

# Functions Test Paper 1 [53 marks]

1a. [3 marks]

## Markscheme

### METHOD 1

attempt to set up equation (MI)

$$\text{eg } 2 = \sqrt{y-5}, 2 = \sqrt{x-5}$$

correct working (AI)

$$\text{eg } 4 = y - 5, x = 2^2 + 5$$

$$f^{-1}(2) = 9 \quad \text{AI} \quad \text{N2}$$

### METHOD 2

interchanging  $x$  and  $y$  (seen anywhere) (MI)

$$\text{eg } x = \sqrt{y-5}$$

correct working (AI)

$$\text{eg } x^2 = y - 5, y = x^2 + 5$$

$$f^{-1}(2) = 9 \quad \text{AI} \quad \text{N2}$$

[3 marks]

1b. [3 marks]

## Markscheme

recognizing  $g^{-1}(3) = 30$  (MI)

$$\text{eg } f(30)$$

correct working (AI)

$$\text{eg } (f \circ g^{-1})(3) = \sqrt{30-5}, \sqrt{25}$$

$$(f \circ g^{-1})(3) = 5 \quad \text{AI} \quad \text{N2}$$

**Note:** Award A0 for multiple values, eg  $\pm 5$ .

[3 marks]

2. [2 marks]

## Markscheme

in any order

translated 1 unit to the right AI NI

stretched vertically by factor 2 AI NI

[2 marks]

[3 marks]

3a.

## Markscheme

interchanging  $x$  and  $y$  (seen anywhere) (MI)

eg  $x = 4y - 2$

evidence of correct manipulation (AI)

eg  $x + 2 = 4y$

$f^{-1}(x) = \frac{x+2}{4}$  (accept  $y = \frac{x+2}{4}$ ,  $\frac{x+2}{4}$ ,  $f^{-1}(x) = \frac{1}{4}x + \frac{1}{2}$  AI N2

[3 marks]

[3 marks]

3b.

## Markscheme

### METHOD 1

attempt to substitute 1 into  $g(x)$  (MI)

eg  $g(1) = -2 \times 1^2 + 8$

$g(1) = 6$  (AI)

$f(6) = 22$  AI N3

### METHOD 2

attempt to form composite function (in any order) (MI)

eg  $(f \circ g)(x) = 4(-2x^2 + 8) - 2 (= -8x^2 + 30)$

correct substitution

eg  $(f \circ g)(1) = 4(-2 \times 1^2 + 8) - 2, -8 + 30$

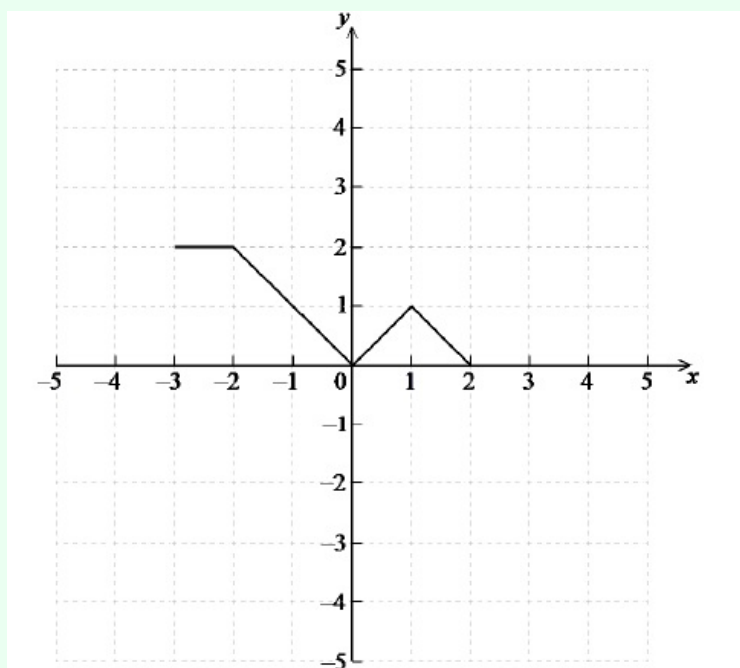
$f(6) = 22$  AI N3

[3 marks]

[2 marks]

4a.

## Markscheme



A2 N2

[2 marks]

4b. [4 marks]

### Markscheme

$$a = -2, b = -1 \quad A2A2 \quad N4$$

Note: Award *A1* for  $a = 2$ , *A1* for  $b = 1$ .

[4 marks]

5a. [1 mark]

### Markscheme

$$f(2) = 3 \quad A1 \quad N1$$

[1 mark]

5b. [2 marks]

### Markscheme

$$f^{-1}(-1) = 0 \quad A2 \quad N2$$

[2 marks]

5c. [3 marks]

### Markscheme

**EITHER**

attempt to draw  $y = x$  on grid (*MI*)

**OR**

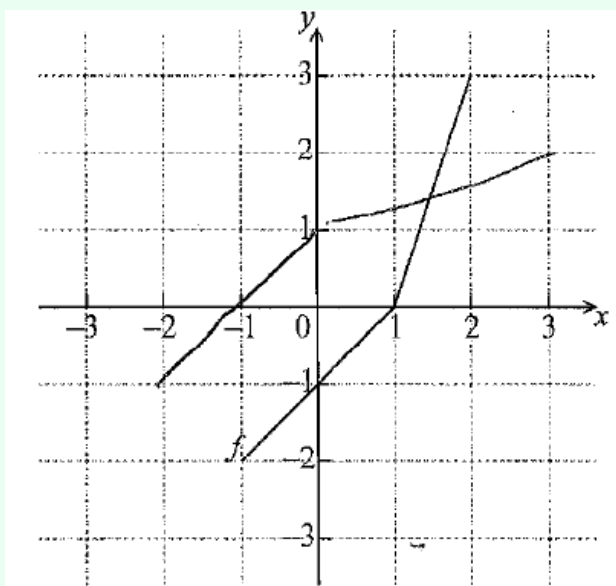
attempt to reverse  $x$  and  $y$  coordinates (*MI*)

eg writing or plotting **at least two** of the points

$$(-2, -1), (-1, 0), (0, 1), (3, 2)$$

**THEN**

correct graph *A2 N3*



[3 marks]

6a. [1 mark]

**Markscheme**

$f(-3) = -1$  *AI NI*

[1 mark]

6b. [1 mark]

**Markscheme**

$f^{-1}(1) = 0$  (accept  $y = 0$ ) *AI NI*

[1 mark]

6c. [2 marks]

**Markscheme**

domain of  $f^{-1}$  is range of  $f$  (*RI*)

eg  $Rf = Df^{-1}$

correct answer *AI N2*

eg  $-3 \leq x \leq 3, x \in [-3, 3]$  (accept  $-3 < x < 3, -3 \leq y \leq 3$ )

[2 marks]

6d. [3 marks]

**Markscheme**

*AIAI N2*

**Note:** Graph must be approximately correct reflection in  $y = x$ .  
**Only** if the shape is approximately correct, award the following:  
*AI* for  $x$ -intercept at 1, and *AI* for endpoints within circles.

[2 marks]

7. [6 marks]

**Markscheme**

(i)  $(-3, -9)$  *AI NI*

(ii)  $(1, -4)$  *AIAI N2*

(iii) reflection gives  $(3, 9)$  *(AI)*

stretch gives  $(\frac{3}{2}, 9)$  *AIAI N3*

[6 marks]

8a. [2 marks]

**Markscheme**

interchanging  $x$  and  $y$  *(M1)*

eg  $x = 3y - 2$

$f^{-1}(x) = \frac{x+2}{3}$  (accept  $y = \frac{x+2}{3}, \frac{x+2}{3}$ ) *AI N2*

[2 marks]

8b. [2 marks]

**Markscheme**

attempt to form composite (in any order) *(M1)*

eg  $g\left(\frac{x+2}{3}\right), \frac{\frac{5}{3}+2}{3}$

correct substitution *AI*

eg  $\frac{5}{3\left(\frac{x+2}{3}\right)}$

$(g \circ f^{-1})(x) = \frac{5}{x+2}$  *AG N0*

[2 marks]

8c. [2 marks]

**Markscheme**

valid approach *(M1)*

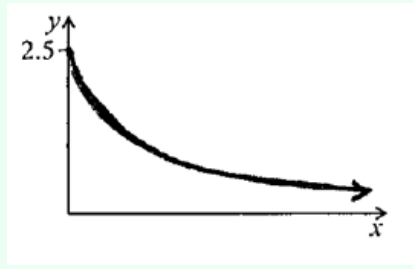
eg  $h(0), \frac{5}{0+2}$

$y = \frac{5}{2}$  (accept  $(0, 2.5)$ ) *AI N2*

[2 marks]

8d. [3 marks]

### Markscheme



A1A2 N3

**Notes:** Award *A1* for approximately correct shape (reciprocal, decreasing, concave up).

**Only** if this *A1* is awarded, award *A2* for all the following approximately correct features: y-intercept at  $(0, 2.5)$ , asymptotic to x-axis, correct domain  $x \geq 0$ .

If only two of these features are correct, award *A1*.

[3 marks]

8e. [1 mark]

### Markscheme

$x = \frac{5}{2}$  (accept  $(2.5, 0)$ ) *A1 N1*

[1 mark]

8f. [1 mark]

### Markscheme

$x = 0$  (must be an equation) *A1 N1*

[1 mark]

8g. [3 marks]

### Markscheme

#### METHOD 1

attempt to substitute 3 into  $h$  (seen anywhere) (*MI*)

eg  $h(3), \frac{5}{3+2}$

correct equation (*A1*)

eg  $a = \frac{5}{3+2}, h(3) = a$

$a = 1$  *A1 N2*

[3 marks]

#### METHOD 2

attempt to find inverse (may be seen in (d)) (*MI*)

eg  $x = \frac{5}{y+2}, h^{-1} = \frac{5}{x} - 2, \frac{5}{x} + 2$

correct equation,  $\frac{5}{x} - 2 = 3$  (*A1*)

$a = 1$  *A1 N2*

[3 marks]