

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

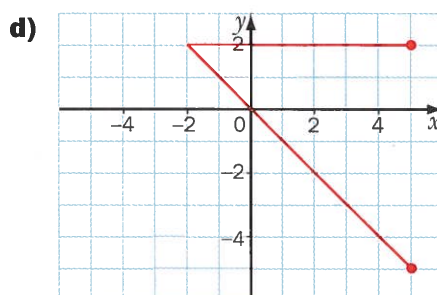
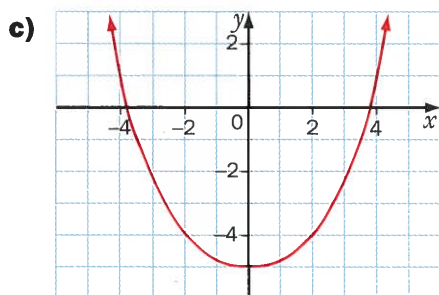
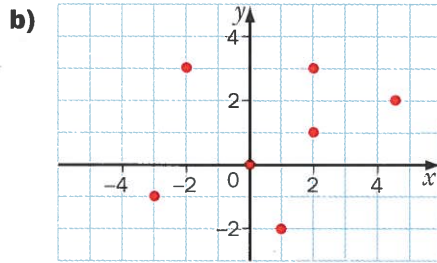
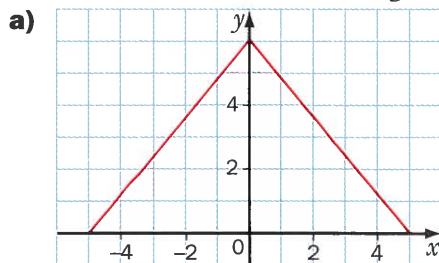
5. If $m = 2n^2 - 4n + 3$, find the value of m for each of the following values of n .

- 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.

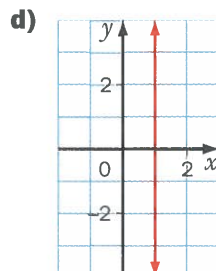
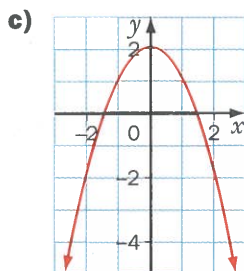
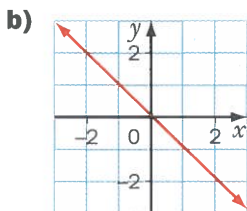
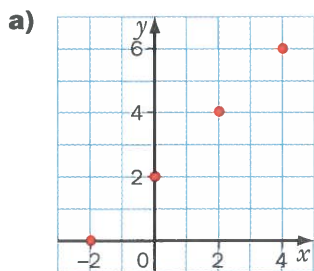
a)

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.

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