

3.4

A Growing Business

Combining Linear Equations

LEARNING GOALS

In this lesson, you will:

- Write linear functions using the Distributive Property.
- Write and analyze a linear function as a combination of multiple linear functions.
- Interpret and understand component parts of functions.
- Analyze problem situations modeled by a combination of multiple linear functions.

You probably don't think about flowers on a daily basis, but there are some people who do! Florists routinely think about different types of flowers, arrangements of those flowers, ordering flowers, plants, balloons, baskets, and vases, and—pew! There's a lot to floristry! But make no mistake, the business of floristry is more than just flowers—it's dollars and cents and mathematics. For example, there are certain days of the year when there is a huge demand for roses, vases, and baby's breath. When this occurs, florists must accurately order roses and baby's breath in comparison to other flowers to make sure they can fulfill the demand, but not have a lot of these flowers left over.

What certain days do you think might have a higher demand for roses or vases? How do you think mathematics can help florists order and arrange flowers?

PROBLEM 1 Flowers for Sale!

Alexis is a flower vendor who grows and sells her own fresh-cut flowers. She has a stand in the city, and she distributes flowers to pedestrians during the day. She charges \$5 for each flower, and each month she randomly gives away two flowers for free.

1. Identify the independent and dependent quantities in this problem situation.

2. Write a linear function, $a(x)$, to represent how much money Alexis earns each month. Use x to represent the number of flowers she sells each month. Write the function in simplest form.

a. $a(x) =$ _____

$a(x) =$ _____

b. What property did you use to write the simplified form of the function?

Remember, she gives away 2 flowers each month. How would you represent this information?



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3. Describe the function. Is it increasing or decreasing? Is it discrete or continuous? Explain your reasoning.



4. Complete the table shown. First, determine the unit of measure for each expression. Then, describe the contextual meaning of each part of the function. Finally, choose a term from the word box to describe the mathematical meaning of each part.

input value output value rate of change y-intercept

Expression	Unit	What It Means	
		Contextual Meaning	Mathematical Meaning
$a(x)$			
5			
x			
$(x - 2)$			
-10			
$5x - 10$			

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5. How much will Alexis earn in a month if she distributes 45 flowers? Show your work.

In this situation, the word "distribute" refers to the flowers she sold and gave away.





6. How many flowers does Alexis distribute in a month if she earns \$300?
Show your work.

PROBLEM 2 Joining Forces

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Bashir is also a flower vendor in a different part of the same city. He sells flowers for \$3 each and gives away 4 flowers for free each month. He also earns an extra \$6 each month by selling one of his homemade bracelets.

1. Write a linear function, $b(x)$, to represent the amount of money Bashir earns each month. Be sure to simplify your function.

$b(x) =$ _____

2. Consider the parts of Bashir's function and the parts of Alexis' function.
- a. Explain the meaning of the rate of change and the y -intercept of each function.

b. Compare the units of the:

- output values,
- input values,
- rate of change, and
- y-intercepts

of *both* functions. What do you notice?



Bashir and Alexis decide to become business partners and combine their monthly earnings. They will each continue to sell to their own customers in different parts of the city. Bashir distributes twice as many flowers each month as Alexis.



3. At the end of the month when Alexis and Bashir combine their earnings, about how much will they will earn from each flower sold? Explain your prediction.

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4. Suppose in one month Alexis distributes 20 flowers.

a. Use Alexis' function to calculate her earnings. Show your work.

b. Use Bashir's function to calculate his earnings. Show your work.

- c. How much money would Bashir and Alexis make together if they combined their earnings?



- d. Use your answer to part (c) to determine the average selling price of each flower after Alexis and Bashir combined their earnings. Does this match your prediction?



5. Nick tried to write a new function, $c(x)$, to represent Alexis' and Bashir's combined earnings. He said, "I can add the two functions like this:"

$$c(x) = a(x) + b(x)$$

$$c(x) = 5x - 10 + 3x - 6$$

$$= 8x - 16$$

Madison disagreed. She said, "That's not right. You can't add the functions because the x -values in the two functions don't mean the same thing, so they might be different values."

Who's correct—Madison or Nick? Explain your reasoning.



6. Use your answers to Question 4 and Nick's function to show why his function is not correct. Explain your method.

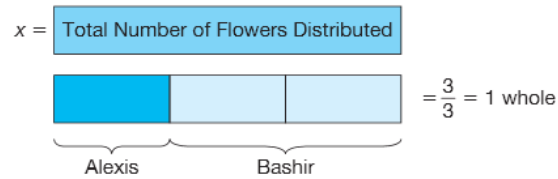
7. What does the slope represent in Nick's function? How does this compare with your answer to Question 4, part (d)?

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Nick *could* actually add the two functions together. However, he did not recognize that the input values were different for Alexis and Bashir. To add two functions together, you must ensure the input values represent the same thing in both functions. A model can be used to represent the input values.

Let x represent the total number of flowers Alexis and Bashir distribute each month. The model shows that Bashir distributes twice as many flowers as Alexis each month and that together the number of flowers adds up to x .



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8. Write an expression to represent Alexis' share of the total flowers distributed. Then write an expression to represent Bashir's share of the total flowers distributed. Let x represent the total number of flowers distributed.

Alexis:

Bashir:

9. Rewrite Alexis' and Bashir's functions so they show each person's share of the total earnings. Then, add the functions to determine a new function, $c(x)$, that describes the combined amount of money Alexis and Bashir earn each month. Show your work.



10. What does the slope of the new function mean? What does the y -intercept of the new function mean?

PROBLEM 3 The Silent Partner

Alexis and Bashir decide to partner with an investor. The investor will supply money for equipment, flower seeds, and other materials. In return, the investor will receive \$0.50 for every flower distributed.

1. Write a new function, $d(x)$, to represent the amount of money the investor will earn each month from the total number of flowers distributed. Define what the variable x means in the function.
2. Write a function, $t(x)$, to represent the combined amount of money Alexis and Bashir will earn each month after they partner with the investor. Show your work.
3. In this case, why was it possible to determine a new function without rewriting $d(x)$?
4. Think about each problem situation and compare the functions $t(x)$ and $c(x)$. What do you notice?

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Be prepared to share your solutions and methods.