

Practice

A

1. State whether each set of ordered pairs represents a function.

- a)** $\{(2, 3), (3, 4), (4, 5), (5, 6), (6, 7)\}$ **b)** $\{(5, -3), (6, -4), (7, -5), (8, -6)\}$
c) $\{(4, 2), (5, 3), (4, 6), (6, 7)\}$ **d)** $\{(6, 3), (7, 3), (8, 3)\}$
e) $\{(7, -1), (8, 0), (9, 1)\}$ **f)** $\{(5, 4), (5, 5), (5, 6), (5, 7)\}$

2. If $y = 4x - 5$, find the value of y for each of the following values of x .

- a)** 2 **b)** 7 **c)** 0 **d)** -2 **e)** -4
f) 100 **g)** 0.5 **h)** -0.5 **i)** 1000

3. If $y = 8 - 2x$, find the value of y for each of the following values of x .

- a)** 1 **b)** 3 **c)** 5 **d)** -3 **e)** 0
f) 10 **g)** 0.5 **h)** -0.1 **i)** 4

4. If $y = x^2 + 5$, find the value of y for each of the following values of x .

- a)** 2 **b)** 0 **c)** -2 **d)** 10 **e)** -10
f) 0.5 **g)** -0.1

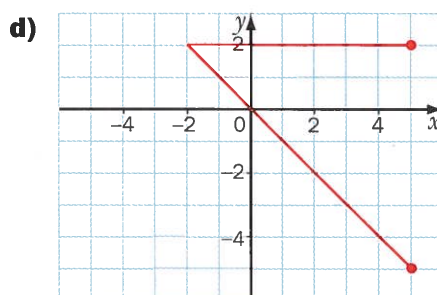
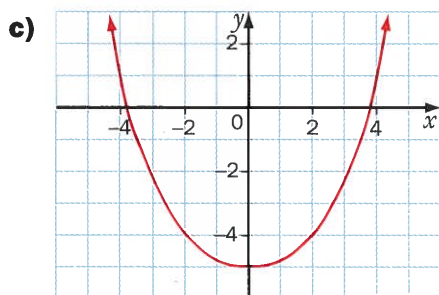
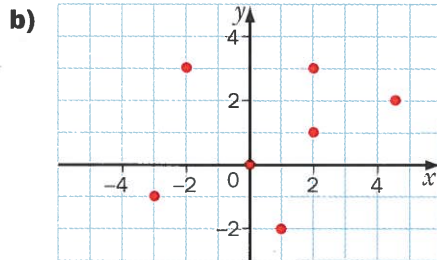
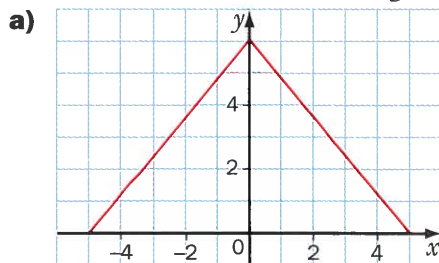
5. If $m = 2n^2 - 4n + 3$, find the value of m for each of the following values of n .

- a)** 0 **b)** 1 **c)** -2 **d)** 10 **e)** -10
f) 0.5 **g)** 1.5

6. **a)** Graph the equation $y = 2x + 1$.

b) Is the relation a function?

7. State which of the following are graphs of functions.



8. State the domain and range of each relation.

- a)** $\{(3, 1), (4, -2), (5, 3), (6, 0)\}$ **b)** $\{(-3, 2), (-1, 4), (1, 4), (3, 2), (5, 3)\}$
c) $\{(-2, 3), (-1, 3), (0, 3), (1, 4)\}$ **d)** $\{(-1, 1), (-1, 2), (-1, 3), (-1, 4)\}$

9. State the domain and range of each relation, and state whether it is a function.

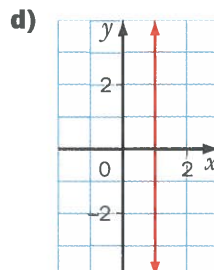
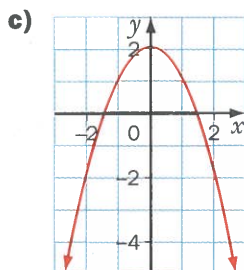
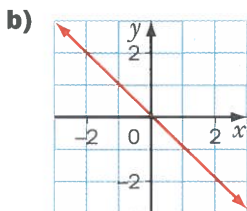
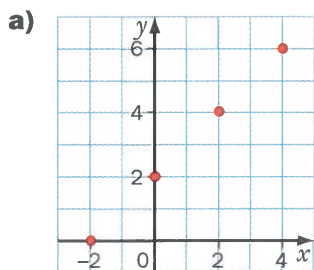
a)

x	y
2	5
1	2
0	1
-1	2
-2	5

b)

x	y
3	1
3	-2
2	0
1	-1
0	-2

10. Determine the domain and range of each of the following relations.



11. The function $y = x^2 + 2$ has a domain $\{-2, -1, 0, 1, 2\}$. Find the range.

Applications and Problem Solving

12. **Mach number** An aircraft breaks the sound barrier when it flies at about 1200 km/h. This speed is known as Mach 1. The Mach number, M , is given by the function $M = \frac{s}{1200}$, where s is the speed of the aircraft in kilometres per hour.

a) What is the value of M when $s = 2400$? when $s = 3000$?

b) **Communication** In the function defined by the ordered pairs (speed, Mach number), identify the dependent variable and the independent variable. Explain your reasoning.

B

13. **Canadian population** a) Use the census data in the table to sketch a graph of the population of Canada as a function of the year.

b) Use the graph to estimate the population in 1958.

c) Use the graph to predict the year in which the population will reach 40 million.

Year	Population (millions)
1921	8.8
1931	10.4
1941	11.5
1951	14.0
1961	18.2
1971	21.6
1981	24.3
1991	27.3

14. **Communication** a) On the same set of axes, graph the functions $y = x$ and $y = x^2$, where x and y are real numbers.

b) For the graph of $y = x$, does x or y have a maximum or minimum value? Explain.

c) For the graph of $y = x^2$, does x or y have a maximum or minimum value? Explain.

d) Describe any other similarities and differences in the graphs.

15. Graph each function. The domain is the set of real numbers. Find the range.

a) $y = 3x - 4$

b) $y = x^2 - 2$

16. **Algebra** If $y = x^2 - 4$, what value(s) of x give each of the following values of y ?

a) 0

b) 12

c) -4

d) 7

17. **Communication** a) Is the set of ordered pairs (n, f) a function, if n is a person's name and f is the person's fingerprints?

b) Reverse the terms of the ordered pairs so that the set of ordered pairs is (f, n) . Is the new set of ordered pairs a function? Explain.

18. **Communication** Is the set of ordered pairs (f, l) a function, if f is the first name of a person in your school and l is the last name of the person? Explain.

19. **Communication** Explain why the vertical line test works.

C

20. **Algebra** Write and simplify the equation obtained when the given expression is substituted for x .

a) $y = 4x + 3; x = 2a$

b) $y = 2 - 3x; x = n + 1$

c) $y = x^2 + 1; x = m - 1$

d) $y = 2x^2 - 3; x = 2k + 1$

e) $y = x^2 + 4x - 1; x = 3t - 1$

f) $y = 3x^2 - 2x + 4; x = 3 - 2w$

21. **Communication** If a linear relation is not a function, what can you state about the graph of the relation? Explain.

22. **Gym rental** The cost of renting a gym includes an initial fee, plus an additional fee for each hour or part of an hour of use. The rates are shown in the table.

The graph of the cost as a function of time is shown.

a) **Communication** Explain why the open and closed dots are used on the graph.

b) **Communication** The function represented by the graph is known as a **step function**.

Explain why.

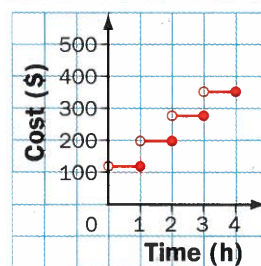
c) State the domain and range of the function.

d) Write two ordered pairs with the same cost value to represent points on the graph.

e) Write two ordered pairs with different cost values to represent points on the graph.

f) **Communication** Is it possible to write two different ordered pairs with the same time value to represent points on the graph? Explain.

Time (h)	Cost (\$)
Up to and including 1	120
Greater than 1; up to and including 2	200
Greater than 2; up to and including 3	280
Greater than 3; up to and including 4	360



23. **Research** Use your research skills to find a rule used to calculate each of the following. Then, sketch the graph of each function.

a) the cost of mailing a first-class letter to an address in Canada as a function of the mass of the letter

b) a taxi fare as a function of the distance travelled

Section 4.1 pp. 197–199

Practice 1. a) function **b)** function **c)** not a function **d)** function **e)** function **f)** not a function **2. a)** 3 **b)** 23 **c)** -5 **d)** -13 **e)** -21 **f)** 395 **g)** -3 **h)** -7 **i)** 3995 **3. a)** 6 **b)** 2 **c)** -2 **d)** 14 **e)** 8 **f)** -12 **g)** 7 **h)** 8.2 **i)** 0 **4. a)** 9 **b)** 5 **c)** 9 **d)** 105 **e)** 105 **f)** 5.25 **g)** 5.01 **5. a)** 3 **b)** 1 **c)** 19 **d)** 163 **e)** 243 **f)** 1.5 **g)** 1.5 **6. b)** yes **7. a)** function **b)** not a function **c)** function **d)** not a function **8. a)** domain: {3, 4, 5, 6}, range: {-2, 0, 1, 3} **b)** domain: {-3, -1, 1, 3, 5}, range: {2, 3, 4} **c)** domain: {-2, -1, 0, 1}, range: {3, 4} **d)** domain: {-1}, range: {1, 2, 3, 4} **9. a)** domain: {-2, -1, 0, 1, 2}, range: {1, 2, 5}; function **b)** domain: {0, 1, 2, 3}, range: {-2, -1, 0, 1}; not a function **10. a)** domain: {-2, 0, 2, 4, 6}, range: {0, 2, 4, 6, 8} **b)** domain: set of real numbers, range: set of real numbers **c)** domain: set of real numbers, range: $y \leq 2$ **d)** domain: {1}, range: set of real numbers **11.** {2, 3, 6}

Applications and Problem Solving 12. a) 2; 2.5 **b)** speed: independent, Mach number: dependent. The Mach number depends on the speed.

13. b) 17.6 million **c)** 2039 **14. b)** No, the domain and range are both the set of real numbers. **c)** x does not have a minimum or maximum value. The domain is the set of real numbers. y has a minimum value of 0, but no maximum value. The range is the set of real numbers greater than 0. **15. a)** range: set of real numbers **b)** range: $y \geq -2$ **16. a)** ± 2 **b)** ± 4 **c)** 0 **d)** $\pm \sqrt{11}$ **17. a)** no **b)** Yes, there is only one name for every set of fingerprints. **18.** No, there are likely several people with the same first name. **19.** Since the x -coordinates of the points on a vertical line are all equal, if a vertical line passes through more than one point of the graph of a relation, then the relation contains two different points with the same x -coordinate, and so is not a function.

20. a) $y = 8a + 3$ **b)** $y = -1 - 3n$ **c)** $y = m^2 - 2m + 2$

d) $y = 8k^2 + 8k - 1$ **e)** $y = 9t^2 + 6t - 4$

f) $y = 12w^2 - 32w + 25$ **21.** It is a vertical line.

22. a) A closed dot is used to show the location of an ordered pair on a graph; an open dot is used to show that an ordered pair is omitted from the graph. **b)** It looks like steps. **c)** domain: $0 \leq t \leq 4$, range: {120, 200, 280, 360} **d)** (0.5, 120), (1, 120) **e)** (1, 120), (2, 200) **f)** No, the graph is a function.

Investigation pp. 200–203

1 Translations on a Coordinate Grid 1. a) $D'(2, 4)$, $E'(-2, 4)$, $F'(-2, -2)$ **b)** $P'(-1, 4)$, $Q'(-5, 6)$, $R'(-7, -3)$ **c)** $U'(-3, -4)$, $V'(-1, 3)$, $W'(0, 0)$ **d)** $F'(4, -1)$, $G'(-2, 6)$, $H'(1, -2)$ **e)** $A'(1, -3)$, $B'(7, -4)$, $C'(5, -7)$

f) $J'(-1, -2)$, $K'(-4, -1)$, $L'(-6, -6)$ **2. R**(1, -4), $S(-2, 3)$, $T(-4, -5)$ **3. a)** $A'(7, 3)$, $B'(3, 8)$, $C'(1, 4)$ **b)** $A''(6, -2)$, $B''(2, 3)$, $C''(0, -1)$ **c)** 3 units to the right, 2 units downward

2 Reflections on a Coordinate Grid 1. a) $A'(2, -4)$, $B'(1, -1)$, $C'(6, -2)$ **b)** $D'(0, -3)$, $E'(5, -4)$, $F'(2, 0)$ **c)** $P'(1, -2)$, $Q'(-3, 2)$, $R'(3, 1)$ **2. a)** $A'(-1, 3)$, $B'(-2, 1)$, $C'(-6, 3)$ **b)** $D'(-1, 2)$, $E'(0, -2)$, $F'(-3, 1)$ **c)** $P'(2, 1)$, $Q'(3, -3)$, $R'(-1, -2)$ **3. a)** (2, -3), (-2, 3) **b)** (-1, 2), (1, -2) **c)** (-3, -2), (3, 2) **d)** (4, 0), (-4, 0) **4. A'**(-1, 1), $B'(-5, 2)$, $C'(-3, 6)$ **5. R'**(2, -5), $S'(-2, -4)$, $T'(-1, 2)$ **6. a)** y -axis **b)** x -axis

3 Dilatations on a Coordinate Grid 1. a) 2 **b)** $\frac{1}{3}$

2. a) $A'(6, 4)$, $B'(2, 8)$ **b)** $C'(3, 2)$, $D'(-1, 1)$ **c)** $E'(-3, -3)$, $F'(3, 6)$ **d)** $G'(3, 1)$, $H'(-2, 0)$ **3. R'**(6, 9), $S'(-3, 12)$, $T'(-9, -6)$ **4. D'**(3, 2), $E'(-1, 3)$, $F'(-2, -2)$, $G'(2, -3)$ **5. b)** 8 **c)** $P'(-6, 6)$, $Q'(-6, -6)$, $R'(6, -6)$ **d)** 72 **e)** $P''(-1, 1)$, $Q''(-1, -1)$, $R''(1, -1)$ **f)** 2 **g)** 9:1; $\frac{1}{4}$:1 **h)** The first term is the square of the scale factor.

Section 4.2 pp. 213–216

Practice 1. a) up; (0, 5); $x = 0$; domain: set of real numbers, range: $y \geq 5$; minimum: 5 **b)** up; (0, -2); $x = 0$; domain: set of real numbers, range: $y \geq -2$; minimum: -2 **c)** down; (0, -1); $x = 0$; domain: set of real numbers, range: $y \leq -1$; maximum: -1 **d)** down; (0, 4); $x = 0$; domain: set of real numbers, range: $y \leq 4$; maximum: 4 **e)** up; (0, 0); $x = 0$; domain: set of real numbers, range: $y \geq 0$; minimum: 0 **f)** down; (0, 0); $x = 0$; domain: set of real numbers, range: $y \leq 0$; maximum: 0 **g)** up; (0, -1); $x = 0$; domain: set of real numbers, range: $y \geq -1$; minimum: -1 **h)** down; (0, 0); $x = 0$; domain: set of real numbers, range: $y \leq 0$; maximum: 0 **i)** down; (0, -3); $x = 0$; domain: set of real numbers, range: $y \leq -3$; maximum: -3 **j)** up; (0, 1); $x = 0$; domain: set of real numbers, range: $y \geq 1$; minimum: 1 **k)** down; (0, 7); $x = 0$; domain: set of real numbers, range: $y \leq 7$; maximum: 7 **l)** down; (0, -6); $x = 0$; domain: set of real numbers, range: $y \leq -6$; maximum: -6 **2. a)** The graph of $y = x^2 - 4$ is a translation of the graph of $y = x^2$ 4 units downward **b)** The graph of $y = -x^2 + 5$ is a translation of the graph of $y = -x^2$ 5 units upward. **c)** The graph of $y = 3x^2$ is a vertical stretch of the graph of $y = x^2$ by a factor of 3. **d)** The graph of $y = -\frac{1}{3}x^2$ is a vertical

shrink of the graph of $y = -x^2$ by a factor of $\frac{1}{3}$ **e)** The graph of $y = 2x^2 - 2$ is a translation of the graph of $y = 2x^2 + 7$ 9 units downward. **f)** The graph of