2.3 Finding Costs
Unit Rate and Constant of Proportionality

In *Comparing Bits and Pieces,* you found unit rates. Recall that a **unit rate** is a rate in which the second quantity is 1 unit. The rates *45 miles per gallon* and *$3.50 per hour* are unit rates because "per gallon" means "for one gallon" and "per hour" means "for one hour."

You may have used the following unit rates in previous Problems:

- amount of pizza per person

- number of people per pizza

- price per pizza

The unit rate for the price of one pizza at Howdy's is $13. The equation $C = 13n$ relates cost of pizza and number of pizzas.

This equation represents a *proportional relationship* because you multiply one variable by a constant number to get the value of the other variable. The constant multiplier is called the **constant of proportionality.**

$$C = 13n$$
$$\uparrow$$
$$\text{constant of}$$
$$\text{proportionality}$$

When a delivery charge of $5 is added to the cost, the relationship is no longer proportional: $C = 13n + 5$ is not a proportional relationship.

> **(?)** How can you recognize a proportional relationship from a table or graph?

In this Problem you will find and work with unit rates.

Problem 2.3

A FreshFoods has oranges on sale at 10 for $2. For each part, find the unit rate. Be sure to label your answers with the proper units.

1. What is the cost per orange?

2. How many oranges can you buy for $1?

**3.** Copy and complete the table below.

Cost of Oranges at FreshFoods

Number of Oranges, n	10	■	1	20	11	■
Cost, C	$2	$1	■	■	■	$2.60

4. How does finding a unit rate help you answer questions such as the ones below?

- How many oranges can you buy for $5?

- How much do 25 oranges cost?

5. The equation $n = 5C$ relates cost C to number of oranges n.

a. What does this equation tell you about the relationship between the number of oranges and the cost of the oranges?

b. What is another equation relating these same two variables? What information does this other equation give you?

c. Identify two unit rates from these equations. Explain how you found the unit rates. What information do the unit rates give you?

d. How does the constant of proportionality relate to the unit rate?

6. a. Graph the equations from Question 5 on two coordinate planes. Show values of n from 1 to 20.

b. How can you use the graphs to find the unit rates?

c. How can you use the graphs to find the constants of proportionality?

Problem 2.3 *continued*

B Noralie's car uses 20 gallons of gasoline to go 600 miles.

1. Write two unit rates relating the number of miles Noralie drives and the number of gallons her car uses. Explain your reasoning. What does each unit rate mean?

2. The graph below shows the relationship between distance d and gallons g of gasoline. Which unit rate appears on the graph? Explain.

Miles Driven and Gasoline Used
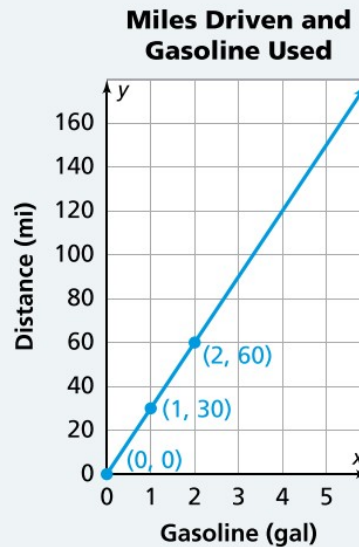
3. What equation relating d and g does the graph represent?

4. Which coordinate pair represents how far Noralie can drive on 1 gallon of gas? On zero gallons of gas?

5. Josh used the proportion $\frac{600}{20} = \frac{x}{4}$ to find the number of miles Noralie's car can travel on 4 gallons of gasoline. Lisa says she can use a unit rate.

   a. Do you agree with Josh or with Lisa? Explain.

   b. What other strategies can you use to find the number of miles Noralie's car can travel on 4 gallons of gasoline?

Problem **2.3** *continued*

C Gus wants to determine which store has better prices for groceries.

1. At More for Your Money, pasta is on sale at 7 boxes for $6. Gus makes a rate table and writes the proportions $\frac{7}{6} = \frac{n}{1}$ and $\frac{6}{7} = \frac{C}{1}$. What information does Gus get from solving each proportion?

2. Copy the rate table below. Fill in the missing values.

Pasta Prices at More for Your Money

Cost, C	$6	$1	▪
Boxes, n	7	▪	1

3. At FreshFoods, pasta is on sale at 6 boxes for $5. Gus decides he needs to divide. What value does the quotient $6 \div 5$ describe? What value does the quotient $5 \div 6$ describe?

4. At which store should Gus buy pasta? Explain.

A C E Homework starts on page 51.