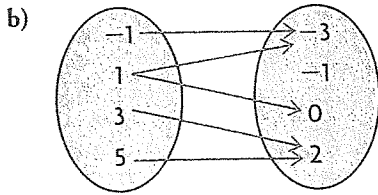


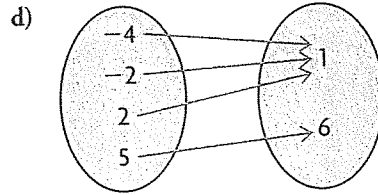
Relations and Functions

1. State which relations are functions. Explain.

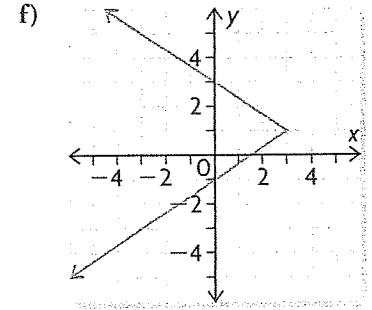
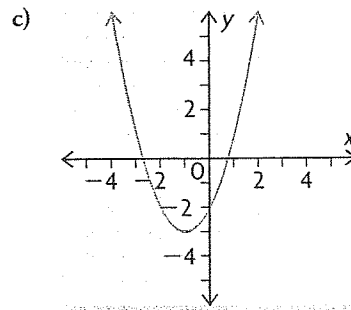
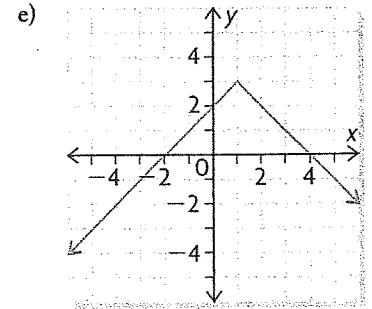
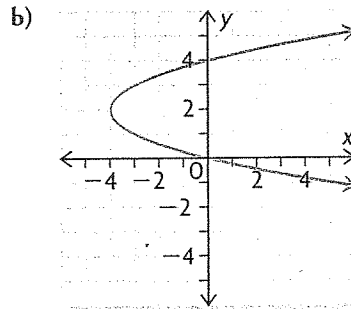
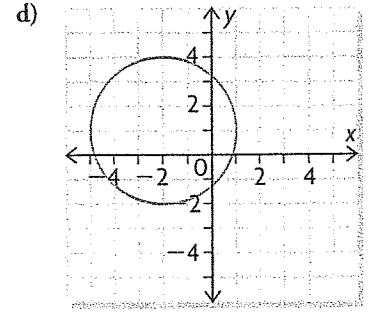
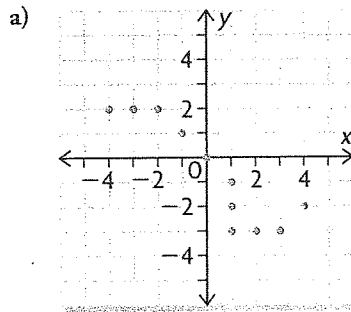
a) $\{(-5, 1), (-3, 2), (-1, 3), (1, 2)\}$



c) $\{(0, 4), (3, 5), (5, -2), (0, 1)\}$



2. Use a ruler and the vertical-line test to determine which graphs are functions.



3. Substitute -6 for x in each equation and solve for y . Use your results to explain why $y = x^2 - 5x$ is a function but $x = y^2 - 5y$ is not.

4. The grades and numbers of credits for students are listed.

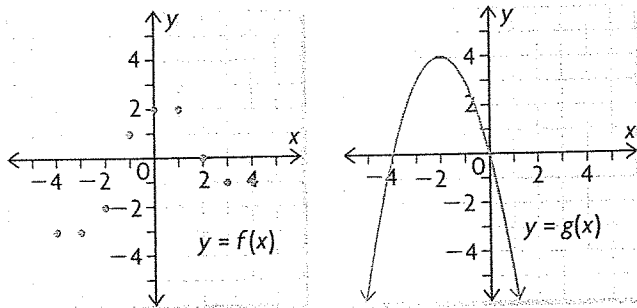
Student	Grade	Number of Credits
Barbara	10	8
Pierre	12	25
Kateri	11	15
Mandeep	11	18
Elly	10	16

- a) Write a list of ordered pairs and create a mapping diagram for the relation between
- students and grades
 - grades and numbers of credits
 - students and numbers of credits
- b) State the domain and range of each relation in part (a).
- c) Which relations in part (a) are functions? Explain.

5. Graph the relations in question 4. Then use the vertical-line test to confirm your answers to part (c).
6. Describe the graphs of the relations $y = 3$ and $x = 3$. Are these relations functions? Explain.
7. Identify each type of relation and predict whether it is a function. Then graph each function and use the vertical-line test to determine whether your prediction was correct.
 - a) $y = 5 - 2x$
 - b) $y = 2x^2 - 3$
 - c) $y = -\frac{3}{4}(x + 3)^2 + 1$
 - d) $x^2 + y^2 = 25$
8. a) Substitute $x = 0$ into each equation and solve for y . Repeat for $x = -2$.
 - i) $3x + 4y = 5$
 - ii) $x^2 + y^2 = 4$
 - iii) $x^2 + y = 2$
 - iv) $x + y^2 = 0$
 - b) Which relations in part (a) appear to be functions?
 - c) How could you verify your answer to part (b)?
9. Determine which relations are functions.
 - a) $y = \sqrt{x + 2}$
 - b) $y = 2 - x$
 - c) $3x^2 - 4y^2 = 12$
 - d) $y = -3(x + 2)^2 - 4$
10. Use numeric and graphical representations to investigate whether the relation $x - y^2 = 2$ is a function. Explain your reasoning.
11. Determine which of the following relations are functions.
 - a) The relation between earnings and sales if Olwen earns \$400 per week plus 5% commission on sales
 - b) The relation between distance and time if Bran walks at 5 km/h
 - c) The relation between students' ages and the number of credits earned

Function Notation

1. Evaluate, where $f(x) = 2 - 3x$.
 - a) $f(2)$
 - b) $f(0)$
 - c) $f(-4)$
 - d) $f\left(\frac{1}{2}\right)$
 - e) $f(a)$
 - f) $f(3b)$
2. The graphs of $y = f(x)$ and $y = g(x)$ are shown.



Using the graphs, evaluate

- a) $f(1)$
- b) $g(-2)$
- c) $f(4) - g(-2)$
- d) x when $f(x) = -3$

3. Milk is leaking from a carton at a rate of 3 mL/min. There is 1.2 L of milk in the carton at 11:00 a.m.
- Use function notation to write an equation for this situation.
 - How much will be left in the carton at 1:00 p.m.?
 - At what time will 450 mL of milk be left in the carton?

4. Evaluate $f(-1)$, $f(3)$, and $f(1.5)$ for

a) $f(x) = (x - 2)^2 - 1$ b) $f(x) = 2 + 3x - 4x^2$

5. For $f(x) = \frac{1}{2x}$, determine

a) $f(-3)$ b) $f(0)$ c) $f(1) - f(3)$ d) $f\left(\frac{1}{4}\right) + f\left(\frac{3}{4}\right)$

6. The graph of $y = f(x)$ is shown at the right.

- a) State the domain and range of f .

- b) Evaluate.

i) $f(3)$

iii) $f(5 - 3)$

ii) $f(5)$

iv) $f(5) - f(3)$

7. For $h(x) = 2x - 5$, determine

a) $h(a)$

c) $h(3c - 1)$

b) $h(b + 1)$

d) $h(2 - 5x)$

8. Consider the function $g(t) = 3t + 5$.

- a) Create a table of values and graph the function.

- b) Determine each value.

i) $g(0)$

iv) $g(2) - g(1)$

ii) $g(3)$

v) $g(1001) - g(1000)$

iii) $g(1) - g(0)$

vi) $g(a + 1) - g(a)$

9. Consider the function $f(s) = s^2 - 6s + 9$.

- a) Create a table of values for the function.

- b) Determine each value.

i) $f(0)$

iv) $f(3)$

ii) $f(1)$

v) $[f(2) - f(1)] - [f(1) - f(0)]$

iii) $f(2)$

vi) $[f(3) - f(2)] - [f(2) - f(1)]$

- c) In part (b), what do you notice about the answers to parts (v) and (vi)? Explain why this happens.

10. The graph at the right shows $f(x) = 2(x - 3)^2 - 1$.

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

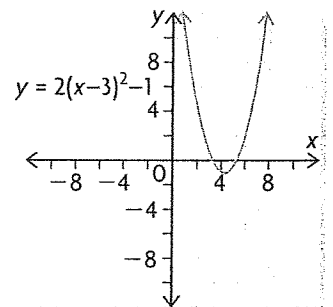
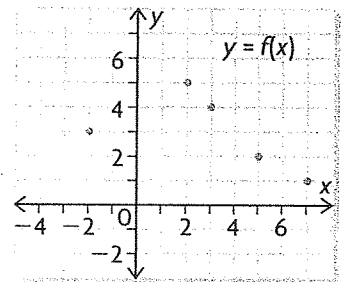
- b) What does $f(-2)$ represent on the graph of f ?

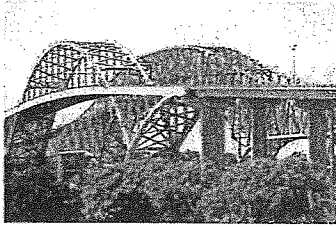
- c) State the domain and range of the relation.

- d) How do you know that f is a function from its graph?

11. For $g(x) = 4 - 5x$, determine the input for x when the output of $g(x)$ is

a) -6 b) 2 c) 0 d) $\frac{3}{5}$





12. A company rents cars for \$50 per day plus \$0.15/km.
- Express the daily rental cost as a function of the number of kilometres travelled.
 - Determine the rental cost if you drive 472 km in one day.
 - Determine how far you can drive in a day for \$80.
13. As a mental arithmetic exercise, a teacher asked her students to think of a number, triple it, and subtract the resulting number from 24. Finally, they were asked to multiply the resulting difference by the number they first thought of.
- Use function notation to express the final answer in terms of the original number.
 - Determine the result of choosing numbers 3, -5 , and 10.
 - Determine the maximum result possible.
14. The second span of the Bluewater Bridge in Sarnia, Ontario, is supported by two parabolic arches. Each arch is set in concrete foundations that are on opposite sides of the St. Clair River. The arches are 281 m apart. The top of each arch rises 71 m above the river. Write a function to model the arch.
15. a) Graph the function $f(x) = 3(x - 1)^2 - 4$.
- What does $f(-1)$ represent on the graph? Indicate on the graph how you would find $f(-1)$.
 - Use the equation to determine
 - $f(2) - f(1)$
 - $2f(3) - 7$
 - $f(1 - x)$
16. Let $f(x) = x^2 + 2x - 15$. Determine the values of x for which
- $f(x) = 0$
 - $f(x) = -12$
 - $f(x) = -16$
17. Let $f(x) = 3x + 1$ and $g(x) = 2 - x$. Determine values for a such that
- $f(a) = g(a)$
 - $f(a^2) = g(2a)$
18. Explain, with examples, what function notation is and how it relates to the graph of a function. Include a discussion of the advantages of using function notation.

Extending

19. The highest and lowest marks awarded on an examination were 285 and 75. All the marks must be reduced so that the highest and lowest marks become 200 and 60.
- Determine a linear function that will convert 285 to 200 and 75 to 60.
 - Use the function to determine the new marks that correspond to original marks of 95, 175, 215, and 255.
20. A function $f(x)$ has these properties:
- The domain of f is the set of natural numbers.
 - $f(1) = 1$
 - $f(x + 1) = f(x) + 3x(x + 1) + 1$
- Determine $f(2)$, $f(3)$, $f(4)$, $f(5)$, and $f(6)$.
 - Describe the function.