



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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9709/11

May/June 2024

1 hour 50 minutes

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]

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

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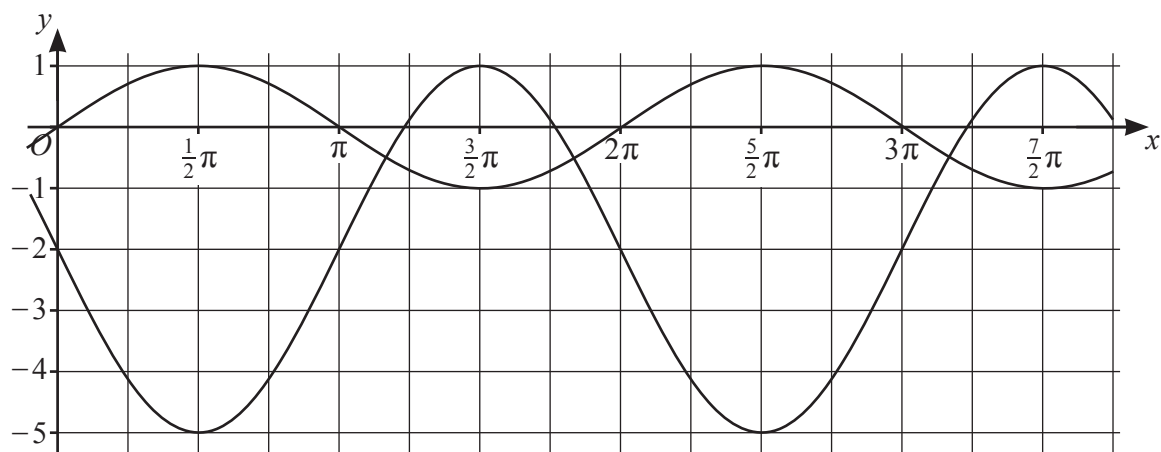
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The diagram shows two curves. One curve has equation $y = \sin x$ and the other curve has equation $y = f(x)$.

- (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]

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

[2]

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

(a) Find the value of the constant a .

[2]

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

[3]

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- 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]

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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]

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

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- 5 (a) Prove the identity $\frac{\sin^2 x - \cos x - 1}{1 + \cos x} \equiv -\cos x$. [3]

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- (b) Hence solve the equation $\frac{\sin^2 x - \cos x - 1}{2 + 2 \cos x} = \frac{1}{4}$ for $0^\circ \leq x \leq 360^\circ$. [3]

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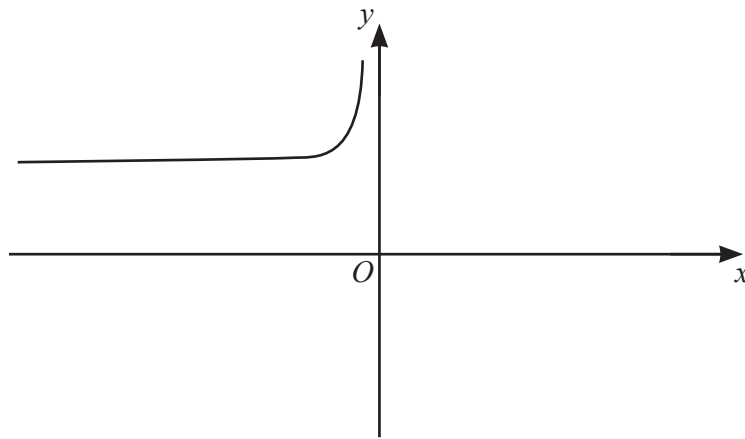
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The function f is defined by $f(x) = \frac{2}{x^2} + 4$ for $x < 0$. The diagram shows the graph of $y = f(x)$.

- (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]

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

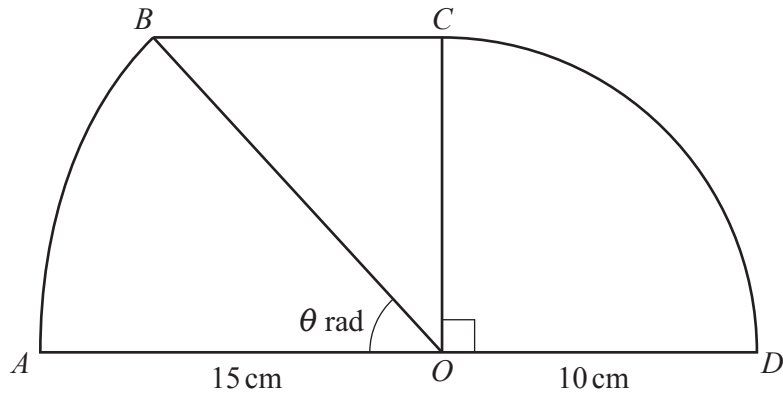
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- (d) Explain why the equation $f^{-1}(x) = f(x)$ has no solution. [1]

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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]

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

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- 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]

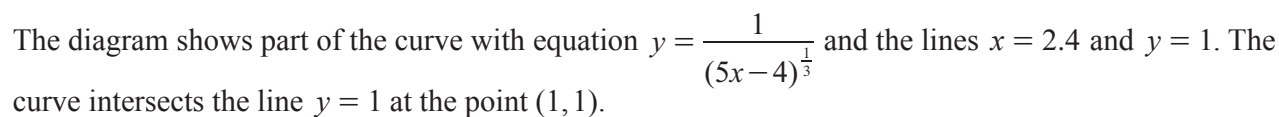
This image shows a full page of a handwriting practice worksheet. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dashed lines, creating a series of uniform gaps for letter height. The lines are evenly spaced across the entire page, providing a guide for consistent letter formation. There is no text or other markings on the page.

- (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]

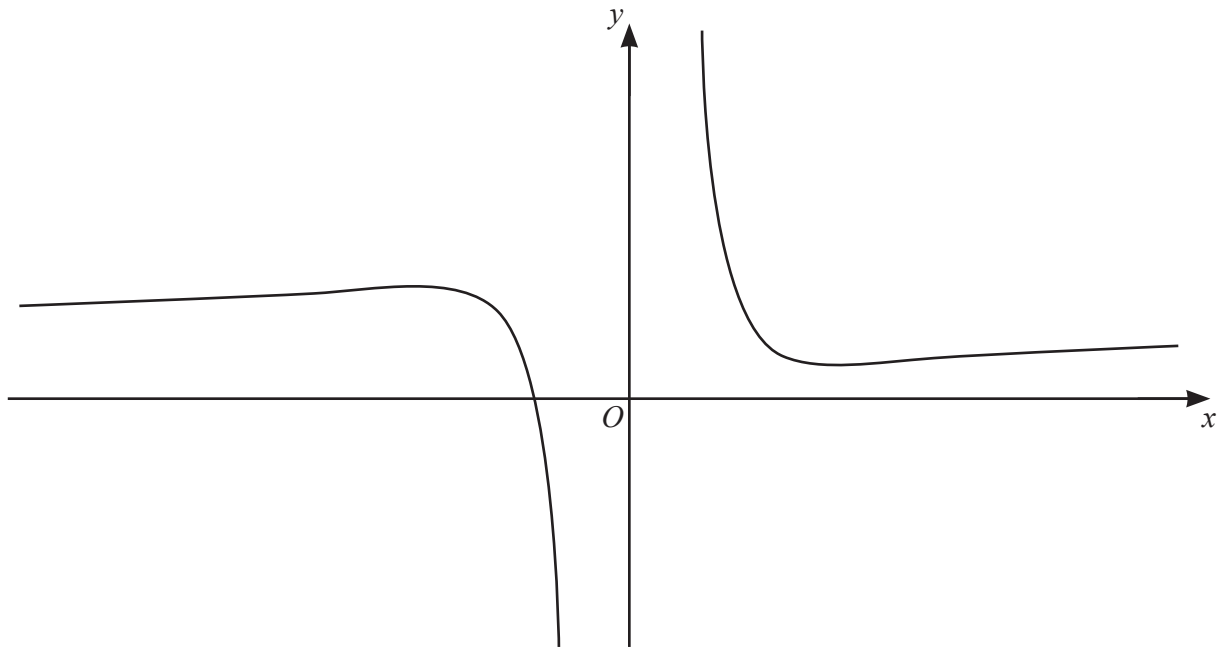


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- 10** The equation of a circle is $(x-3)^2 + y^2 = 18$. The line with equation $y = mx + c$ passes through the point $(0, -9)$ and is a tangent to the circle.

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]



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]

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- (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]

[illegible]

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