Write your name here

Surname	Other Names

AS/A Level Mathematics

Functions

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

• Use **black** ink or ball-point pen.
• If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
• **Fill in the boxes** at the top of this page with your name.
• Answer **all** questions and ensure that your answers to parts of questions are clearly labelled..
• Answer the questions in the spaces provided
– there may be more space than you need.
• You should show sufficient working to make your methods clear.
Answers without working may not gain full credit.
• Answers should be given to three significant figures unless otherwise stated.

Information

• The marks for **each** question are shown in brackets
– use this as a guide as to how much time to spend on each question.

Advice

• Read each question carefully before you start to answer it.
• Try to answer every question.
• Check your answers if you have time at the end.

1 The functions f and g are defined by

$$f : x \to 3x + 4, \qquad x \in \mathbb{R}$$

$$g : x \to \frac{2}{x+3}, \qquad x \in \mathbb{R},\ x \neq 3$$

(a) Evaluate fg(1) **(2)**

(b) Solve the equation gf(x) = 6 **(4)**

(Total for question 1 is 6 marks)

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2 The function f is defined by

$$f(x) = x^2 + 2x + 1, \quad x \in \mathbb{R}, \quad x \geq -1$$

(a) State the range of f **(1)**

(b) Sketch the graphs of f(x) and $f^{-1}(x)$ on the same diagram **(3)**

(c) Find an expression for $f^{-1}(x)$ and state its domain **(4)**

(Total for question 2 is 8 marks)

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3 The function f is defined by

$$f(x) = 2 + \ln(2x - 1), \quad x \in \mathbb{R}, \quad x > 0.5$$

(a) Find the exact value of ff(1) **(2)**

(b) Find an expression for $f^{-1}(x)$ **(3)**

(Total for question 3 is 5 marks)

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4 The functions f and g are defined by

$$f : x \to e^x, \qquad x \in \mathbb{R}$$

$$g : x \to 2x + \ln x, \qquad x \in \mathbb{R},\ x > 0$$

(a) Write down the range of f **(1)**

(b) Find an expression for the composite function gf **(2)**

(c) Write down the range of gf **(1)**

(Total for question 4 is 4 marks)

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5 The function f is defined by

$$f(x) = \frac{1}{x+2}, \qquad x \in \mathbb{R},\ x \neq -2$$

(a) Write down the range of f(x) **(2)**

(b) Find an expression for $f^{-1}(x)$ and state its domain **(3)**

$$g(x) = x^2 - 5, \qquad x \in \mathbb{R}$$

(c) Solve $fg(x) = \frac{1}{2}$ **(3)**

(Total for question 5 is 8 marks)

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6 The function f is defined by

$$f(x) = x^2 + 4x + 1, \qquad x \in \mathbb{R}$$

(a) Find the range of f(x) **(3)**

(b) Explain why the function f(x) does not have an inverse **(1)**

(Total for question 6 is 4 marks)

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7 (a) Sketch the graph with equation

$$y = |2x - 3|$$

stating the coordinates where the graph cuts of meets the coordinate axis. **(2)**

(b) Find the values of x which satisfy $|2x - 3| < 9$ **(2)**

(c) Find the values of x which satisfy $|2x - 3| < x + 1$ **(2)**

(Total for question 7 is 6 marks)

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8 The functions f and g are defined by

$$f : x \to \ln(3x - 2), \qquad x \in \mathbb{R},\ x > \frac{2}{3}$$

$$g : x \to \frac{3}{x-2}, \qquad x \in \mathbb{R},\ x \neq 2$$

(a) Find the exact value of fg(3) **(2)**

(b) Find an expression for $f^{-1}(x)$ and state its domain **(4)**

(c) Sketch the graphs of f(x) and $f^{-1}(x)$ on the same diagram **(3)**

(d) Sketch the graph of $y = |g(x)|$ **(3)**

(e) Find the exact values of $\left|\frac{3}{x-2}\right| = 4$ **(3)**

(Total for question 8 is 15 marks)