

# Cambridge International AS & A Level

CANDIDATE  
NAME

|  |
|--|
|  |
|--|

CENTRE  
NUMBER

|  |  |  |  |  |
|--|--|--|--|--|
|  |  |  |  |  |
|--|--|--|--|--|

CANDIDATE  
NUMBER

|  |  |  |  |
|--|--|--|--|
|  |  |  |  |
|--|--|--|--|

## MATHEMATICS

9709/12

Paper 1 Pure Mathematics 1

February/March 2021

**1 hour 50 minutes**

You must answer on the question paper.

You will need: List of formulae (MF19)

## INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

## INFORMATION

- The total mark for this paper is 75.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Any blank pages are indicated.

**BLANK PAGE**

- 1 (a) Find the first three terms in the expansion, in ascending powers of  $x$ , of  $(1 + x)^5$ . [1]

.....

.....

.....

.....

.....

.....

- (b) Find the first three terms in the expansion, in ascending powers of  $x$ , of  $(1 - 2x)^6$ . [2]

.....

.....

.....

.....

.....

.....

- (c) Hence find the coefficient of  $x^2$  in the expansion of  $(1 + x)^5(1 - 2x)^6$ . [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

**2** By using a suitable substitution, solve the equation

$$(2x-3)^2 - \frac{4}{(2x-3)^2} - 3 = 0. \quad [4]$$

This image shows a single page 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** Solve the equation  $\frac{\tan \theta + 2 \sin \theta}{\tan \theta - 2 \sin \theta} = 3$  for  $0^\circ < \theta < 180^\circ$ . [4]

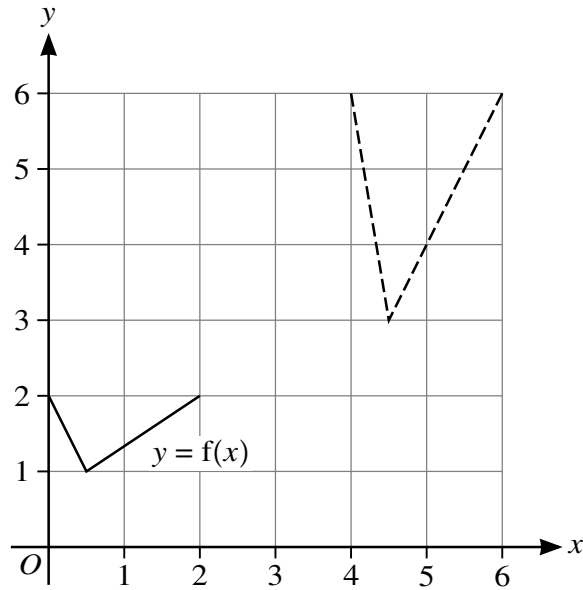
This image shows a full page of primary-ruled paper. It features multiple sets of horizontal dashed lines spaced evenly down the page, providing a guide for handwriting practice. The background is white, and there are no margins or other markings present.

- 4** A line has equation  $y = 3x + k$  and a curve has equation  $y = x^2 + kx + 6$ , where  $k$  is a constant.

Find the set of values of  $k$  for which the line and curve have two distinct points of intersection. [5]

[illegible]

5



In the diagram, the graph of  $y = f(x)$  is shown with solid lines. The graph shown with broken lines is a transformation of  $y = f(x)$ .

- (a) Describe fully the two single transformations of  $y = f(x)$  that have been combined to give the resulting transformation. [4]

.....

.....

.....

.....

.....

.....

.....

.....

- (b) State in terms of  $y$ ,  $f$  and  $x$ , the equation of the graph shown with broken lines. [2]

.....

.....

.....

.....

.....

- 6** A curve is such that  $\frac{dy}{dx} = \frac{6}{(3x-2)^3}$  and  $A(1, -3)$  lies on the curve. A point is moving along the curve and at  $A$  the  $y$ -coordinate of the point is increasing at 3 units per second.

(a) Find the rate of increase at  $A$  of the  $x$ -coordinate of the point. [3]

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)** Find the equation of the curve.

[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.

$$g : x \mapsto 2x + 1 \text{ for } x \geq -1.$$

- (a)** Express  $f(x)$  in the form  $(x + a)^2 + b$  and state the range of  $f$ . [3]

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) Find an expression for  $f^{-1}(x)$ . [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

- (c) Solve the equation  $gf(x) = 13$ . [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

- 8** The points  $A(7, 1)$ ,  $B(7, 9)$  and  $C(1, 9)$  are on the circumference of a circle.

**(a)** Find an equation of the circle.

[5]

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) Find an equation of the tangent to the circle at  $B$ . [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

9 The first term of a progression is  $\cos \theta$ , where  $0 < \theta < \frac{1}{2}\pi$ .

(a) For the case where the progression is geometric, the sum to infinity is  $\frac{1}{\cos \theta}$ .

(i) Show that the second term is  $\cos \theta \sin^2 \theta$ . [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(ii) Find the sum of the first 12 terms when  $\theta = \frac{1}{3}\pi$ , giving your answer correct to 4 significant figures. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

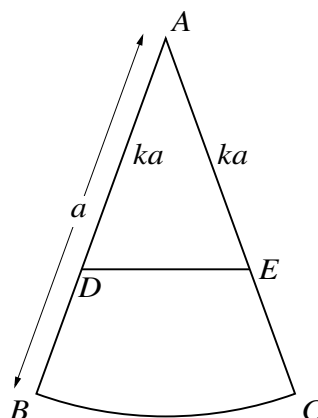
.....

- (b)** For the case where the progression is arithmetic, the first two terms are again  $\cos \theta$  and  $\cos \theta \sin^2 \theta$  respectively.

Find the 85th term when  $\theta = \frac{1}{3}\pi$ .

[4]

[illegible]



(a) For the case where angle  $BAC = \frac{1}{6}\pi$  radians, find  $k$  correct to 4 significant figures. [5]

[illegible]

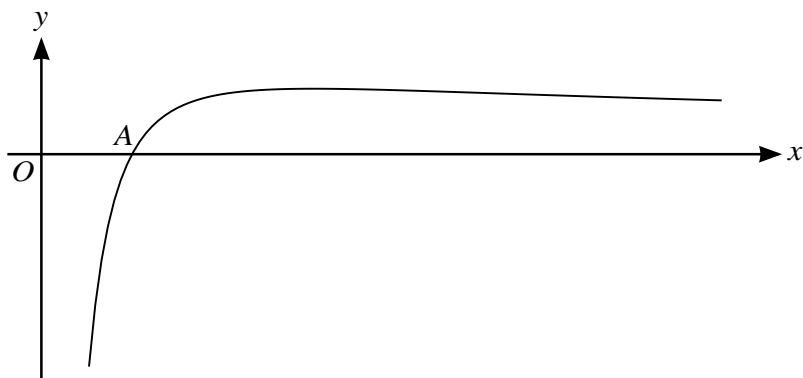
- (b) For the general case in which angle  $BAC = \theta$  radians, where  $0 < \theta < \frac{1}{2}\pi$ , it is given that  $\frac{\theta}{\sin \theta} > 1$ .

Find the set of possible values of  $k$ .

[3]

[illegible]

11



The diagram shows the curve with equation  $y = 9(x^{-\frac{1}{2}} - 4x^{-\frac{3}{2}})$ . The curve crosses the  $x$ -axis at the point  $A$ .

- (a) Find the  $x$ -coordinate of  $A$ . [2]

.....

.....

.....

.....

.....

.....

.....

- (b) Find the equation of the tangent to the curve at  $A$ . [4]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(d) Find the area of the region bounded by the curve, the  $x$ -axis and the line  $x = 9$ . [4]

9709/12/F/M/21

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.

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.