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 15 minutes

Subject code **0580**

Mathematics

Questions from Paper 2 and Paper 4

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.
You may use a calculator.

Total marks

/ 60

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 60 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 $f(x) = 2x + 3$

Find $f(1 - x)$ in its simplest form.

..... [2]

Functions Click for more variations

1	$5 - 2x$ final answer	**2**	**M1** for $2(1 - x) + 3$ oe

2 $f(x) = x^3 + 1$

Find $f^{-1}(x)$.

$f^{-1}(x) =$ ..... [2]

Functions Click for more variations

2	$\sqrt[3]{x-1}$ or $(x-1)^{\frac{1}{3}}$	**2**	**M1** for $x = y^3 + 1$ or for $y - 1 = x^3$ or better

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3 $f(x) = 7^{x-4}$

Find the value of x when

(a) $f(x) = 1$

$x =$ ..... [1]

(b) $f^{-1}(x) = 1$.

$x =$ ..... [2]

(a) Fractional and negative indices (b) Functions Click for more variations

3(a)	4	**1**	
3(b)	$\frac{1}{343}$	**2**	**M1** for [x =] f(1) or better

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4 $f(x) = 5x - 3$ $g(x) = x^2 + 6x + 1$

Find $gf(x)$.
Give your answer in its simplest form.

..... [3]

Functions Click for more variations

4	$25x^2 - 8$ final answer	**3**	**M1** for $(5x - 3)^2 + 6(5x - 3) + 1$ **M1** for $25x^2 - 15x - 15x + 9$ soi or better

5 $f(x) = x^2 - 25$ $g(x) = x + 4$

Solve $fg(x + 1) = gf(x)$.

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$x =$ ..... [4]

Functions Click for more variations

5	$[x =] -2.1$ oe	**4**	**M3** for $x^2 + 10x = x^2 - 21$ or better OR **M1** for $(x + 1 + 4)^2 - 25$ or better **M1** for $x^2 - 25 + 4$ or better If 0 scored **SC1** for answer $-\frac{11}{6}$ oe

6 $f(x) = 7 + 3x$ $g(x) = x^4$ $h(x) = 3^x$

(a) $h(3x) = k^x$

Find the value of k.

$k =$ ..... [2]

(b) Find the value of x when $f(x) = g(2)$.

$x =$ ..... [2]

(c) Find $f^{-1}(x)$.

$f^{-1}(x) =$ ..... [2]

(a) Functions (b) Functions (c) Functions Click for more variations

6(a)	27	**2**	**M1** for 3^{3x} seen
6(b)	3	**2**	**M1** for $7 + 3x = 2^4$
6(c)	$\frac{x-7}{3}$ oe final answer	**2**	**M1** for $x = 7 + 3y$ or $y - 7 = 3x$ or $-3x = 7 - y$ or $\frac{y}{3} = \frac{7}{3} + x$

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7 $f(x) = 3x - 4$ $g(x) = 4x + 1$

(a) Find $f(-2)$.

..... [1]

(b) Find $f^{-1}(x)$.

$f^{-1}(x) =$ ..... [2]

(c) $fg(x) = ax + b$

Find the value of a, and the value of b.

$a =$ ..... $b =$ ..... [2]

(d) Simplify.

$$\frac{2}{f(x)} - \frac{5}{g(x)}$$

Give your answer as a single fraction in terms of x.

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..... [3]

(a) Functions (b) Functions (c) Functions (d) Adding and subtracting algebraic fractions

Click for more variations

7(a)	–10	**1**	

7(b)	$\frac{x+4}{3}$ oe	**2**	**M1** for correct first step $y + 4 = 3x$ or $x = 3y – 4$ or $\frac{y}{3} = x - \frac{4}{3}$
7(c)	$a = 12$, $b = –1$	**2**	**B1** for either a or b correct or **M1** for $3(4x + 1) – 4$
7(d)	$\frac{22-7x}{(3x-4)(4x+1)}$ or $\frac{22-7x}{12x^2-13x-4}$ final answer	**3**	**B1** for $2(4x + 1) – 5(3x – 4)$ oe or better isw **B1** for common denominator $(3x – 4)(4x + 1)$ oe isw

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8 $f(x) = 3 - 2x$ $g(x) = \frac{4}{x},\ x \neq 0$ $h(x) = 4^x$

(a) Find f(5).

..... [1]

(b) Find gh(3).

..... [2]

(c) Find $f^{-1}(x)$.

$f^{-1}(x) =$ ..... [2]

(d) Show that $hf(x) = \frac{64}{16^x}$.

[3]

(e) Find the value of x when $h(x) = g(0.5)$.

$x =$ ..... [2]

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(a) Functions (b) Functions (c) Functions (d) Functions (e) Fractional and negative indices

Click for more variations

8(a)	-7	**1**	
8(b)	$\frac{4}{64}$ or better	**2**	**M1** for g(4^3) soi or $\frac{4}{4^x}$ or better
8(c)	$\frac{3-x}{2}$ oe final answer	**2**	**M1** for $x = 3 - 2y$ or $2x = 3 - y$ or $\frac{y}{2} = \frac{3}{2} - x$ or $\frac{y-3}{-2}$ oe as final answer
8(d)	4^{3-2x}	**M1**	
	Correctly interprets the indices	**M1**	Dep on previous **M1** e.g. $4^3 \times 4^{-2x}$ or $4^3 \times \frac{1}{4^{2x}}$ or $\frac{4^3}{4^{2x}}$
	$\frac{64}{16^x}$ nfww	**A1**	Correct completion with no errors
8(e)	1.5	**2**	**B1** for $4^x = 8$ or better

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9 $f(x) = \frac{21}{2x-1}$, $x \neq \frac{1}{2}$ $g(x) = 3x+4$

(a) Find

(i) g(2)

..... [1]

(ii) gf(−1)

..... [2]

(iii) $f^{-1}(x)$.

$f^{-1}(x) =$ ..... [3]

(b) Solve $f(x) = g(x)$.

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$x =$ ..... or $x =$ ..... [5]

(a)(i) Functions (a)(ii) Functions (a)(iii) Functions (b) Solving equations with algebraic fractions

Click for more variations

9(a)(i)	10	**1**	
9(a)(ii)	–17	**2**	**M1** for g(–7) oe or $3\left(\frac{21}{2x-1}\right)+4$ oe soi
9(a)(iii)	$\frac{21+x}{2x}$ or $\frac{21}{2x}+\frac{1}{2}$ oe final answer	**3**	**M2** for one step from answer e.g. $x=\frac{21+y}{2y}$ or $x=\frac{21}{2y}+\frac{1}{2}$ or $2y=\frac{21}{x}+1$ or $2xy = 21 + x$ or $2y=\frac{21+x}{x}$ or **M1** for correct first step e.g. $x=\frac{21}{2y-1}$ or better or $y\,(2x – 1) = 21$ or better
9(b)	$\frac{5}{3}$ and $-\frac{5}{2}$ oe	**5**	**B3** for $6x^2 + 5x – 25$ [= 0] or **M1** for $21 = (2x – 1)(3x + 4)$ oe **B1** for $6x^2 – 3x + 8x – 4$ or better and **M1** for correct method to solve *their* three-term quadratic e.g. $(3x – 5)(2x + 5)$ [= 0] or $\frac{-5\pm\sqrt{5^2-4\times6\times-25}}{12}$ oe

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10 $f(x) = 2x - 1$ $g(x) = x^2 + 2x$ $h(x) = 4^x$ $j(x) = 2^x$

(a) Find the value of

(i) h(3),

..... [1]

(ii) fh(3).

..... [1]

(b) Solve the equation $gf(x) = 0$.

$x =$ ..... or $x =$ ..... [4]

(c) $p^{-1}(x) = f(x)$

Find $p(x)$.

..... [2]

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(d) $\mathrm{h}(x)\mathrm{j}(x) = \dfrac{1}{\sqrt{2}}$

Find the value of x.

$x =$ ..... [3]

(a)(i) Functions (a)(ii) Functions (b) Functions (c) Functions (d) Fractional and negative indices

Click for more variations

10(a)(i)	64	**1**	
10(a)(ii)	127	**1**	**FT** $2 \times$ *their* **(a)(i)** $- 1$
10(b)	$\pm\dfrac{1}{2}$ oe nfww	**4**	**M1** for $(2x-1)^2 + 2(2x-1)$ **B1** for $4x^2 - 2x - 2x + 1$ or $(2x-1)(2x-1+2)$ **B1** for $4x^2 - 1$ [= 0] or $(2x-1)(2x+1)$ [= 0] OR **M1** for $x(x + 2) = 0$ (solving $g(x) = 0$) **A1** for $x = 0$ or -2 **B1** for $2x - 1 = 0$ or $2x - 1 = -2$
10(c)	$\dfrac{x+1}{2}$ oe final answer	**2**	**M1** for $y + 1 = 2x$ or $\dfrac{y}{2} = x - \dfrac{1}{2}$ or $x = 2y - 1$
10(d)	$-\dfrac{1}{6}$ oe nfww	**3**	**B2** for $3x = -\dfrac{1}{2}$ oe OR **M1** for $2^{2x} \times 2^x$ oe or $4^{\frac{1}{2}x} \times 4^x$ oe or 8^x oe **M1** for $2^{-\frac{1}{2}}$ or $4^{-\frac{1}{4}}$ or $8^{-\frac{1}{6}}$ soi

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