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## MATHEMATICS

9709/12

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** Find the term independent of  $x$  in the expansion of  $\left(2x - \frac{1}{4x^2}\right)^9$ . [4]

[illegible]

2 A function  $f$  is defined by  $f : x \mapsto 4 - 5x$  for  $x \in \mathbb{R}$ .

- (i) Find an expression for  $f^{-1}(x)$  and find the point of intersection of the graphs of  $y = f(x)$  and  $y = f^{-1}(x)$ . [3]

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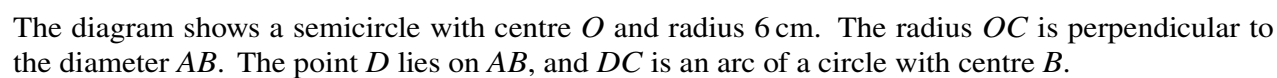
- (ii) Sketch, on the same diagram, the graphs of  $y = f(x)$  and  $y = f^{-1}(x)$ , making clear the relationship between the graphs. [3]

- 3 (a)** Each year, the value of a certain rare stamp increases by 5% of its value at the beginning of the year. A collector bought the stamp for \$10 000 at the beginning of 2005. Find its value at the beginning of 2015 correct to the nearest \$100. [2]

[illegible]

- (b)** The sum of the first  $n$  terms of an arithmetic progression is  $\frac{1}{2}n(3n + 7)$ . Find the 1st term and the common difference of the progression. [4]

[illegible]



- [illegible]



**5** (i) Show that the equation  $\cos 2x(\tan^2 2x + 3) + 3 = 0$  can be expressed as

$$2 \cos^2 2x + 3 \cos 2x + 1 = 0. \quad [3]$$

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

[illegible]

- 6** (a) The function  $f$ , defined by  $f : x \mapsto a + b \sin x$  for  $x \in \mathbb{R}$ , is such that  $f(\frac{1}{6}\pi) = 4$  and  $f(\frac{1}{2}\pi) = 3$ .

(i) Find the values of the constants  $a$  and  $b$ . [3]

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(ii) Evaluate  $ff(0)$ . [2]

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- (b)** The function  $g$  is defined by  $g : x \mapsto c + d \sin x$  for  $x \in \mathbb{R}$ . The range of  $g$  is given by  $-4 \leq g(x) \leq 10$ . Find the values of the constants  $c$  and  $d$ . [3]

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- 7** Points  $A$  and  $B$  lie on the curve  $y = x^2 - 4x + 7$ . Point  $A$  has coordinates  $(4, 7)$  and  $B$  is the stationary point of the curve. The equation of a line  $L$  is  $y = mx - 2$ , where  $m$  is a constant.

(i) In the case where  $L$  passes through the mid-point of  $AB$ , find the value of  $m$ . [4]

[illegible]

[4]

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8 A curve is such that  $\frac{dy}{dx} = -x^2 + 5x - 4$ .

(i) Find the  $x$ -coordinate of each of the stationary points of the curve. [2]

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(ii) Obtain an expression for  $\frac{d^2y}{dx^2}$  and hence or otherwise find the nature of each of the stationary points. [3]

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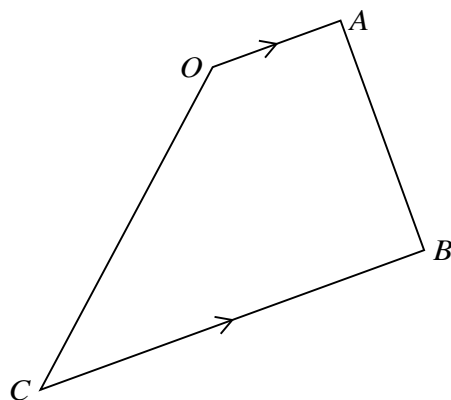
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The diagram shows a trapezium  $OABC$  in which  $OA$  is parallel to  $CB$ . The position vectors of  $A$  and  $B$  relative to the origin  $O$  are given by  $\vec{OA} = \begin{pmatrix} 2 \\ -2 \\ -1 \end{pmatrix}$  and  $\vec{OB} = \begin{pmatrix} 6 \\ 1 \\ 1 \end{pmatrix}$ .

- (i) Show that angle  $OAB$  is  $90^\circ$ . [3]

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The magnitude of  $\vec{CB}$  is three times the magnitude of  $\vec{OA}$ .

- (ii) Find the position vector of  $C$ . [3]

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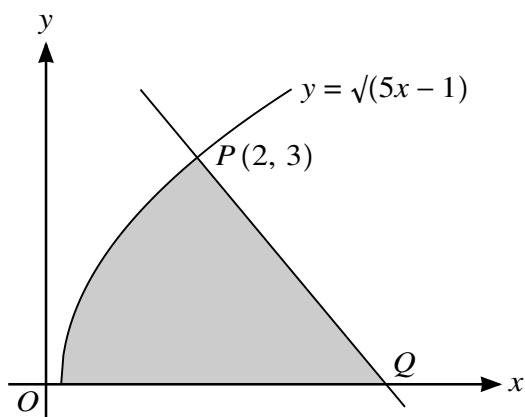
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- (iii) Find the exact area of the trapezium  $OABC$ , giving your answer in the form  $a\sqrt{b}$ , where  $a$  and  $b$  are integers. [3]



The diagram shows part of the curve  $y = \sqrt{(5x - 1)}$  and the normal to the curve at the point  $P(2, 3)$ . This normal meets the  $x$ -axis at  $Q$ .

- (i) Find the equation of the normal at  $P$ .

[4]

[illegible]

[7]

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