Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Functions

Time allowed: 1 hour 40 minutes

Subject code **0606**

Additional Mathematics

Questions from Paper 1 and Paper 2

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.
Questions 3, 9-10 (Paper 1): no calculator.
Questions 1-2, 4-8 (Paper 2): calculator allowed.

Total marks

/ 64

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.
- Unless a question says otherwise, give answers that are not exact to 3 significant figures, and angles in degrees to 1 decimal place.

Information

- This paper has 10 questions worth 64 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

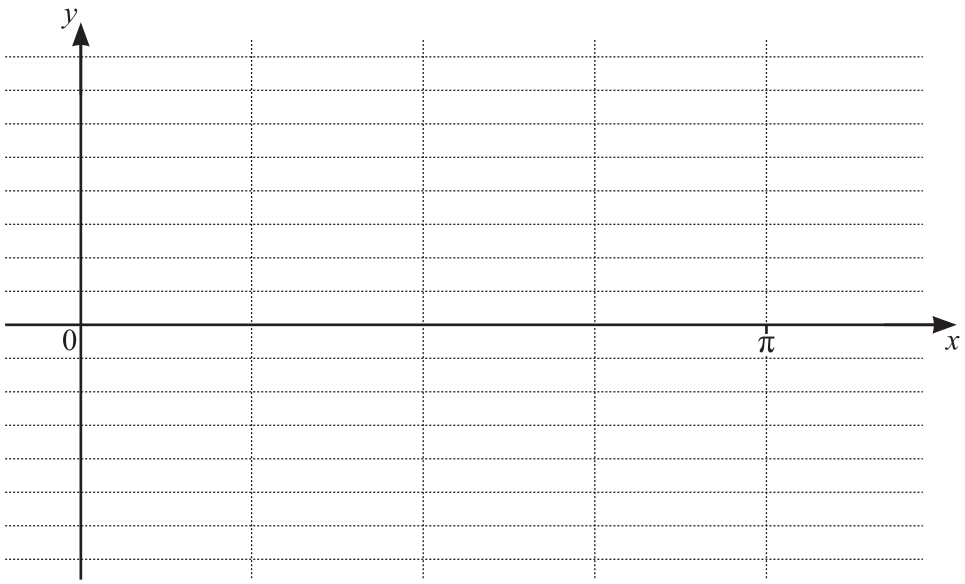
Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

1 On the axes below, sketch the graph of $y = |4\cos 2x|$ for $0 \leqslant x \leqslant \pi$, giving the coordinates of any points where the graph meets the axes. [3]



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2 Functions f and g are such that

$$\mathrm{f}(x) = \frac{3x}{x+4} \quad \text{for } x > 0$$
$$\mathrm{g}(x) = \sqrt{x+2} \quad \text{for } x > -2\,.$$

Solve the equation $\mathrm{fg}(x) = 1$. [4]

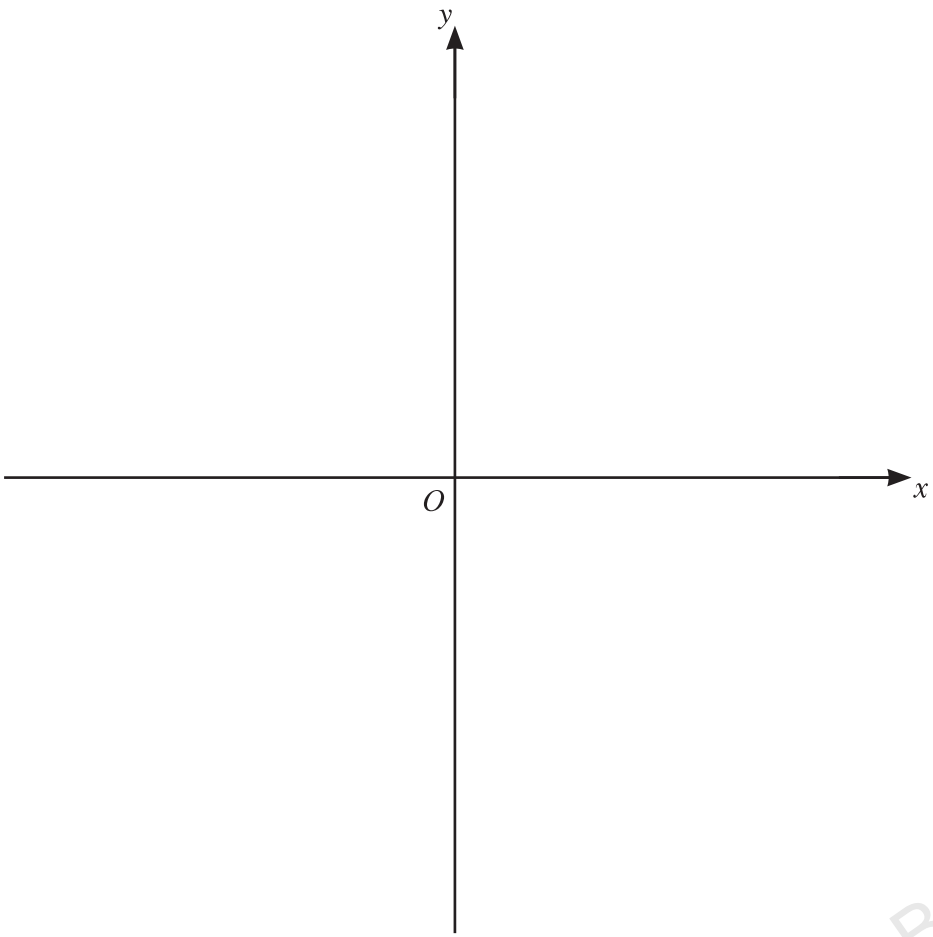
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Domain, range, inverse and composite functions Click for more variations

3 $\mathrm{f}(x) = x^2 + 2x - 3 \quad \text{for } x \geqslant -1$

(a) Given that the minimum value of $x^2 + 2x - 3$ occurs when $x = -1$, explain why $\mathrm{f}(x)$ has an inverse. [1]

(b) On the axes below, sketch the graph of $y = \mathrm{f}(x)$ and the graph of $y = \mathrm{f}^{-1}(x)$. Label each graph and state the intercepts on the coordinate axes.



[4]

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4 It is given that $f(x) = 2e^x + a$ for $x \geqslant 0$, where a is an integer

and $g(x) = \sqrt{x-1}$ for $x \geqslant 1$.

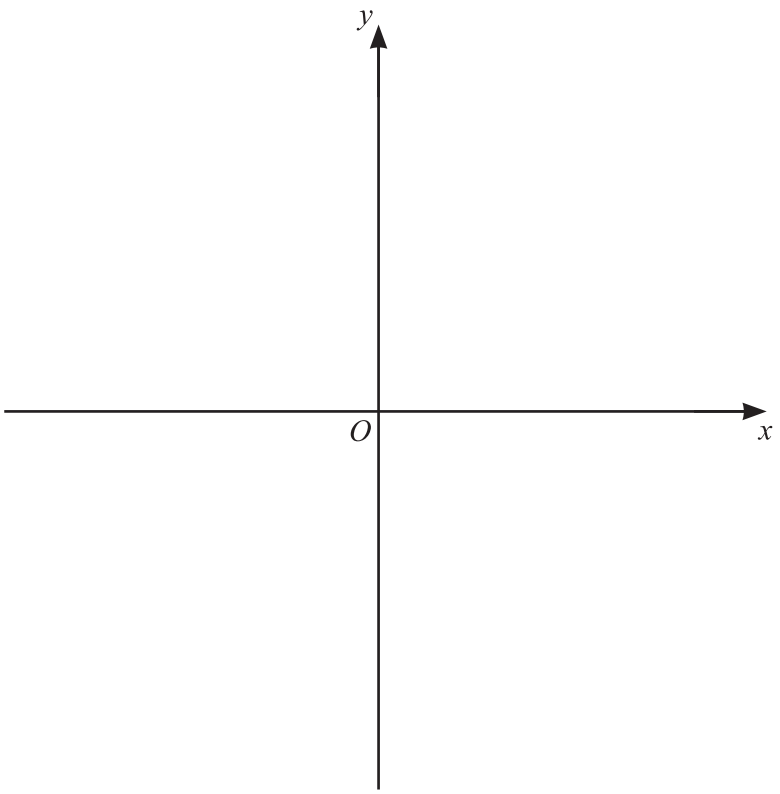
(a) Find the least value of a so that the function gf exists for all $x \geqslant 0$. [2]

(b) In the case where $a = 5$, solve the equation $gf(x) = 3$.
Give your answer correct to 3 decimal places. [3]

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5 **(a)** On the axes below, sketch the graph of $y = |5x - 7|$, showing the coordinates of the points where the graph meets the coordinate axes. [3]



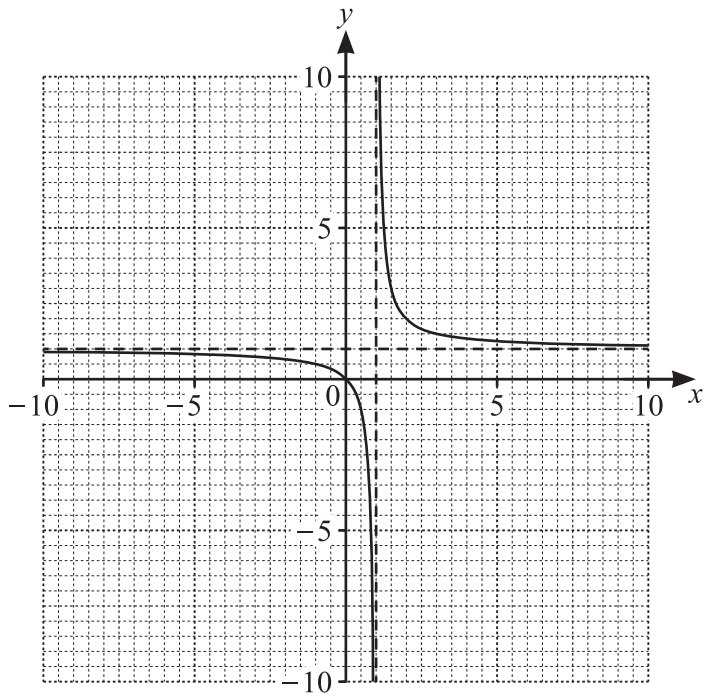
(b) Solve $5|5x - 7| - 1 = 14$. [3]

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6 **(a)** $f(x) = \dfrac{x}{x-1}$ for $-10 \leqslant x \leqslant 10, x \neq 1$.

The diagram shows the graph of $y = f(x)$.



(i) Use the diagram to explain why f is a function. [1]

(ii) Find $ff(x)$, giving your answer in its simplest form. [2]

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(iii) Using your answer to **part (ii)** state the relationship between the functions f and f^{-1}. [1]

(iv) Explain how the diagram shows the relationship between f and f^{-1}. [1]

(b) A function g is defined by $g(x) = \frac{x}{x-1}$ for $x \geqslant 2$. Find the range of g. [1]

(c) A function h is defined by $h(x) = \frac{2x}{3x+1}$ for the largest possible domain. State the domain of h. [1]

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7 The functions f and g are defined as follows, for all real values of x.

$$\mathrm{f}(x) = 2x^2 - 1$$
$$\mathrm{g}(x) = \mathrm{e}^x + 1$$

(a) Solve the equation $\mathrm{fg}(x) = 8$. [3]

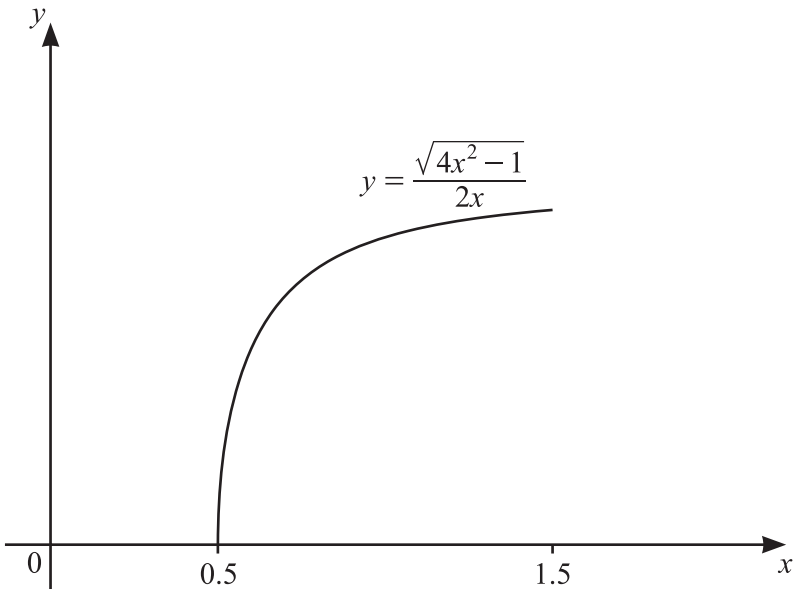
(b) For each of the functions f and g, either explain why the inverse function does not exist or find the inverse function, stating its domain. [4]

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8 The function f is defined by $\mathrm{f}(x) = \dfrac{\sqrt{4x^2 - 1}}{2x}$ for $0.5 \leqslant x \leqslant 1.5$.

The diagram shows a sketch of $y = \mathrm{f}(x)$.



(a) (i) It is given that f^{-1} exists. Find the domain and range of f^{-1}. [3]

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(ii) Find an expression for $\mathrm{f}^{-1}(x)$. [3]

(b) The function g is defined by $\mathrm{g}(x) = \mathrm{e}^{x^2}$ for all real x. Show that $\mathrm{gf}(x) = \mathrm{e}^{\left(1-\frac{a}{bx^2}\right)}$, where a and b are integers. [2]

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9 $\mathrm{f}: x \mapsto (2x+3)^2 \quad \text{for } x > 0$

(a) Find the range of f. [1]

(b) Explain why f has an inverse. [1]

(c) Find f^{-1}. [3]

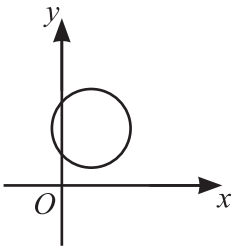
(d) State the domain of f^{-1}. [1]

(e) Given that $\mathrm{g}: x \mapsto \ln(x+4) \quad \text{for } x > 0$, find the exact solution of $\mathrm{fg}(x) = 49$. [3]

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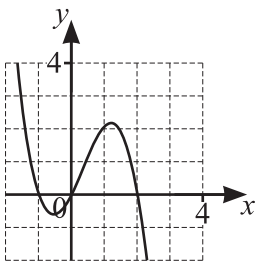
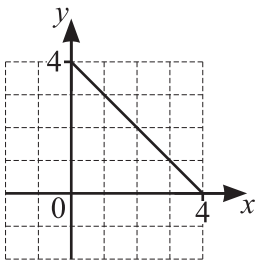
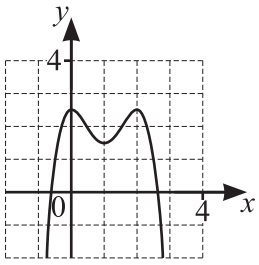
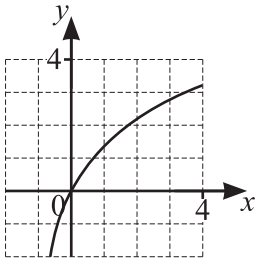
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10 (a)



Explain why this graph does **not** represent a function. [1]

(b) The table shows the graphs of four different functions.

	is one-one	is many-one	is its own inverse
			
			
			
			

Tick (✓) each correct box in the table.
There may be more than one tick in a row or a column. [4]

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(c) Functions f and g are defined as follows.

$\text{f}: x \mapsto \sin x \qquad \text{for } 30° \leqslant x \leqslant a°$

$\text{g}: x \mapsto \sqrt{x - \frac{1}{2}} \qquad \text{for } x \geqslant \frac{1}{2}$

It is given that the function gf exists.

(i) Find the value of a so that the domain of gf is as large as possible.

You may use the information that $\sin 30° = \frac{1}{2}$. [2]

(ii) For the domain found in **part (i)**, find the range of the function gf. [2]

(iii) Determine whether the function g^2 exists. [1]

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