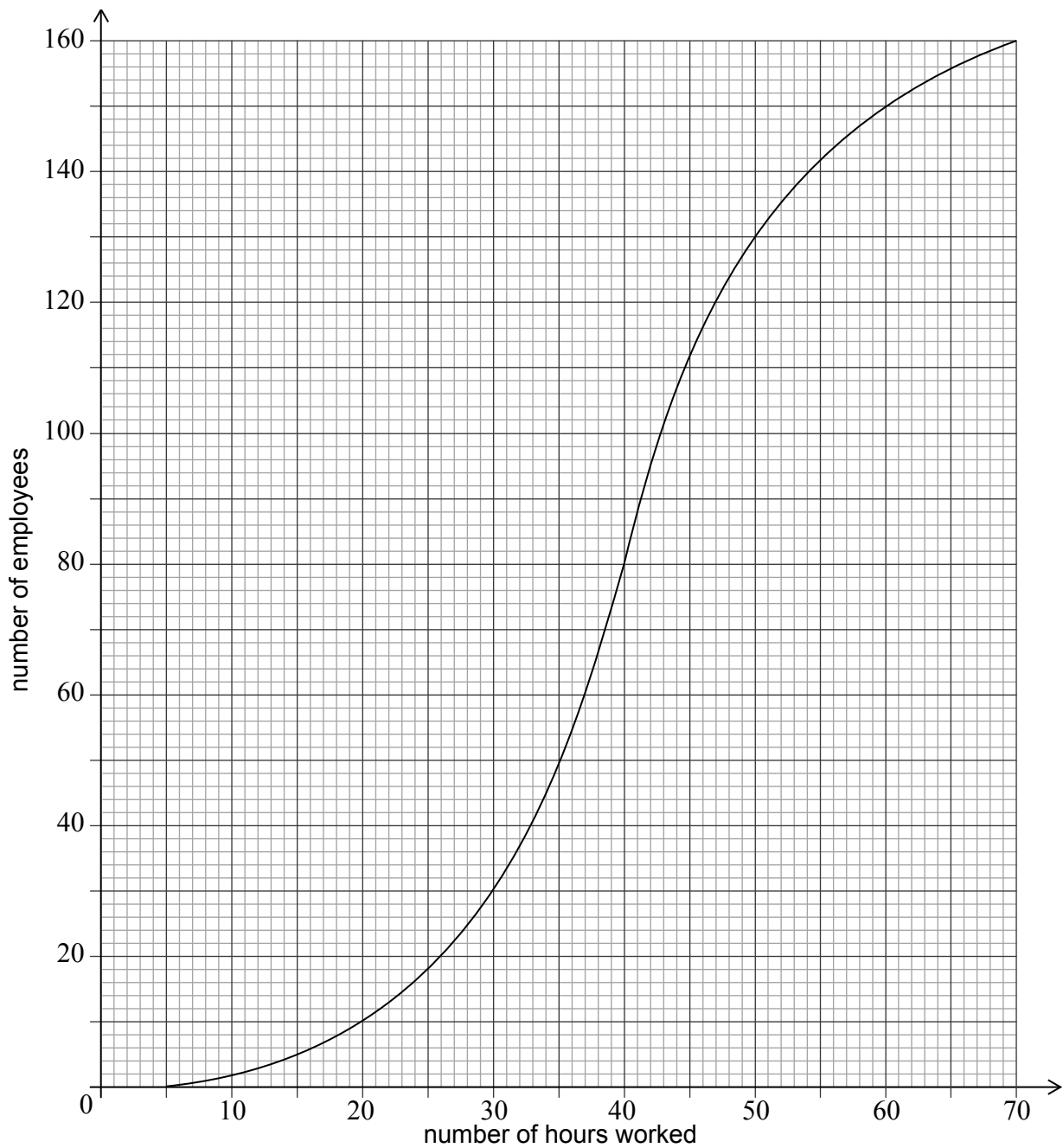
Section B

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

8. [Maximum mark: 14]

A city hired 160 employees to work at a festival. The following cumulative frequency curve shows the number of hours employees worked during the festival.

- (a) (i) Find the median number of hours worked by the employees.
- (ii) Write down the number of employees who worked 50 hours or less. [3]



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(Question 8 continued)

The city paid each of the employees £8 per hour for the first 40 hours worked, and £10 per hour for each hour they worked after the first 40 hours.

- (b) Find the amount of money an employee earned for working
 - (i) 40 hours;
 - (ii) 43 hours. [4]
- (c) Find the number of employees who earned £200 or less. [3]
- (d) Only 10 employees earned more than £ k . Find the value of k . [4]



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9. [Maximum mark: 16]

Note: In this question, distance is in metres and time is in seconds.

Two particles P_1 and P_2 start moving from a point A at the same time, along different straight lines.

After t seconds, the position of P_1 is given by $\mathbf{r} = \begin{pmatrix} 4 \\ -1 \\ 3 \end{pmatrix} + t \begin{pmatrix} 1 \\ 2 \\ -2 \end{pmatrix}$.

(a) Find the coordinates of A. [2]

Two seconds after leaving A, P_1 is at point B.

(b) Find

(i) \vec{AB} ;

(ii) $\left| \vec{AB} \right|$. [5]

Two seconds after leaving A, P_2 is at point C, where $\vec{AC} = \begin{pmatrix} 3 \\ 0 \\ 4 \end{pmatrix}$.

(c) Find $\cos \hat{BAC}$. [5]

(d) Hence or otherwise, find the distance between P_1 and P_2 two seconds after they leave A. [4]

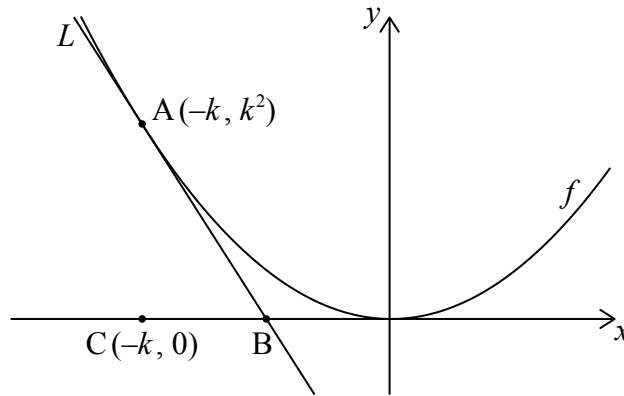


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10. [Maximum mark: 17]

Let $f(x) = x^2$. The following diagram shows part of the graph of f .

diagram not to scale

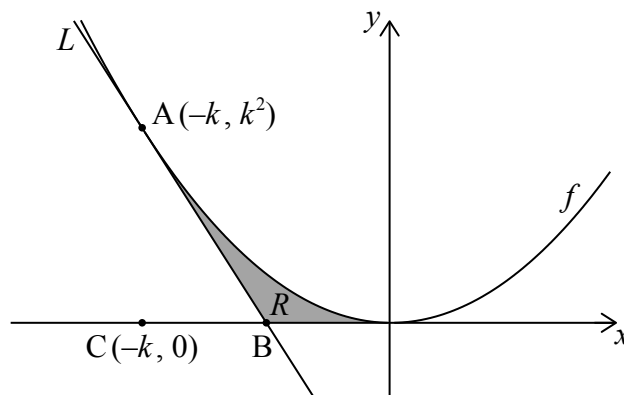


The line L is the tangent to the graph of f at the point $A(-k, k^2)$, and intersects the x -axis at point B . The point C is $(-k, 0)$.

- (a) (i) Write down $f'(x)$.
- (ii) Find the gradient of L . [3]
- (b) Show that the x -coordinate of B is $-\frac{k}{2}$. [5]
- (c) Find the area of triangle ABC , giving your answer in terms of k . [2]

The region R is enclosed by L , the graph of f , and the x -axis. This is shown in the following diagram.

diagram not to scale



- (d) Given that the area of triangle ABC is p times the area of R , find the value of p . [7]



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