

CANDIDATE
NAME

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MATHEMATICS

9709/12

Paper 1 Pure Mathematics 1 (P1)

February/March 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.

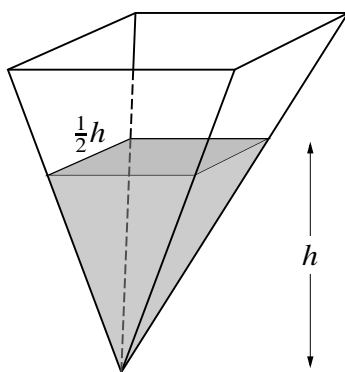
This document consists of **20** printed pages.

- 1 Find the set of values of k for which the equation $2x^2 + 3kx + k = 0$ has distinct real roots. [4]

[illegible]

- 2** In the expansion of $\left(\frac{1}{ax} + 2ax^2\right)^5$, the coefficient of x is 5. Find the value of the constant a . [4]

[illegible]



(i) Express the volume of water in the container in terms of h . [1]

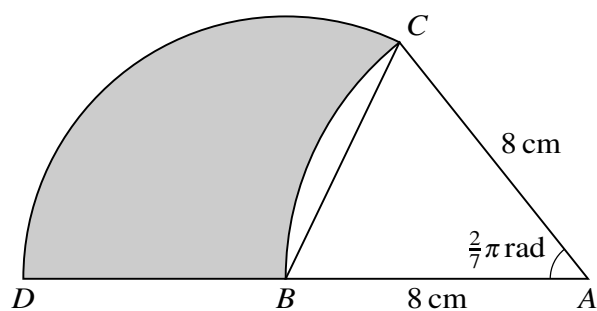
[The volume of a pyramid having a base area A and vertical height h is $\frac{1}{3}Ah$.]

This image shows a full page of a handwriting practice worksheet. It consists of multiple sets of three horizontal dashed lines, providing a guide for letter height and placement. The lines are evenly spaced across the entire page, which is otherwise blank.

Water is steadily dripping into the container at a constant rate of 20 cm^3 per minute.

- (ii) Find the rate, in cm per minute, at which the water level is rising when the height of the water level is 10 cm. [4]

[illegible]



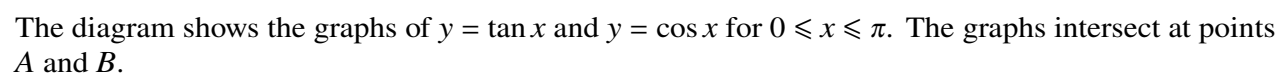
(i) Show that angle $CBD = \frac{9}{14}\pi$ radians. [1]

This image shows a full page of a document template designed for handwritten notes or essays. It features approximately 20 evenly spaced, horizontal grey lines across the entire width of the page. The lines are thin and light, providing a guide for writing without being distracting. There are no margins, headers, footers, or other markings present on the page.

(ii) Find the perimeter of the shaded region.

[5]

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 writing. The lines are evenly spaced across the entire page, providing a guide for letter height and placement. There is no text or other markings on the page.



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

[3]

[illegible]

6 Relative to an origin O , the position vectors of the points A and B are given by

$$\overrightarrow{OA} = 2\mathbf{i} + 3\mathbf{j} + 5\mathbf{k} \quad \text{and} \quad \overrightarrow{OB} = 7\mathbf{i} + 4\mathbf{j} + 3\mathbf{k}.$$

(i) Use a scalar product to find angle OAB .

[5]

[illegible]

[Turn over

7 The function f is defined for $x \geq 0$ by $f(x) = (4x + 1)^{\frac{3}{2}}$.

(i) Find $f'(x)$ and $f''(x)$.

[3]

This image shows a full page of a handwriting practice worksheet. It consists of multiple sets of three horizontal dashed lines spaced evenly down the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.

The first, second and third terms of a geometric progression are respectively $f(2)$, $f'(2)$ and $kf''(2)$.

(ii) Find the value of the constant k .

[5]

[illegible]

- 8 The functions f and g are defined for $x \geq 0$ by

$$f : x \mapsto 2x^2 + 3,$$

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

- (i) Show that $gf(x) = 6x^2 + 11$ and obtain an unsimplified expression for $fg(x)$. [2]

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- (ii) Find an expression for $(fg)^{-1}(x)$ and determine the domain of $(fg)^{-1}$. [5]

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(iii) Solve the equation $gf(2x) = fg(x)$.

[3]

- 9 The point $A(2, 2)$ lies on the curve $y = x^2 - 2x + 2$.

(i) Find the equation of the tangent to the curve at A . [3]

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The normal to the curve at A intersects the curve again at B .

(ii) Find the coordinates of B . [4]

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The tangents at A and B intersect each other at C .

(iii) Find the coordinates of C .

[4]

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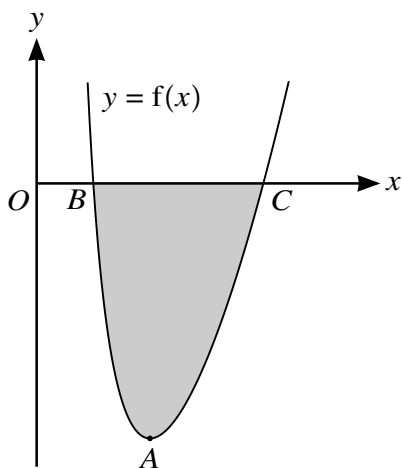
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10



The diagram shows the curve $y = f(x)$ defined for $x > 0$. The curve has a minimum point at A and crosses the x -axis at B and C . It is given that $\frac{dy}{dx} = 2x - \frac{2}{x^3}$ and that the curve passes through the point $(4, \frac{189}{16})$.

(i) Find the x -coordinate of A .

[2]

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(ii) Find $f(x)$.

[3]

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(iii) Find the x -coordinates of B and C .

[4]

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[Question 10 (iv) is printed on the next page.]

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