

CANDIDATE  
NAME

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CENTRE  
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## MATHEMATICS

9709/12

Paper 1 Pure Mathematics 1 (P1)

October/November 2019

**1 hour 45 minutes**

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

## READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name in the spaces at the top of this page.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** the questions in the space provided. If additional space is required, you should use the lined page at the end of this booklet. The question number(s) must be clearly shown.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

The use of an electronic calculator is expected, where appropriate.

You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

The total number of marks for this paper is 75.

This document consists of **19** printed pages and **1** blank page.



- 1** The coefficient of  $x^2$  in the expansion of  $(4 + ax)\left(1 + \frac{x}{2}\right)^6$  is 3. Find the value of the constant  $a$ . [4]

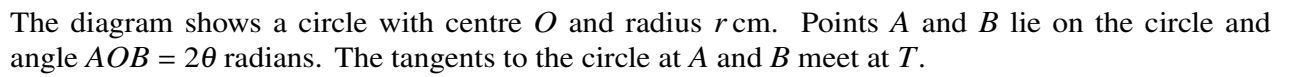
[illegible]

- 2** The point  $M$  is the mid-point of the line joining the points  $(3, 7)$  and  $(-1, 1)$ . Find the equation of the line through  $M$  which is parallel to the line  $\frac{x}{3} + \frac{y}{2} = 1$ . [4]

[illegible]

- 3** A curve is such that  $\frac{dy}{dx} = \frac{k}{\sqrt{x}}$ , where  $k$  is a constant. The points  $P(1, -1)$  and  $Q(4, 4)$  lie on the curve. Find the equation of the curve. [4]

This image shows a full page of white paper with horizontal dashed lines, typical of primary-ruled notebook paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



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- This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

This image shows a full page of white paper with horizontal dashed lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



- [The volume of a cone of radius  $r$  and vertical height  $h$  is  $\frac{1}{3}\pi r^2 h$ .]

[illegible]



[illegible]

- 6** (a) Given that  $x > 0$ , find the two smallest values of  $x$ , in radians, for which  $3 \tan(2x + 1) = 1$ . Show all necessary working. [4]

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

(b) The function  $f : x \mapsto 3 \cos^2 x - 2 \sin^2 x$  is defined for  $0 \leq x \leq \pi$ .

(i) Express  $f(x)$  in the form  $a \cos^2 x + b$ , where  $a$  and  $b$  are constants. [1]

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(ii) Find the range of  $f$ . [2]

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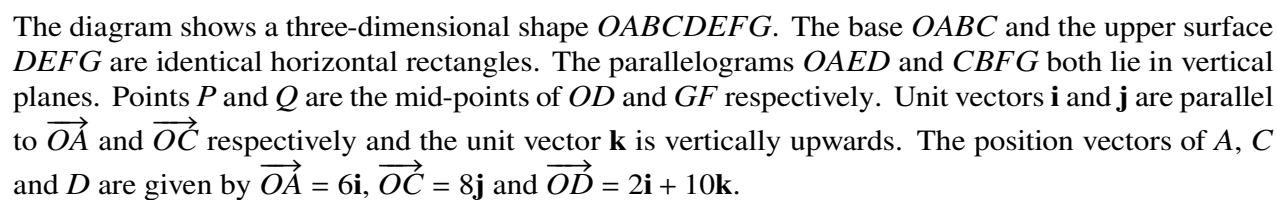
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- (ii) Determine whether  $P$  is nearer to  $Q$  or to  $B$ . [2]

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- (iii) Use a scalar product to find angle  $BPQ$ . [3]

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- 8 (a) Over a 21-day period an athlete prepares for a marathon by increasing the distance she runs each day by 1.2 km. On the first day she runs 13 km.

(i) Find the distance she runs on the last day of the 21-day period. [1]

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(ii) Find the total distance she runs in the 21-day period. [2]

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(b) The first, second and third terms of a geometric progression are  $x$ ,  $x - 3$  and  $x - 5$  respectively.

(i) Find the value of  $x$ . [2]

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(ii) Find the fourth term of the progression. [2]

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(iii) Find the sum to infinity of the progression. [2]

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9 Functions  $f$  and  $g$  are defined by

$$f(x) = 2x^2 + 8x + 1 \quad \text{for } x \in \mathbb{R},$$

$$g(x) = 2x - k \quad \text{for } x \in \mathbb{R},$$

where  $k$  is a constant.

(i) Find the value of  $k$  for which the line  $y = g(x)$  is a tangent to the curve  $y = f(x)$ . [3]

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(ii) In the case where  $k = -9$ , find the set of values of  $x$  for which  $f(x) < g(x)$ . [3]

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- (iii) In the case where  $k = -1$ , find  $g^{-1}f(x)$  and solve the equation  $g^{-1}f(x) = 0$ . [3]

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- (iv) Express  $f(x)$  in the form  $2(x + a)^2 + b$ , where  $a$  and  $b$  are constants, and hence state the least value of  $f(x)$ . [3]

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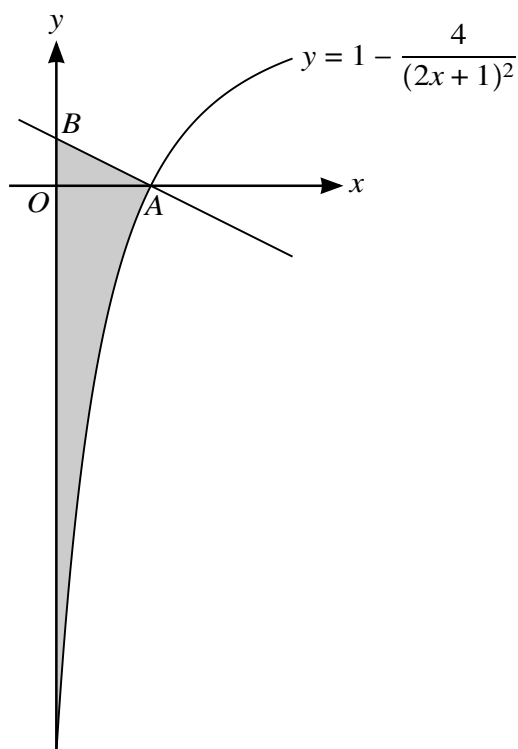
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The diagram shows part of the curve  $y = 1 - \frac{4}{(2x+1)^2}$ . The curve intersects the  $x$ -axis at  $A$ . The normal to the curve at  $A$  intersects the  $y$ -axis at  $B$ .

- (i) Obtain expressions for  $\frac{dy}{dx}$  and  $\int y \, dx$ . [4]

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(ii) Find the coordinates of  $B$ .

[4]

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(iii) Find, showing all necessary working, the area of the shaded region.

[4]

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[illegible]

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