

- |                             |                              |                         |
|-----------------------------|------------------------------|-------------------------|
| 31 $\frac{1}{x+1}$          | 32 $\frac{1}{2n}$            | 33 $\frac{a+b}{5}$      |
| 34 $x+2$                    | 35 $-1$                      | 36 $4x+h$               |
| 37 $\frac{-2x+5}{15}$       | 38 $\frac{b-a}{ab}$          | 39 $\frac{-8x+6}{2x-1}$ |
| 40 $\frac{x^2+x+3}{x^2+3x}$ | 41 $\frac{2x}{x^2-y^2}$      | 42 $\frac{-2}{x-2}$     |
| 43 $6$                      | 44 $\frac{3y-10}{y^2-3y-10}$ | 45 $\frac{1}{ab-b^2}$   |
| 46 $\frac{-5x^2-5x}{2}$     | 47 $\frac{3+\sqrt{2}}{7}$    | 48 $10-5\sqrt{3}$       |
| 49 $\frac{11+4\sqrt{6}}{5}$ | 50 $\frac{7-\sqrt{5}}{44}$   |                         |

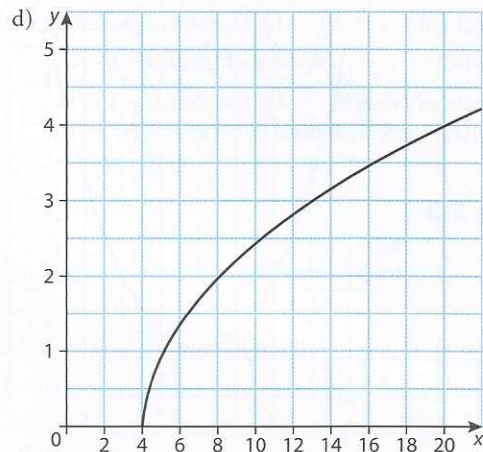
### Exercise 1.6

- |   |                                  |                                      |                  |
|---|----------------------------------|--------------------------------------|------------------|
| 1 $x = h - \frac{n}{m}$   | 2 $a = \frac{v^2+t}{b}$          |                                      |                  |
| 3 $b_1 = \frac{2A}{h} - b_2$  | 4 $r = \sqrt{\frac{2A}{\theta}}$ |                                      |                  |
| 5 $k = \frac{gh}{f}$  | 6 $t = \frac{x}{a+b}$            |                                      |                  |
| 7 $r = \sqrt[3]{\frac{3V}{\pi h}}$  | 8 $k = \frac{g}{F(m_1+m_2)}$     |                                      |                  |
| 9 $y = -\frac{2}{3}x - 5$   | 10 $y = -4$                      |                                      |                  |
| 11 $y = \frac{5}{4}x + 6$   | 12 $x = \frac{7}{3}$             |                                      |                  |
| 13 $y = -4x + 11$   | 14 $y = -\frac{5}{2}x - 7$       |                                      |                  |
| 15 a) 17      b) $(0, \frac{5}{2})$   |                                  |                                      |                  |
| 16 a) $\sqrt{40}$ b) $(2, 3)$   |                                  |                                      |                  |
| 17 a) $\frac{\sqrt{82}}{3}$ b) $(-1, \frac{7}{6})$  |                                  |                                      |                  |
| 18 a) $\sqrt{533}$ b) $(1, \frac{11}{2})$   |                                  |                                      |                  |
| 19 $k = 1$ or $9$   | 20 $k = -11$ or $-3$             |                                      |                  |
| 21 $(\sqrt{5})^2 + (\sqrt{45})^2 = (\sqrt{50})^2$   |                                  |                                      |                  |
| 22 Sides are: $\sqrt{29}, \sqrt{29}, \sqrt{58}$   |                                  |                                      |                  |
| 23 Sides are: $\sqrt{45}, \sqrt{10}, \sqrt{45}, \sqrt{10}$  |                                  |                                      |                  |
| 24 $(5, 1)$   | 25 $(4, \frac{1}{2})$            | 26 $(3, -4)$                         | 27 $(3.8, -1.6)$ |
| 28 No solution  | 29 $(-1, 2)$                     | 30 $\frac{5}{7}, \frac{3}{7}$        | 31 $(-3, -8)$    |
| 32 Lines are coincident; solution set is all points on the line $y = -\frac{1}{4}x - \frac{3}{4}$ |                                  |                                      |                  |
| 33 $(\frac{20}{3}, \frac{40}{3})$   | 34 $(\frac{1}{2}, 3)$            | 35 $(-5, 10)$                        |                  |
| 36 $(5, -3)$  | 37 $(0.99, -2.33)$               | 38 $(\frac{11}{19}, -\frac{18}{19})$ |                  |

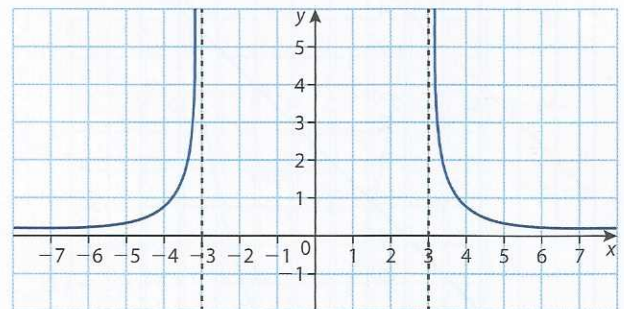
## Chapter 2

### Exercise 2.1

- |   |   |                       |               |
|---|---|-----------------------|---------------|
| 1 a) G      b) Function   | 2 a) L      b) Function                   |                       |               |
| 3 a) H      b) Function   | 4 a) K      b) Not function               |                       |               |
| 5 a) J      b) Function   | 6 a) C      b) Function                   |                       |               |
| 7 a) A      b) Function   | 8 a) I      b) Function                   |                       |               |
| 9 a) F      b) Function   |   |                       |               |
| 10 $A = \frac{C^2}{4\pi}$   | 11 $A = \frac{l^2\sqrt{3}}{4}$            | 12 $x \in \mathbb{R}$ |               |
| 13 $x \in \mathbb{R}$   | 14 $t \leq 3$                             | 15 $t \in \mathbb{R}$ | 16 $r \geq 0$ |
| 17 $x \in \mathbb{R}, x \neq \pm 3$   |   |                       |               |
| 18 No, a vertical line does not represent a function.                         |   |                       |               |
| 19 Domain: $x \in \mathbb{R}, x \neq 5$ , range: $y \in \mathbb{R}, y \neq 0$ |   |                       |               |
| 20 a) (i) $\sqrt{17}$   | (ii) 7                                    | (iii) 0               |               |
| b) $x < 4$  | c) Domain: $x \geq 4$ , range: $y \geq 0$ |                       |               |



21 Domain:  $x \in (-\infty, -3) \cup (3, \infty)$ ; range:  $y \in (0, \infty)$



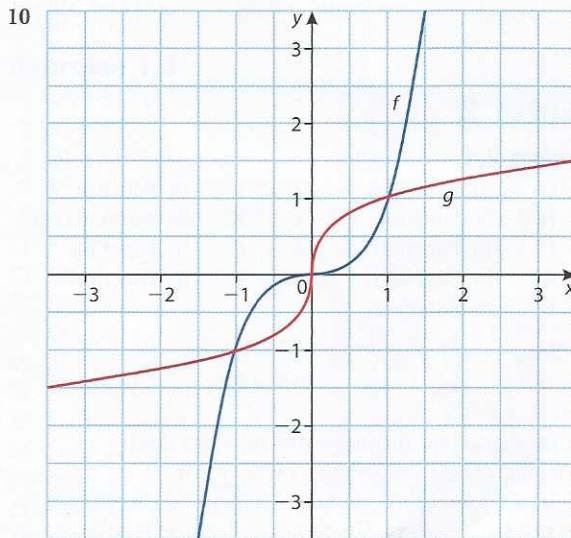
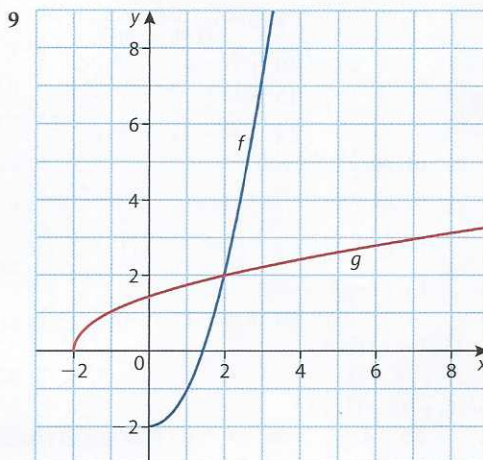
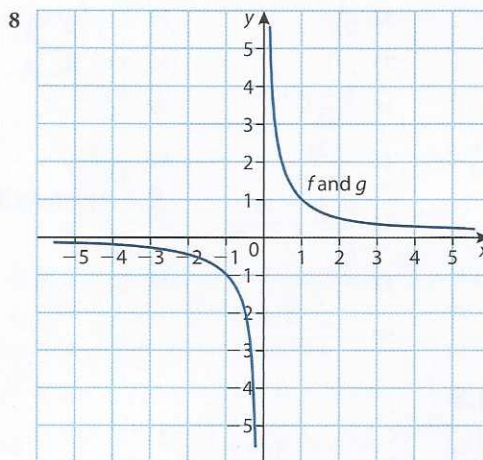
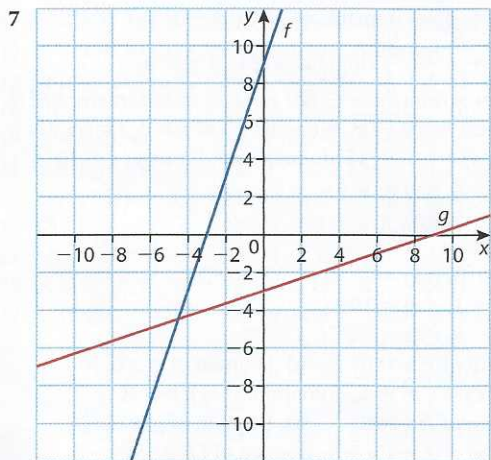
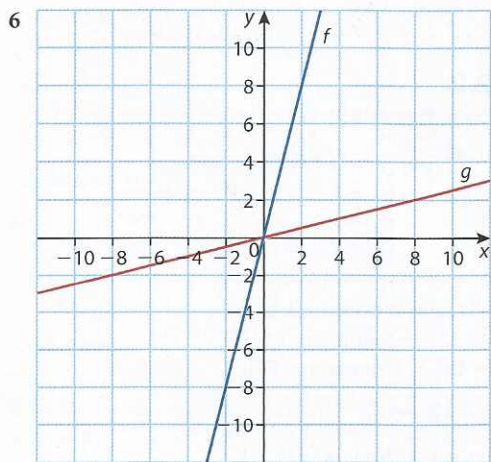
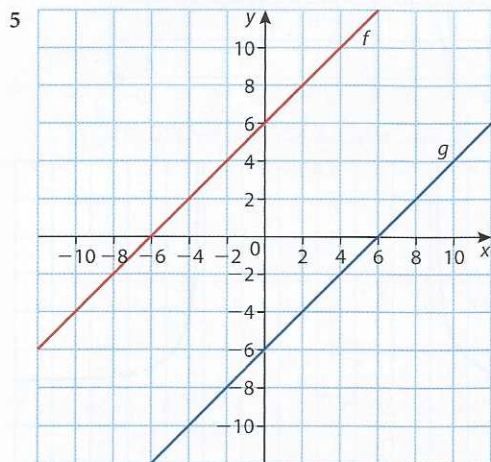
### Exercise 2.2

- |   |
|---|
| 1 a) $(f \circ g)(5) = 1, (g \circ f)(5) = \frac{1}{7}$   |
| b) $(f \circ g)(x) = \frac{2}{x-3}, (g \circ f)(x) = \frac{1}{2x-3}$  |
| 2 a) 1      b) -7      c) 7   |
| d) -47      e) -1      f) -79   |
| g) $1 - 2x^2$ h) $-4x^2 + 12x - 7$  |
| i) $4x - 9$ j) $-x^4 + 4x^2 - 2$  |
| 3 $(f \circ g)(x) = 12x + 7$ , domain: $x \in \mathbb{R}$ ;<br>$(g \circ f)(x) = 12x - 1$ , domain: $x \in \mathbb{R}$                                      |
| 4 $(f \circ g)(x) = 4x^2 + 1$ , domain: $x \in \mathbb{R}$ ;<br>$(g \circ f)(x) = -2x^2 - 2$ , domain: $x \in \mathbb{R}$                                   |
| 5 $(f \circ g)(x) = \sqrt{x^2 + 2}$ , domain: $x \in \mathbb{R}$ ;<br>$(g \circ f)(x) = x + 2$ , domain: $x \geq -1$  |
| 6 $(f \circ g)(x) = \frac{2}{x+3}$ , domain: $x \in \mathbb{R}, x \neq -3$ ;<br>$(g \circ f)(x) = -\frac{x+2}{x+4}$ , domain: $x \in \mathbb{R}, x \neq -4$ |
| 7 $(f \circ g)(x) = x$ , domain: $x \in \mathbb{R}$ ; $(g \circ f)(x) = x$ , domain: $x \in \mathbb{R}$   |
| 8 a) $(g \circ h)(x) = \sqrt{9 - x^2}$ , domain: $-3 \leq x \leq 3$ , range: $y \geq 0$   |
| b) $(h \circ g)(x) = -x + 11$ , domain: $x \geq 1$ , range: $y \leq 10$   |
| 9 $h(x) = x + 3, g(x) = x^2$  |
| 10 $h(x) = x - 5, g(x) = \sqrt{x}$  |
| 11 $h(x) = \sqrt{x}, g(x) = 7 - x$  |
| 12 $h(x) = x + 3, g(x) = \frac{1}{x}$   |
| 13 $h(x) = x + 1, g(x) = 10^x$  |
| 14 $h(x) = x - 9, g(x) = \sqrt[3]{x}$   |
| 15 a) Domain of $f$ : $x \geq 0$ b) Domain of $g$ : $x \in \mathbb{R}$  |
| c) $(f \circ g)(x) = \sqrt{x^2 + 1}$ , domain of $(f \circ g)$ : $x \in \mathbb{R}$   |
| 16 a) Domain of $f$ : $x \geq 0$ b) Domain of $g$ : $x \in \mathbb{R}$  |
| c) $(f \circ g)(x) = 7 - \sqrt{x+1}$ , domain of $(f \circ g)$ : $x \geq -1$  |

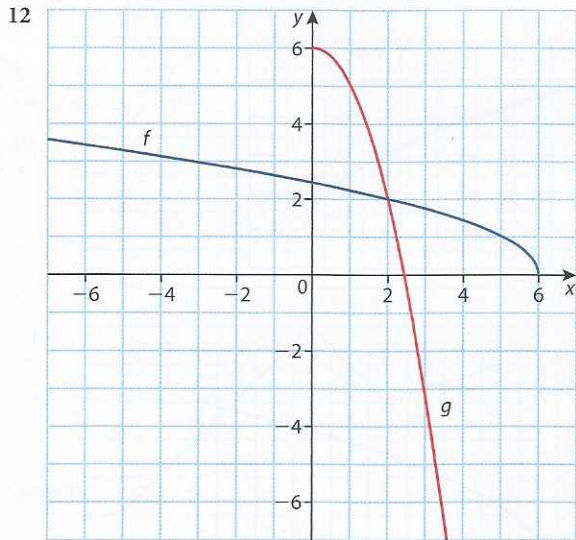
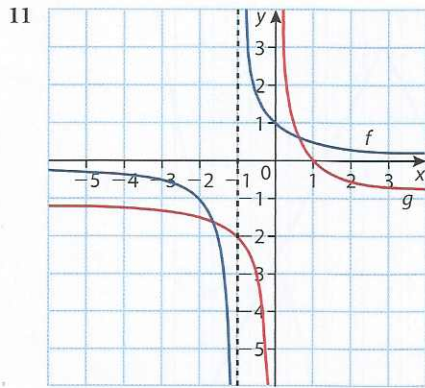
- 17 a) Domain of  $f: x \neq \pm 1$     b) Domain of  $g: x \in \mathbb{R}$   
 c)  $(f \circ g)(x) = \frac{3}{x^2 + 2x}$ , domain of  $(f \circ g): x \neq 0, -2$   
 18 a) Domain of  $f: x \in \mathbb{R}$     b) Domain of  $g: x \in \mathbb{R}$   
 c)  $(f \circ g)(x) = x + 3$ , domain of  $(f \circ g): x \in \mathbb{R}$

**Exercise 2.3**

- 1 a) 2    b) 6  
 2 a) -1    b)  $b$   
 3 4  
 4 6







13  $f^{-1}(x) = \frac{1}{2}x + \frac{3}{2}, x \in \mathbb{R}$

14  $f^{-1}(x) = 4x - 7, x \in \mathbb{R}$

15  $f^{-1}(x) = x^2, x \geq 0$

16  $f^{-1}(x) = \frac{1}{x} - 2, x \in \mathbb{R}, x \neq 0$

17  $f^{-1}(x) = \sqrt{4-x}, x \leq 4$

18  $f^{-1}(x) = x^2 + 5, x \geq 0$

19  $f^{-1}(x) = \frac{1}{a}x - \frac{b}{a}, x \in \mathbb{R}$

20  $f^{-1}(x) = \sqrt{x+1} - 1, x \geq -1$

21  $\frac{3}{2}$

22 5

23 -4

24  $\frac{7}{2}$

25  $g^{-1} \circ h^{-1} = \frac{1}{2}x - 1$

26  $h^{-1} \circ g^{-1} = \frac{1}{2}x + \frac{1}{2}$

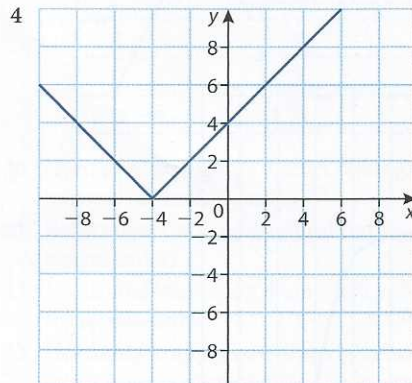
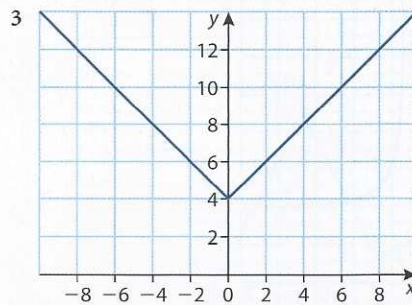
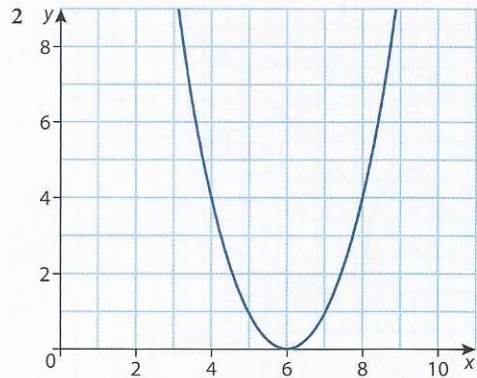
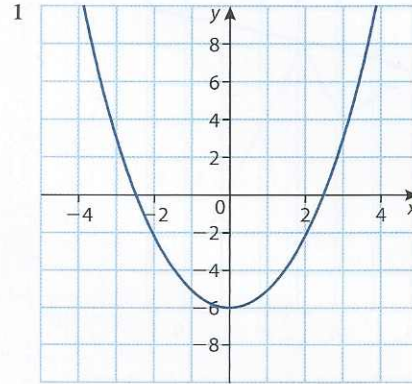
27  $(g \circ h)^{-1} = \frac{1}{2}x + \frac{1}{2}$

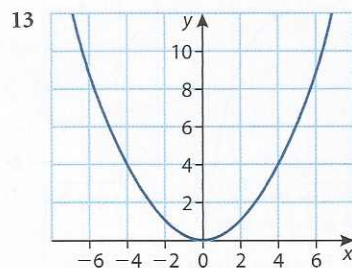
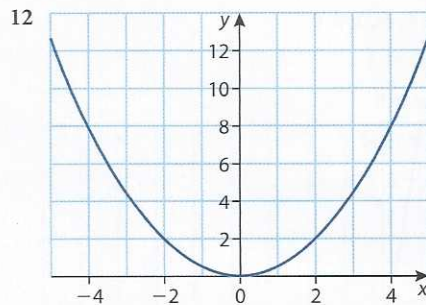
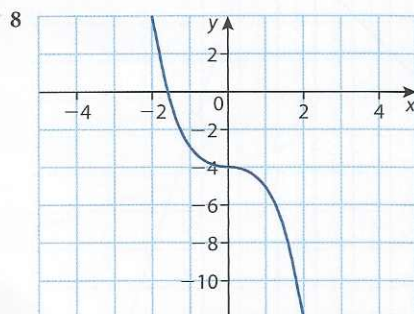
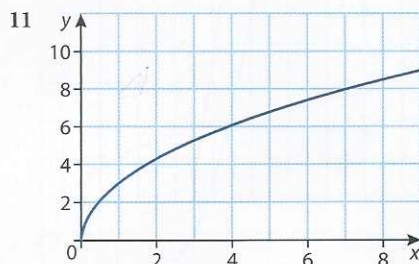
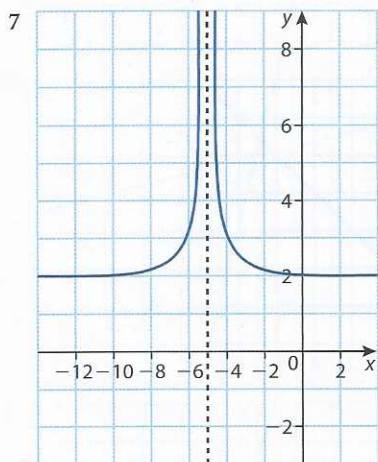
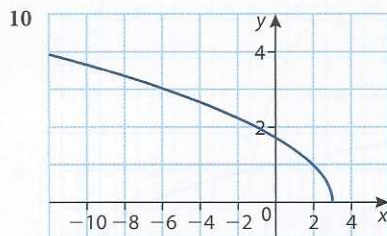
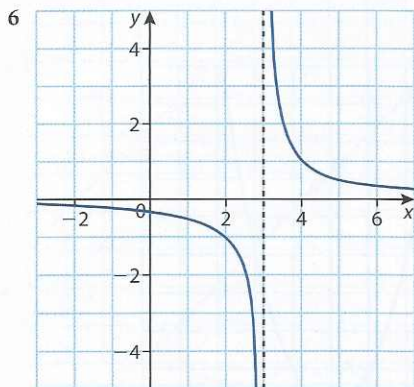
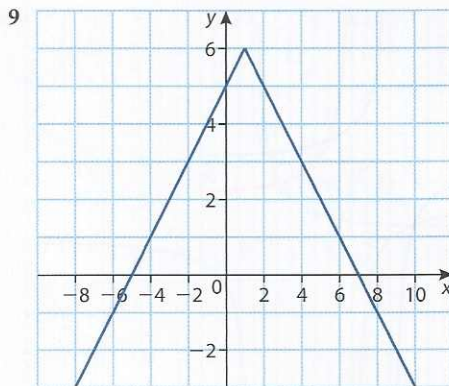
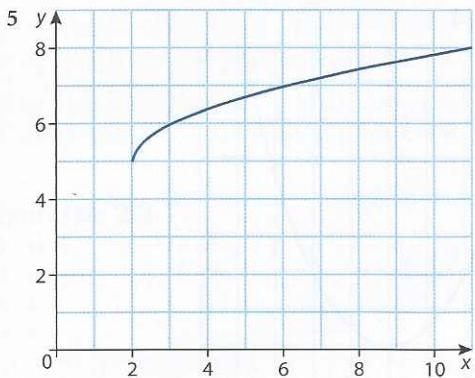
28  $(h \circ g)^{-1} = \frac{1}{2}x - 1$

29  $f(f(x)) = f\left(\frac{a}{x+b} - b\right) = \frac{\frac{a}{x+b} - b + b}{\frac{a}{x+b} - b + b} - b = \frac{\frac{a}{x+b}}{\frac{a}{x+b}} - b = \frac{a}{x+b} - b = \frac{a}{1} \cdot \frac{x+b}{a} - b = x + b - b = x$

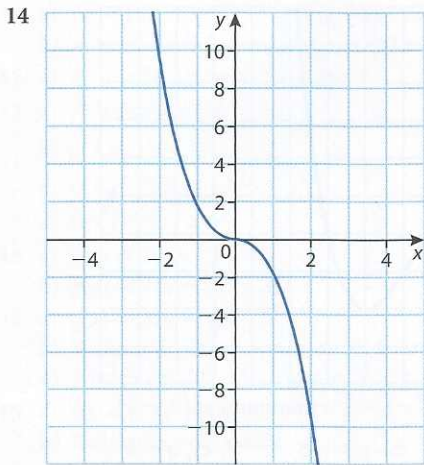
Since  $f(f(x)) = x$ , then the function  $f$  is its own inverse.

## Exercise 2.4







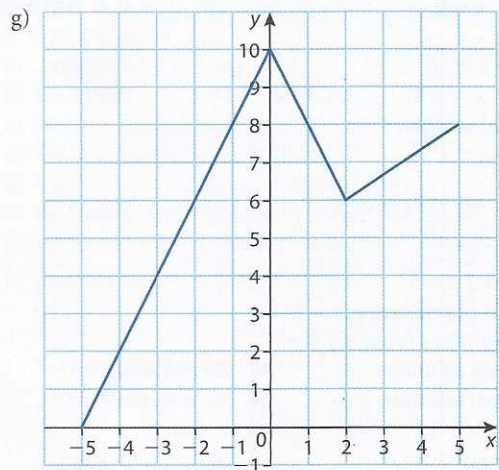
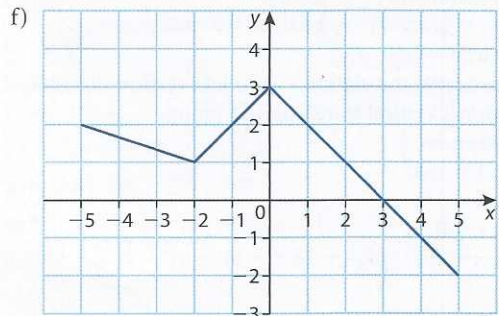
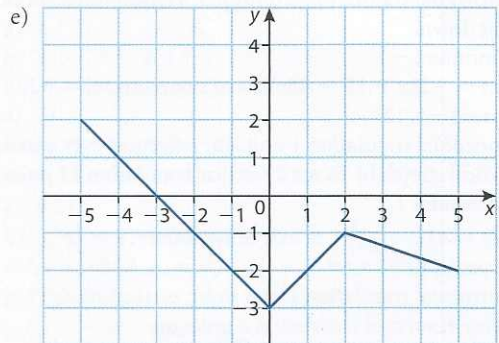
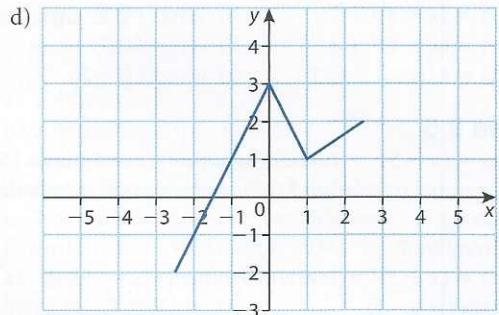
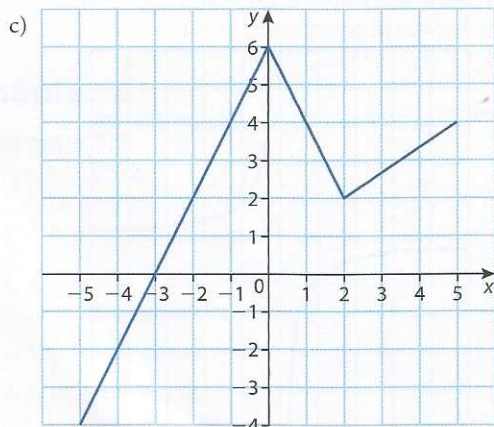
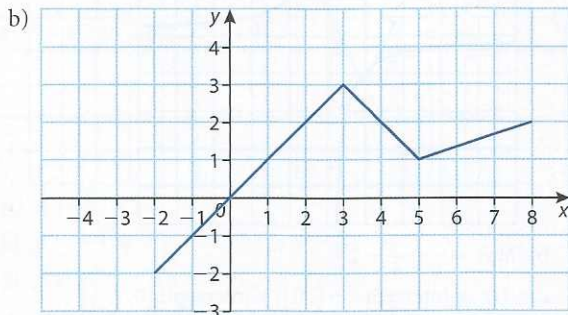
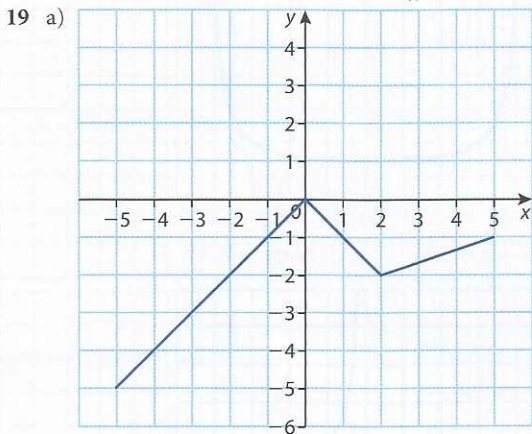


15  $y = -x^2 + 5$

16  $y = \sqrt{-x}$

17  $y = -|x + 1|$

18  $y = \frac{1}{x-2} - 3$



- 20 Horizontal translation 3 units right; vertical translation 5 units up (or reverse order).
- 21 Reflect over the  $x$ -axis; vertical translation 2 units up (or reverse order).
- 22 Horizontal translation 4 units left; vertical shrink by factor  $\frac{1}{2}$  (or reverse order).
- 23 Horizontal translation 1 unit right; horizontal shrink by factor  $\frac{1}{3}$ ; vertical translation 6 units down.

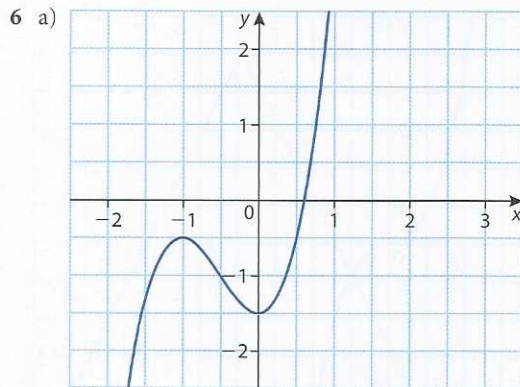
- 24 a)  $f(x) = (x + 3)^2 - 7$       b) vertex  $(-3, -7)$   
 25 a)  $f(x) = (x - 1)^2 + 3$       b) vertex  $(1, 3)$   
 26 a)  $f(x) = 4(x - \frac{1}{2})^2 - 2$       b) vertex  $(\frac{1}{2}, -2)$

**Exercise 2.5**

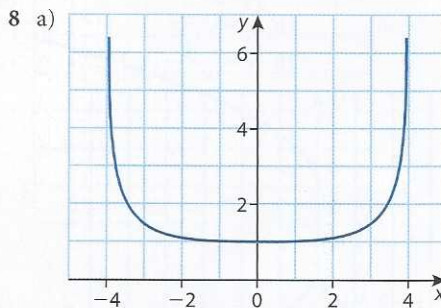
- 1 a)  $f(x) = (x - 5)^2 + 7$ ; axis of symmetry:  $x = 5$ , vertex  $(5, 7)$   
 b) Horizontal translation 5 units right; vertical translation 7 units up.  
 c) Minimum: 7  
 2 a)  $f(x) = (x + 3)^2 - 1$ ; axis of symmetry:  $x = -3$ , vertex  $(-3, -1)$   
 b) Horizontal translation 3 units left; vertical translation 1 unit down.  
 c) Minimum:  $-1$   
 3 a)  $f(x) = -2(x + 1)^2 + 12$ ; axis of symmetry:  $x = -1$ , vertex  $(-1, 12)$   
 b) Horizontal translation 1 unit left; reflection over  $x$ -axis; vertical stretch by factor 2; vertical translation 12 units up.  
 c) Maximum: 12  
 4 a)  $f(x) = 4(x - \frac{1}{2})^2 + 8$ ; axis of symmetry:  $x = \frac{1}{2}$ , vertex  $(\frac{1}{2}, 8)$   
 b) Horizontal translation  $\frac{1}{2}$  unit right; vertical stretch by factor 4; vertical translation 8 units up.  
 c) Maximum: 8  
 5 a)  $f(x) = \frac{1}{2}(x + 7)^2 + \frac{3}{2}$ ; axis of symmetry:  $x = -7$ , vertex  $(-7, \frac{3}{2})$   
 b) Horizontal translation 7 units left; vertical shrink by factor  $\frac{1}{2}$ ; vertical translation  $\frac{3}{2}$  unit up.  
 c) Minimum:  $\frac{3}{2}$   
 6  $x = 2, x = -4$   
 7  $x = 5, x = -2$   
 8  $x = \frac{3}{2}, x = 0$   
 9  $x = 6, x = -1$   
 10  $x = 3$   
 11  $x = \frac{1}{3}, x = -4$   
 12  $x = 3, x = 2$   
 13  $x = 2, x = \frac{1}{4}$   
 14  $x = -2 \pm \sqrt{7}$   
 15  $x = 5, x = -1$   
 16 No real solution  
 17  $x = -4 \pm \sqrt{13}$   
 18  $x = 2, x = -4$   
 19  $x = \frac{2 \pm \sqrt{22}}{2}$   
 20 a)  $x = 2 \pm \sqrt{5}$   
 b) axis of symmetry:  $x = 2$   
 c) minimum value of  $f$  is  $-5$   
 21 Two real solutions      22 No real solutions  
 23 Two real solutions      24 No real solutions  
 25  $p = \pm 2\sqrt{2}$       26  $k < 4$   
 27  $k < -1, k > 1$       28  $m < -3, m > 3$

**Practice questions**

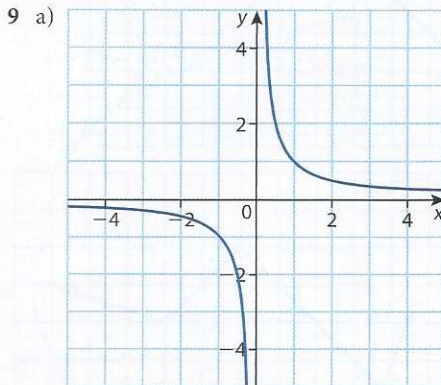
- 1 a)  $a = -3, b = 1$       b) range:  $y \geq 0$   
 2 a) 5      b)  $-9$   
 3 a)  $g^{-1}(x) = -3x + 4$       b)  $x = \frac{2}{3}$   
 4 a)  $(g \circ h)(x) = 2x - 3$       b) 24  
 5 a)  $f(x) = (x + 4)^2 - 5$       b)  $f^{-1}(x) = -4 + \sqrt{x + 5}$   
 c) domain:  $x \geq 5$



- b) Maximum at  $(-1, -\frac{1}{2})$ ; minimum at  $(0, -\frac{3}{2})$   
 7 a)  $k = \frac{1}{2}$       b)  $p = -5$       c)  $q = 3$



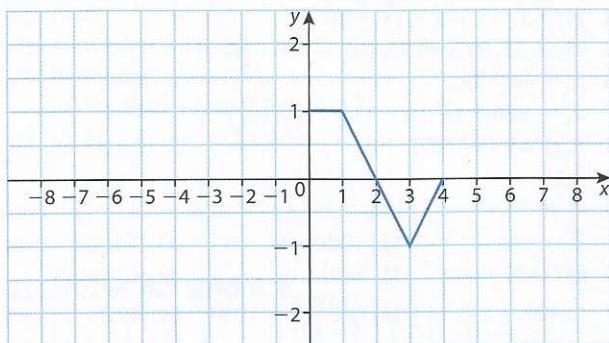
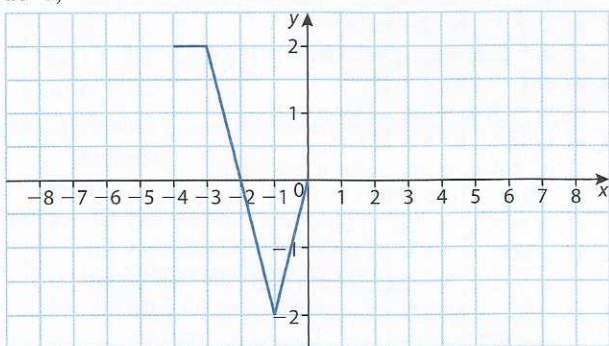
- b)  $x = 4, x = -4$       c) range:  $y \geq 1$



- b)  $h(x) = \frac{1}{x + 4} - 2$   
 c) (i)  $x$ -intercept:  $(-\frac{7}{2}, 0)$ ;  $y$ -intercept:  $(0, -\frac{7}{4})$   
 (ii) Vertical asymptote:  $x = -4$ ; horizontal asymptote:  $y = -2$   
 (iii)



- 10 a) (i)  $\sqrt{11}$  (ii) 7 (iii) 0  
 b)  $x < -3$  c)  $(g \circ f)(x) = x - 2$
- 11 a) 4 b)  $(g^{-1} \circ h)(x) = 2x^2 + 6$  c)  $x = \pm 2\sqrt{2}$
- 12 a)  $f^{-1}(x) = \frac{1}{3}x + \frac{1}{3}$   
 b)  $(f \circ g)(x) = \frac{12}{x} - 1$   
 c)  $(f \circ g)^{-1}(x) = \frac{12}{x+1}$   
 d)  $(g \circ g)(x) = x$
- 13 a)  $f(x) = 2(x+2)^2 + 9$   
 b)  $g(x) = 2(x-3)^2 + 11$
- 14 a)  $g(x) = 3(x-1)^2 - 7$   
 b) Vertex:  $(1, -7)$  c)  $x = 1$   
 d)  $y$ -intercept:  $(0, -4)$  e)  $p = 3, q = 21, r = 3$
- 15 a) (i)  $a = 8$  (ii)  $b = -3$   
 b) Reflection over  $x$ -axis
- 16 a)



- b)  $A'(-3, -2)$
- 17 a)  $p = -3, q = \frac{1}{3}$  b)  $x = -\frac{4}{3}$   
 c)  $f(x) = x^2 + \frac{8}{3}x - 1$
- 18  $A(-5, 0), B(-\frac{3}{2}, \frac{49}{4}), C(2, 0)$

## Chapter 3

### Exercise 3.1

- 1 -1, 1, 3, 5, 7, 97  
 2 2, 6, 18, 54, 162,  $4.786 \times 10^{23}$   
 3  $\frac{2}{3}, -\frac{2}{3}, \frac{6}{11}, -\frac{4}{9}, \frac{10}{27}, \frac{50}{1251}$   
 4 1, 2, 9, 64, 625,  $1.776 \times 10^{83}$   
 5 3, 11, 27, 59, 123,  $4.50 \times 10^{15}$   
 6  $0, 3, \frac{3}{7}, \frac{21}{13}, \frac{39}{55}$ , approx. 1  
 7 2, 6, 18, 54, 162,  $4.786 \times 10^{23}$   
 8 -1, 1, 3, 5, 7, 97