

--

--	--	--	--	--

--	--	--	--

## 9709/11

**May/June 2024**

**1 hour 50 minutes**

You must answer on the question paper.

You will need: List of formulae (MF19)

- 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.

- 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.

- 1 (a) Express  $3y^2 - 12y - 15$  in the form  $3(y + a)^2 + b$ , where  $a$  and  $b$  are constants. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

- (b) Hence find the exact solutions of the equation  $3x^4 - 12x^2 - 15 = 0$ . [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

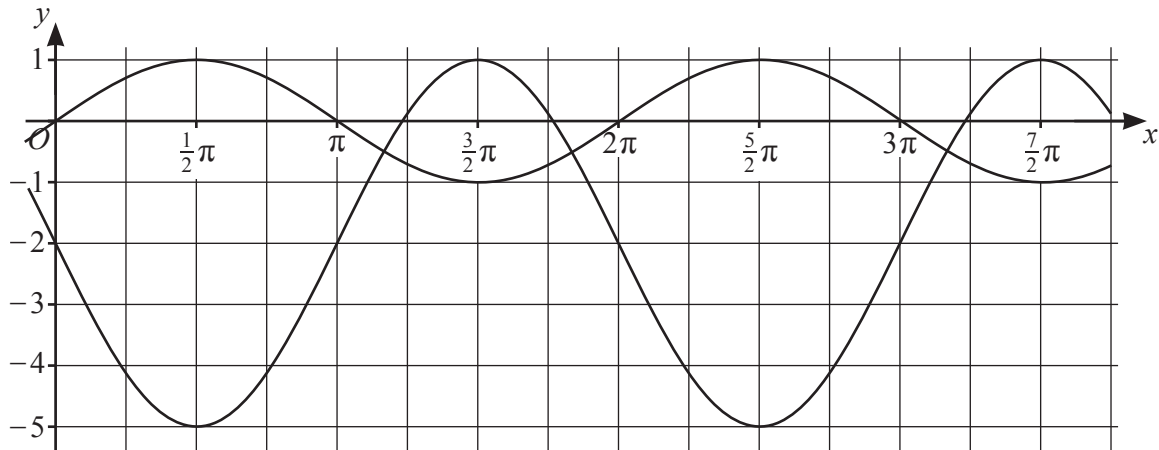
.....

.....

.....

.....

2



The diagram shows two curves. One curve has equation  $y = \sin x$  and the other curve has equation  $y = f(x)$ .

- (a) In order to transform the curve  $y = \sin x$  to the curve  $y = f(x)$ , the curve  $y = \sin x$  is first reflected in the  $x$ -axis.

Describe fully a sequence of two further transformations which are required.

[4]

.....

.....

.....

.....

.....

.....

.....

- (b) Find  $f(x)$  in terms of  $\sin x$ .

[2]

.....

.....

.....

.....

.....

.....

.....

3 The coefficient of  $x^3$  in the expansion of  $(3 + ax)^6$  is 160.

(a) Find the value of the constant  $a$ .

[2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) Hence find the coefficient of  $x^3$  in the expansion of  $(3 + ax)^6(1 - 2x)$ .

[3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

- 4 The equation of a curve is  $y = f(x)$ , where  $f(x) = (2x - 1)\sqrt{3x - 2} - 2$ . The following points lie on the curve. Non-exact values have been given correct to 5 decimal places.

$A(2, 4)$ ,  $B(2.0001, k)$ ,  $C(2.001, 4.00625)$ ,  $D(2.01, 4.06261)$ ,  $E(2.1, 4.63566)$ ,  $F(3, 11.22876)$

- (a) Find the value of  $k$ . Give your answer correct to 5 decimal places. [1]

.....

.....

.....

.....

The table shows the gradients of the chords  $AB$ ,  $AC$ ,  $AD$  and  $AF$ .

Chord	$AB$	$AC$	$AD$	$AE$	$AF$
Gradient of chord	6.2501	6.2511	6.2608		7.2288

- (b) Find the gradient of the chord  $AE$ . Give your answer correct to 4 decimal places. [1]

.....

.....

.....

.....

.....

.....

.....

.....

- (c) Deduce the value of  $f'(2)$  using the values in the table. [1]

.....

.....

.....

.....

.....

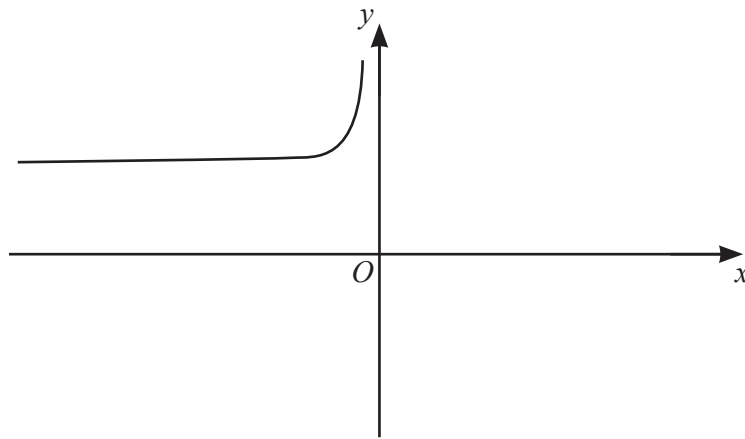
.....

.....

.....

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.

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 width of the page. There are no margins, text, or other markings on the paper.



The function  $f$  is defined by  $f(x) = \frac{2}{x^2} + 4$  for  $x < 0$ . The diagram shows the graph of  $y = f(x)$ .

- (a) On this diagram, sketch the graph of  $y = f^{-1}(x)$ . Show any relevant mirror line. [2]
- (b) Find an expression for  $f^{-1}(x)$ . [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

- (c) Solve the equation  $f(x) = 4.5$ . [1]

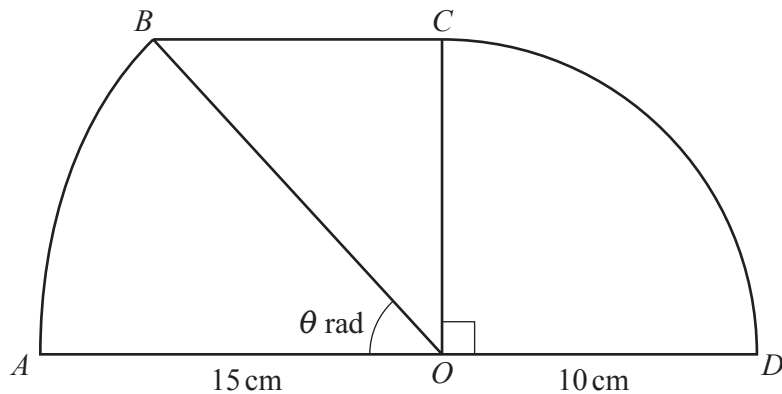
.....

.....

- (d) Explain why the equation  $f^{-1}(x) = f(x)$  has no solution. [1]

.....

.....



In the diagram,  $AOD$  and  $BC$  are two parallel straight lines. Arc  $AB$  is part of a circle with centre  $O$  and radius 15 cm. Angle  $BOA = \theta$  radians. Arc  $CD$  is part of a circle with centre  $O$  and radius 10 cm. Angle  $COD = \frac{1}{2}\pi$  radians.

- (a) Show that  $\theta = 0.7297$ , correct to 4 decimal places. [1]

.....

.....

.....

.....

.....

.....

- (b) Find the perimeter and the area of the shape  $ABCD$ . Give your answers correct to 3 significant figures. [7]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



Handwriting practice area with 25 horizontal dotted lines.

- 8 (a)** The first three terms of an arithmetic progression are  $25$ ,  $4p - 1$  and  $13 - p$ , where  $p$  is a constant.

Find the value of the tenth term of the progression.

[4]

[illegible]

- (b) The first three terms of a geometric progression are  $25$ ,  $4q - 1$  and  $13 - q$ , where  $q$  is a positive constant.

Find the sum to infinity of the progression.

[4]

[illegible]

Find the exact volume of the solid generated when the shaded region is rotated through  $360^\circ$  about the  $x$ -axis. [6]

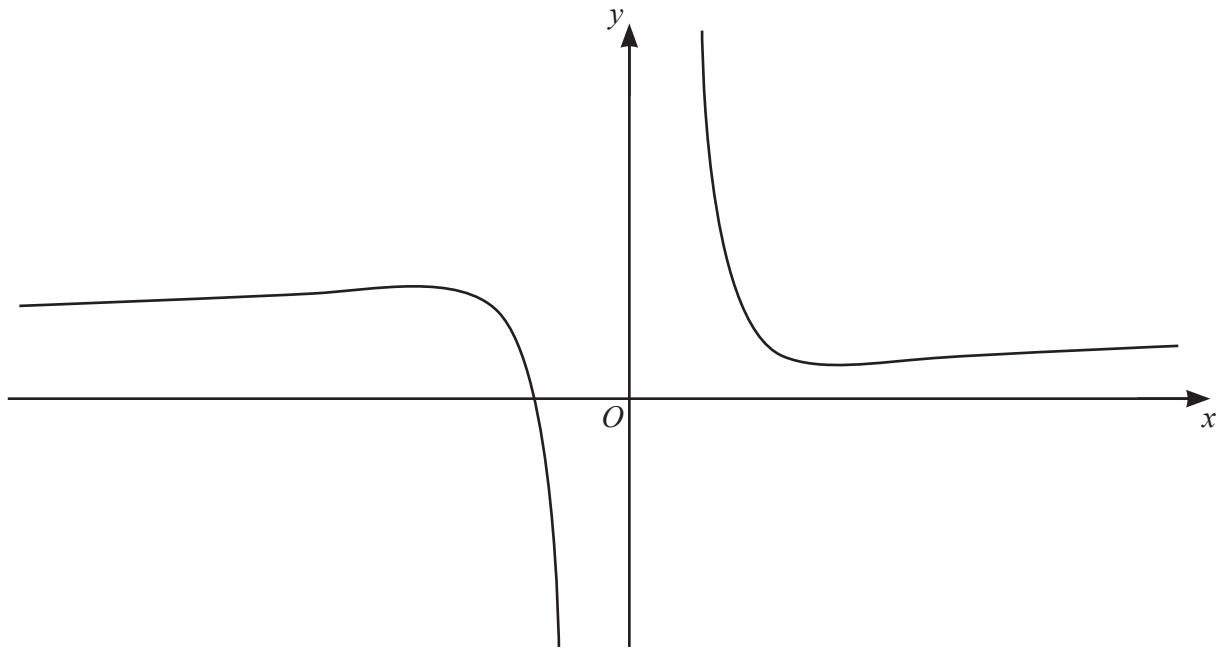
[illegible]

[illegible]

- Find the two possible values of  $m$  and, for each value of  $m$ , find the coordinates of the point at which the tangent touches the circle. [8]

[illegible]

[illegible]



A function is defined by  $f(x) = \frac{4}{x^3} - \frac{3}{x} + 2$  for  $x \neq 0$ . The graph of  $y = f(x)$  is shown in the diagram.

- (a) Find the set of values of  $x$  for which  $f(x)$  is decreasing. [5]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



- (b) A triangle is bounded by the  $y$ -axis, the normal to the curve at the point where  $x = 1$  and the tangent to the curve at the point where  $x = -1$ .

Find the area of the triangle. Give your answer correct to 3 significant figures.

[8]

[illegible]

## Additional page

If you use the following page to complete the answer to any question, the question number must be clearly shown.

[illegible]

**BLANK PAGE**

**BLANK PAGE**

---

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at [www.cambridgeinternational.org](http://www.cambridgeinternational.org) after the live examination series.

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