Section 9.6
Introduction to Functions

Say *WHAT*???

Along the way in this textbook, you have noticed that mathematical notation occasionally can have more than one meaning depending on the context.

For example, $(-3, 6)$ could refer to the ordered pair where $x = -3$ and $y = 6$, or it could refer to the open interval $-3 < x < 6$.

Similarly, in this section of the textbook, we will use the notation, $f(x)$. It may surprise you to find out that it does *not* mean to multiply "f times x."

It will be important for you to gain an understanding of what this notation *does* mean as you work through this essential concept of "functions."

$$f(x) \quad f(x) \quad f(x)$$

First Steps:

- ☐ **Take comprehensive notes** from your instructor's lecture and insert your notes into this section of the *Learning Guide*. Be sure to write down all examples, definitions, and other key concepts. Additional learning resources include the *Lecture Series on DVD*, the *PowerPoints*, and Section 9.6 of your textbook which begins on page 664.
- ☐ Complete the ***Concept and Vocabulary Check*** on page 671 of the textbook.

Guided Practice:

- ☐ Review each of the following ***Solved Problems*** and complete each ***Pencil Problem***.

Objective #1: Find the domain and range of a relation.

✔ *Solved Problem #1*

1. The following set shows calories burned per hour in various activities.
Find the domain and range of the relation:
{(golf, 250), (lawn mowing, 325), (water skiing, 430), (hiking, 430), (bicycling, 720)}.

The domain is the set of all first components.

Domain:
{golf, lawn mowing, water skiing, hiking, bicycling}

The range is the set of all second components.

Range:
{250, 325, 430, 720}

✎ *Pencil Problem #1* ✎

1. Find the domain and range of the relation:
{(1, 2), (3, 4), (5, 5)}

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Objective #2: Determine whether a relation is a function.

✔ *Solved Problem #2*

2a. Determine whether the relation is a function:

$$\{(1,2),(3,4),(6,5),(8,5)\}$$

Every element in the domain corresponds to exactly one element in the range. No two ordered pairs in the given relation have the same first component and different second components.

Thus, the relation is a function.

✎ *Pencil Problem #2*

2a. Determine whether the relation is a function:

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

2b. Determine whether the relation is a function:

$$\{(1,2),(3,4),(5,6),(5,8)\}$$

5 corresponds to both 6 and 8. If any element in the domain corresponds to more than one element in the range, the relation is not a function.

Thus, the relation is not a function.

2b. Determine whether the relation is a function:

$$\{(1,4),(1,5),(1,6)\}$$

Objective #3: Evaluate a function.

✔ *Solved Problem #3*

3a. If $f(x)=4x+3$, find $f(5)$, $f(-2)$, and $f(0)$.

$$\begin{aligned} f(x) &= 4x+3 \\ f(5) &= 4(5)+3 \\ &= 20+3 \\ &= 23 \end{aligned}$$

$$\begin{aligned} f(x) &= 4x+3 \\ f(-2) &= 4(-2)+3 \\ &= -8+3 \\ &= -5 \end{aligned}$$

$$\begin{aligned} f(x) &= 4x+3 \\ f(0) &= 4(0)+3 \\ &= 0+3 \\ &= 3 \end{aligned}$$

✎ *Pencil Problem #3*

3a. If $f(x)=8x-3$, find $f(12)$, $f\left(-\frac{1}{2}\right)$, and $f(0)$.

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3b. If $g(x) = x^2 + 4x + 3$,
find $g(5)$, $g(-4)$, and $g(0)$.

$$g(x) = x^2 + 4x + 3$$
$$g(5) = (5)^2 + 4(5) + 3$$
$$= 25 + 20 + 3$$
$$= 48$$

$$g(x) = x^2 + 4x + 3$$
$$g(-4) = (-4)^2 + 4(-4) + 3$$
$$= 16 - 16 + 3$$
$$= 3$$

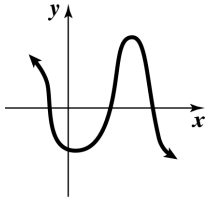
$$g(x) = x^2 + 4x + 3$$
$$g(0) = 0^2 + 4(0) + 3$$
$$= 0 + 0 + 3$$
$$= 3$$

3b. If $g(x) = x^2 + 3x$,
find $g(2)$, $g(-2)$, and $g(0)$.

Objective #4: Use the vertical line test to identify functions.

✔ *Solved Problem #4*

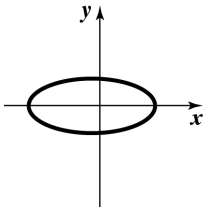
4. Use the vertical line test to determine if the graph represents y as a function of x.



The graph passes the vertical line test and thus y is a function of x.

✎ *Pencil Problem #4* ✎

4. Use the vertical line test to determine if the graph represents y as a function of x.



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Objective #5: Find function values for functions that model data.

✔ *Solved Problem #5*

5. The linear function $f(x) = -2.9x + 286$ and the quadratic function $g(x) = 0.01x^2 - 4.9x + 370$ model the chance, as a percent, that a 60-year-old will survive to age x.
Given that the National Center for Health Statistics reports the actual chance of surviving to age 90 to be 24%, which model serves as a better description?

First, determine the chance that a 60-year-old will survive to age 90 according to the linear function.

$f(x) = -2.9x + 286$

$f(90) = -2.9(90) + 286 = 25$

According to the linear function, a 60-year-old has a 25% chance to survive to age 90.

Next, determine the chance that a 60-year-old will survive to age 90 according to the quadratic function.

$g(x) = 0.01x^2 - 4.9x + 370$

$g(90) = 0.01(90)^2 - 4.9(90) + 370 = 10$

According to the quadratic function, a 60-year-old has a 10% chance to survive to age 90.

The linear function, at 25%, serves as a better description of the actual data value of 24%.

✎ *Pencil Problem #5* ✎

5. The function $C(x) = 0.28x^2 - 5.2x + 29$ models the average cost of cellphone use per minute, $C(x)$, in cents, x years after 2000.
Find and interpret $C(9)$.

Answers for Pencil Problems *(Textbook Exercise references in parentheses)*:

1. Domain: {1,3,5}; Range: {2,4,5} *(9.6 #1)*

2a. function *(9.6 #5)* **2b.** not a function *(9.6 #7)*

3a. $f(12) = 93$; $f\left(-\frac{1}{2}\right) = -7$; $f(0) = -3$ *(9.6 #13)* **3b.** $g(2) = 10$; $g(-2) = -2$; $g(0) = 0$ *(9.6 #15)*

4. y is not a function of x *(9.6 #29)*

5. $C(9) \approx 5$; In 2009, cellphone use cost approximately 5¢ per minute. *(9.6 #45)*

Homework:

- ☐ **Review the Section 9.6 summary** on page 678 of the textbook.
- ☐ **Insert your homework** into this section of the *Learning Guide*. Show all work neatly and check your answers. Strive to work through difficulties when possible, making note of any exercises where you need additional help. Remember, even if your instructor assigns homework through *MyMathLab*, you should still write out your work.

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