

Lesson 3: Linear Functions and Proportionality

Classwork

Example 1

In the last lesson, we looked at several tables of values that represented the inputs and outputs of functions. For example:

Bags of candy (x)	1	2	3	4	5	6	7	8
Cost (y)	\$1.25	\$2.50	\$3.75	\$5.00	\$6.25	\$7.50	\$8.75	\$10.00

Example 2

Walter walks 8 miles in 2 hours. What is his average speed?

Example 3

Veronica runs at a constant speed. The distance she runs is a function of the time she spends running. The function has the table of values shown below.

Time in minutes (x)	8	16	24	32
Distance run in miles (y)	1	2	3	4

Example 4

Water flows from a faucet at a constant rate. That is, the volume of water that flows out of the faucet is the same over any given time interval. If 7 gallons of water flow from the faucet every 2 minutes, determine the rule that describes the volume function of the faucet.

Now assume that you are filling the same tub (a tub with a volume of 50 gallons) with the same faucet (a faucet where the rate of water flow is 3.5 gallons per minute). This time, however, the tub already has 8 gallons in it. Will it still take 14 minutes to fill the tub? Explain.

Time in minutes (x)	0	3	6	9	12
Total volume in tub in gallons (y)					

Example 5

Water flows from a faucet at a constant rate. Assume that 6 gallons of water are already in a tub by the time we notice the faucet is on. This information is recorded as 0 minutes and 6 gallons of water in the table below. The other values show how many gallons of water are in the tub at the given number of minutes.

Time in minutes (x)	0	3	5	9
Total volume in tub in gallons (y)	6	9.6	12	16.8

Exercises 1–3

1. A linear function has the table of values below. The information in the table shows the function of time in minutes with respect to mowing an area of lawn in square feet.

Number of minutes (x)	5	20	30	50
Area mowed in square feet (y)	36	144	216	360

- a. Explain why this is a linear function.

- b. Describe the function in terms of area mowed and time.
- c. What is the rate of mowing a lawn in 5 minutes?
- d. What is the rate of mowing a lawn in 20 minutes?
- e. What is the rate of mowing a lawn in 30 minutes?
- f. What is the rate of mowing a lawn in 50 minutes?
- g. Write the rule that represents the linear function that describes the area in square feet mowed, y , in x minutes.
- h. Describe the limitations of x and y .

- i. What number does the function assign to 24? That is, what area of lawn can be mowed in 24 minutes?
- j. How many minutes would it take to mow an area of 400 square feet?
2. A linear function has the table of values below. The information in the table shows the volume of water that flows from a hose in gallons as a function of time in minutes.

Time in minutes (x)	10	25	50	70
Total volume of water in gallons (y)	44	110	220	308

- a. Describe the function in terms of volume and time.
- b. Write the rule that represents the linear function that describes the volume of water in gallons, y , in x minutes.
- c. What number does the function assign to 250? That is, how many gallons of water flow from the hose in 250 minutes?

d. The average pool has about 17,300 gallons of water. The pool has already been filled $\frac{1}{4}$ of its volume. Write the rule that describes the volume of water flow as a function of time for filling the pool using the hose, including the number of gallons that are already in the pool.

e. Approximately how much time, in hours, will it take to finish filling the pool?

3. Recall that a linear function can be described by a rule in the form of $y = mx + b$, where m and b are constants. A particular linear function has the table of values below.

Input (x)	0	4	10	11	15	20	23
Output (y)	4	24	54	59			

a. What is the equation that describes the function?

b. Complete the table using the rule.

Lesson Summary

Linear functions can be described by a rule in the form of $y = mx + b$, where m and b are constants.

Constant rates and proportional relationships can be described by a function, specifically a linear function where the rule is a linear equation.

Functions are described in terms of their inputs and outputs. For example, if the inputs are related to time and the outputs are distances traveled at given time intervals, then we say that the distance traveled is a function of the time spent traveling.

Problem Set

1. A food bank distributes cans of vegetables every Saturday. They keep track of the cans in the following manner in the table. A linear function can be used to represent the data. The information in the table shows the function of time in weeks to the number of cans of vegetables distributed by the food bank.

Number of weeks (x)	1	12	20	45
Number of cans of vegetables distributed (y)	180	2,160	3,600	8,100

- Describe the function in terms of cans distributed and time.
 - Write the equation or rule that represents the linear function that describes the number of cans handed out, y , in x weeks.
 - Assume that the food bank wants to distribute 20,000 cans of vegetables. How long will it take them to meet that goal?
 - Assume that the food bank has already handed out 35,000 cans of vegetables and continues to hand out cans at the same rate each week. Write a linear function that accounts for the number of cans already handed out.
 - Using your function in part (d), determine how long in years it will take the food bank to hand out 80,000 cans of vegetables.
2. A linear function has the table of values below. The information in the table shows the function of time in hours to the distance an airplane travels in miles. Assume constant speed.

Number of hours traveled (x)	2.5	4	4.2
Distance in miles (y)	1,062.5	1,700	1,785

- Describe the function in terms of distance and time.
- Write the rule that represents the linear function that describes the distance traveled in miles, y , in x hours.

- c. Assume that the airplane is making a trip from New York to Los Angeles, which is approximately 2,475 miles. How long will it take the airplane to get to Los Angeles?
 - d. The airplane flies for 8 hours. How many miles will it be able to travel in that time interval?
3. A linear function has the table of values below. The information in the table shows the function of time in hours to the distance a car travels in miles.

Number of hours traveled (x)	3.5	3.75	4	4.25
Distance in miles (y)	203	217.5	232	246.5

- a. Describe the function in terms of distance and time.
 - b. Write the rule that represents the linear function that describes the distance traveled in miles, y , in x hours.
 - c. Assume that the person driving the car is going on a road trip that is 500 miles from the starting point. How long will it take the person to get to the destination?
 - d. Assume that a second car is going on the road trip from the same starting point and traveling at the same constant rate. However, this car has already driven 210 miles. Write the rule that represents the linear function that accounts for the miles already driven by this car.
 - e. How long will it take the second car to drive the remainder of the trip?
4. A particular linear function has the table of values below.

Input (x)	2	3	8	11	15	20	23
Output (y)	7	10		34		61	

- a. What is the equation that describes the function?
 - b. Complete the table using the rule.
5. A particular linear function has the table of values below.

Input (x)	0	5	8	13	15	18	21
Output (y)	6	11	14		21		

- a. What is the rule that describes the function?
- b. Complete the table using the rule.