



Cambridge International AS & A Level

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MATHEMATICS

9709/11

Paper 1 Pure Mathematics 1

May/June 2024

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.

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

$$\begin{aligned}
 3y^2 - 12y - 15 &= 3(y^2 - 4y) - 15 \\
 &= 3\left[(y^2 - 4y + 4) - 4\right] - 15 \\
 &= 3\left[(y-2)^2 - 4\right] - 15 = 3(y-2)^2 - 12 - 15 \\
 &= 3(y-2)^2 - 27
 \end{aligned}$$

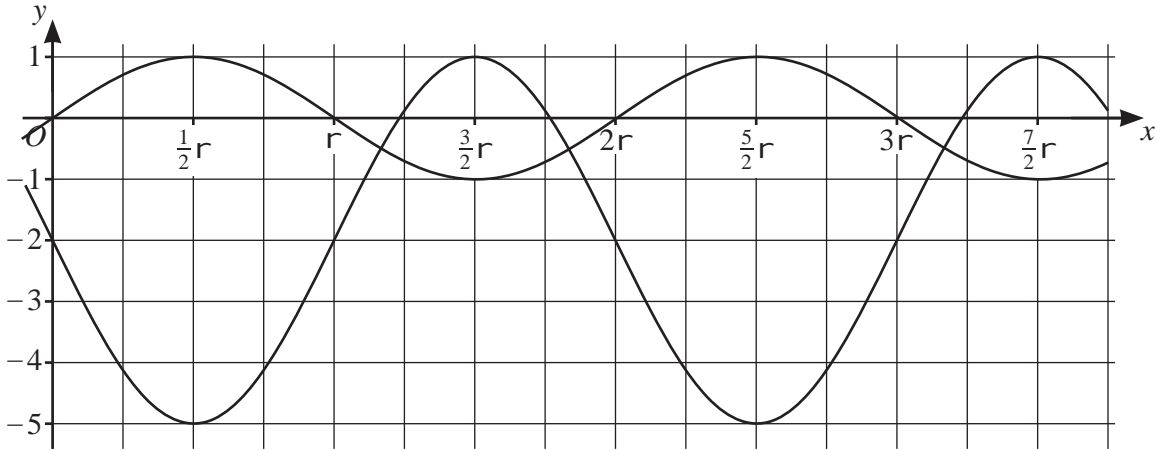
$$a = -2, \quad b = -27 \quad \#$$

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

$$3(x^2 - 2)^2 - 27 = 0 \rightarrow (x^2 - 2)^2 = 9$$

$$\rightarrow \begin{cases} x^2 - 2 = 3 \rightarrow x^2 = 5 \rightarrow x = \pm\sqrt{5} \quad \# \\ x^2 - 2 = -3 \rightarrow x^2 = -1 \quad \text{rejected} \end{cases}$$

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]

$$\sin x \xrightarrow{x \rightarrow -x} -\sin x \xrightarrow{\times 3} -3\sin x \xrightarrow{-2} -3\sin x - 2$$

① $\sin x$ reflect to x -axis $\rightarrow -\sin x$

② Stretch in y -direction factor = 3 $\rightarrow -3\sin x$

③ Shift 2 units down in y -direction $\rightarrow -3\sin x - 2$ #

- (b) Find $f(x)$ in terms of $\sin x$. [2]

$$f(x) = -3\sin x - 2$$

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

(a) Find the value of the constant a .

[2]

$$(3+ax)^6 = C_0^6 3^6 + C_1^6 3^5(ax)^1 + C_2^6 3^4(ax)^2 + C_3^6 3^3(ax)^3 + \dots$$

$$= 729 + 1458ax + 1215a^2x^2 + 20 \times 27 a^3x^3 + \dots$$

$$\rightarrow 20 \times 27 a^3 = 160 \rightarrow 27a^3 = 8 \rightarrow a^3 = 8/27 \rightarrow$$

$$a = 2/3 \quad \#$$

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

[3]

$$(729 + 1458ax + 1215a^2x^2 + 540a^3x^3 + \dots)(1-2x)$$

$$-2430a^2x^3 + 540a^3x^3 = (-2430a^2 + 540a^3)x^3$$

$$a = \frac{2}{3} \rightarrow = -920x^3$$

$$\text{answer} = -920 \quad \#$$

- 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]

$$f(2.0001) = (2(2.0001) - 1)\sqrt{3(2.0001) - 2} - 2 = 4.00063 \quad *$$

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]

$$m_{AE} = \frac{y_E - y_A}{x_E - x_A} = \frac{4.63566 - 4}{2.1 - 2} = 6.3566 \quad *$$

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

$$x_A = 2 \rightarrow f'(2) \approx 6.25 \quad *$$

when x tends $x=2$ from the right, gradient

tends to 6.25 *