

CANDIDATE  
NAME

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## MATHEMATICS

9709/11

Paper 1 Pure Mathematics 1 (P1)

October/November 2017

**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.

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** A curve has equation  $y = 2x^{\frac{3}{2}} - 3x - 4x^{\frac{1}{2}} + 4$ . Find the equation of the tangent to the curve at the point  $(4, 0)$ . [4]

[illegible]

- 2** A function  $f$  is defined by  $f : x \mapsto x^3 - x^2 - 8x + 5$  for  $x < a$ . It is given that  $f$  is an increasing function. Find the largest possible value of the constant  $a$ . [4]

[illegible]

- 3 (a) A geometric progression has first term  $3a$  and common ratio  $r$ . A second geometric progression has first term  $a$  and common ratio  $-2r$ . The two progressions have the same sum to infinity. Find the value of  $r$ . [3]

This image shows a full page of primary-ruled paper. It features multiple sets of horizontal dashed lines spaced evenly down the page, providing a guide for handwriting practice. The background is white, and there are no other markings or text present.

- (b) The first two terms of an arithmetic progression are 15 and 19 respectively. The first two terms of a second arithmetic progression are 420 and 415 respectively. The two progressions have the same sum of the first  $n$  terms. Find the value of  $n$ . [3]

[illegible]

- 4 Machines in a factory make cardboard cones of base radius  $r$  cm and vertical height  $h$  cm. The volume,  $V$  cm<sup>3</sup>, of such a cone is given by  $V = \frac{1}{3}\pi r^2 h$ . The machines produce cones for which  $h + r = 18$ .

(i) Show that  $V = 6\pi r^2 - \frac{1}{3}\pi r^3$ . [1]

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(ii) Given that  $r$  can vary, find the non-zero value of  $r$  for which  $V$  has a stationary value and show that the stationary value is a maximum. [4]

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**(iii)** Find the maximum volume of a cone that can be made by these machines. [1]

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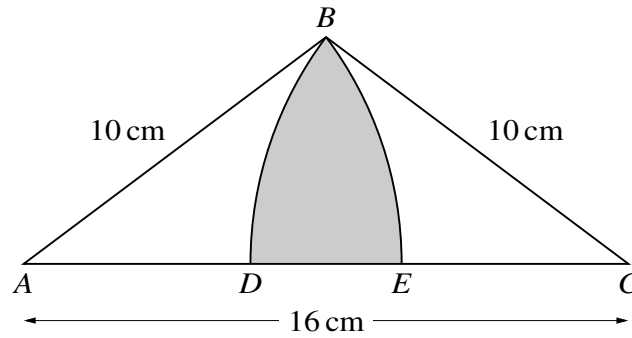
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The diagram shows an isosceles triangle  $ABC$  in which  $AC = 16$  cm and  $AB = BC = 10$  cm. The circular arcs  $BE$  and  $BD$  have centres at  $A$  and  $C$  respectively, where  $D$  and  $E$  lie on  $AC$ .

- (i) Show that angle  $BAC = 0.6435$  radians, correct to 4 decimal places. [1]

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- (ii) Find the area of the shaded region. [5]

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- 6** The points  $A(1, 1)$  and  $B(5, 9)$  lie on the curve  $6y = 5x^2 - 18x + 19$ .

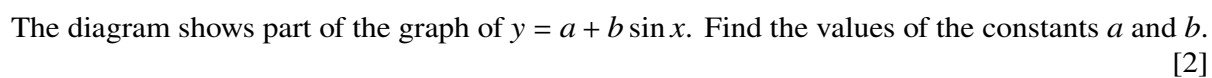
**(i)** Show that the equation of the perpendicular bisector of  $AB$  is  $2y = 13 - x$ .

[4]

[illegible]

(ii) Find, by calculation, the distance  $CD$ , giving your answer in the form  $\sqrt{\left(\frac{p}{q}\right)}$ , where  $p$  and  $q$  are integers. [5]

This image shows a full page of white paper with horizontal dotted 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.

[illegible]

- (b) (i) Show that the equation

$$(\sin \theta + 2 \cos \theta)(1 + \sin \theta - \cos \theta) = \sin \theta(1 + \cos \theta)$$

may be expressed as  $3 \cos^2 \theta - 2 \cos \theta - 1 = 0$ .

[3]

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- (ii) Hence solve the equation

$$(\sin \theta + 2 \cos \theta)(1 + \sin \theta - \cos \theta) = \sin \theta(1 + \cos \theta)$$

for  $-180^\circ \leq \theta \leq 180^\circ$ .

[4]

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- 8** (a) Relative to an origin  $O$ , the position vectors of two points  $P$  and  $Q$  are  $\mathbf{p}$  and  $\mathbf{q}$  respectively. The point  $R$  is such that  $PQR$  is a straight line with  $Q$  the mid-point of  $PR$ . Find the position vector of  $R$  in terms of  $\mathbf{p}$  and  $\mathbf{q}$ , simplifying your answer. [3]

[illegible]

- (b) The vector  $6\mathbf{i} + a\mathbf{j} + b\mathbf{k}$  has magnitude 21 and is perpendicular to  $3\mathbf{i} + 2\mathbf{j} + 2\mathbf{k}$ . Find the possible values of  $a$  and  $b$ , showing all necessary working. [6]

This image shows a full page of a handwriting practice worksheet. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dotted lines, creating a series of uniform gaps for letter height. The entire page is otherwise blank, with no text or other markings.

- 9 Functions  $f$  and  $g$  are defined for  $x > 3$  by

$$f : x \mapsto \frac{1}{x^2 - 9},$$

$$g : x \mapsto 2x - 3.$$

- (i) Find and simplify an expression for  $gg(x)$ . [2]

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- (ii) Find an expression for  $f^{-1}(x)$  and state the domain of  $f^{-1}$ . [4]

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(iii) Solve the equation  $fg(x) = \frac{1}{7}$ .

[4]

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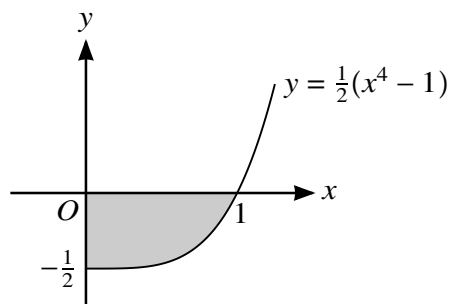
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The diagram shows part of the curve  $y = \frac{1}{2}(x^4 - 1)$ , defined for  $x \geq 0$ .

- (i) Find, showing all necessary working, the area of the shaded region. [3]

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- (ii) Find, showing all necessary working, the volume obtained when the shaded region is rotated through  $360^\circ$  about the  $x$ -axis. [4]

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- (iii) Find, showing all necessary working, the volume obtained when the shaded region is rotated through  $360^\circ$  about the y-axis. [5]

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