

Cambridge International AS & A Level

CANDIDATE
NAME

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CENTRE
NUMBER

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MATHEMATICS

9709/13

Paper 1 Pure Mathematics 1

May/June 2020

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. Blank pages are indicated.

- [4]

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- 2** The equation of a curve is such that $\frac{dy}{dx} = 3x^{\frac{1}{2}} - 3x^{-\frac{1}{2}}$. It is given that the point (4, 7) lies on the curve.

Find the equation of the curve.

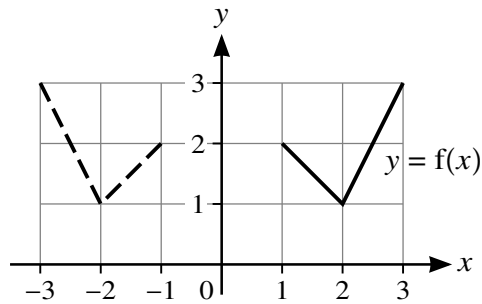
[4]

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- 3 In each of parts (a), (b) and (c), the graph shown with solid lines has equation $y = f(x)$. The graph shown with broken lines is a transformation of $y = f(x)$.

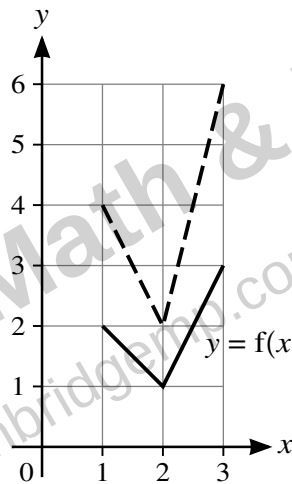
(a)



State, in terms of f , the equation of the graph shown with broken lines.

[1]

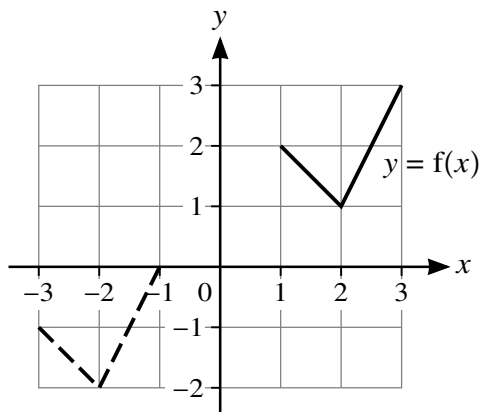
(b)



State, in terms of f , the equation of the graph shown with broken lines.

[1]

(c)



State, in terms of f , the equation of the graph shown with broken lines.

[2]

- 4 (a) Expand $(1 + a)^5$ in ascending powers of a up to and including the term in a^3 . [1]

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- (b) Hence expand $[1 + (x + x^2)]^5$ in ascending powers of x up to and including the term in x^3 , simplifying your answer. [3]

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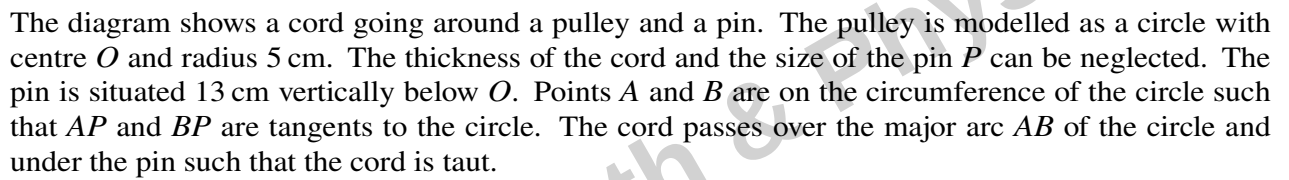
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[6]

[illegible]

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- (a) Find the rate at which the y-coordinate is increasing when $x = 1$. [4]

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7 (a) Show that $\frac{\tan \theta}{1 + \cos \theta} + \frac{\tan \theta}{1 - \cos \theta} \equiv \frac{2}{\sin \theta \cos \theta}$. [4]

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[illegible]

- (a) Given that the progression is geometric, find the sum to infinity. [3]

[illegible]

It is now given instead that the progression is arithmetic.

- (b) (i) Find the common difference of the progression in terms of $\sin \theta$. [3]

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- (ii) Find the sum of the first 16 terms when $\theta = \frac{1}{3}\pi$. [3]

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- 9 The functions f and g are defined by

$$f(x) = x^2 - 4x + 3 \quad \text{for } x > c, \text{ where } c \text{ is a constant,}$$

$$g(x) = \frac{1}{x+1} \quad \text{for } x > -1.$$

- (a) Express $f(x)$ in the form $(x - a)^2 + b$. [2]

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It is given that f is a one-one function.

- (b) State the smallest possible value of c . [1]

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It is now given that $c = 5$.

- (c) Find an expression for $f^{-1}(x)$ and state the domain of f^{-1} . [3]

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- (d) Find an expression for $gf(x)$ and state the range of gf . [3]

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- 10 (a)** The coordinates of two points A and B are $(-7, 3)$ and $(5, 11)$ respectively.

Show that the equation of the perpendicular bisector of AB is $3x + 2y = 11$.

[4]

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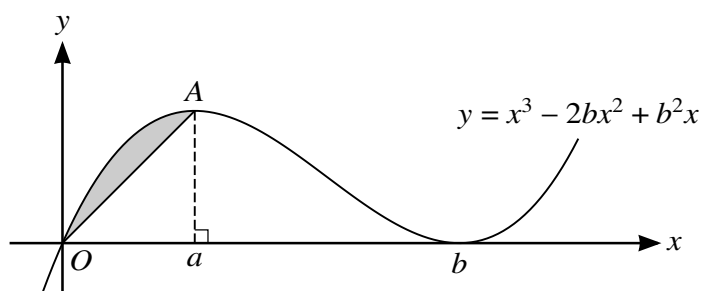
- (b)** A circle passes through A and B and its centre lies on the line $12x - 5y = 70$.

Find an equation of the circle.

[5]

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The diagram shows part of the curve with equation $y = x^3 - 2bx^2 + b^2x$ and the line OA , where A is the maximum point on the curve. The x -coordinate of A is a and the curve has a minimum point at $(b, 0)$, where a and b are positive constants.

- (a) Show that $b = 3a$. [4]

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