3.1 Decimals and Estimation

Essential Question How can you use estimation to check that your answer is reasonable?

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The newspaper ad shows the weekly specials at a grocery store.

Weekly Specials

Bag of apples $3.99	Pack of hot dogs $2.52
Gallon of milk $3.49	Box of cereal $3.15	Pack of water $6.59	Orange juice $3.10
Bag of potatoes $2.99	Can of soup $1.29	Box of crackers $2.09	Syrup $2.62
Jar of baby food $.99	Carton of eggs $2.14	Loaf of bread $1.99	Ketchup $2.15

1 ACTIVITY: Estimating a Decimal Sum

Work with a partner. You are buying the items on your shopping list.

- Find the *exact* total cost.
- *Estimate* the total cost.
- Use your estimate to check that your total is reasonable.

a. Sample:

Shopping List
- Hot Dogs
- Bread
- Potatoes
- Cereal
- Apples
- Water

Hot Dogs	$2.52	$\longrightarrow$	3
Bread	$1.99	$\longrightarrow$	2
Potatoes	$2.99	$\longrightarrow$	3
Cereal	$3.15	$\longrightarrow$	3
Apples	$3.99	$\longrightarrow$	4
Water	+ $6.59	$\longrightarrow$	+ 7
	$21.23		22

Exact   Estimate

Your estimate is close to the exact total, so your answer is reasonable.

b. Shopping List
- Crackers
- Potatoes
- Milk
- Ketchup
- Orange Juice

c. Shopping List
- Cereal
- Bread
- Eggs
- Syrup
- Apples

d. Shopping List
- Baby Food
- Soup
- Water
- Ketchup
- Hot Dogs

2 ACTIVITY: Estimating Decimal Products

You get home and realize you forgot to buy four boxes of crackers. Your friend says the crackers cost about $2.00 a box, so you should take $8.00.

a. Fill in the blanks to show how your friend got the estimate.

$$2.09 \longrightarrow \boxed{}$$

$$\times \quad 4 \longrightarrow \times \boxed{}$$

$$\boxed{}$$

b. Find the actual total.

$$
\begin{aligned}
&\$2.09 \\
&\$2.09 \\
&\$2.09 \\
+\ &\$2.09 \\
\hline
&\boxed{}
\end{aligned}
$$

c. What is wrong with your friend's estimate?

3 ACTIVITY: Writing a Story

Work with a partner. Write a story about the shopping list. As part of your story, imagine that the grocery clerk told you that the total was $137.56 and you used estimation to decide that the total was way too much.

Shopping List
2 Gallons Milk
3 Cartons Eggs
3 Boxes Cereal
Syrup
6 Cans Soup
2 Boxes Crackers

What Is Your Answer?

4. **IN YOUR OWN WORDS** How can you use estimation to check that your answer is reasonable?

5. The problems on this page are about groceries. Describe two other real-life examples in which estimation of decimals is useful.

6. In the cartoon, does Newton's rule work? Why does "lining up the decimal points" help when you are adding decimals?

7. Think of a cartoon that involves decimal addition or subtraction. Then draw the cartoon.

Yessss SIR!

"To add decimals I pretend I'm a top sergeant and say "All RIGHT you decimal points... LINE UP!""

Practice
Use what you learned about estimation to complete Exercises 8–15 on page 110.

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BigIdeasMath.com

To estimate decimal products and quotients, you can round each factor to the nearest whole number.

EXAMPLE 1 **Estimating Decimal Products and Quotients**

a. **Estimate 12.3 × 4.8 by rounding to the nearest whole number.**

$$12.3 \times 4.8 \approx 12 \times 5 \qquad \text{12.3 rounds down to 12. 4.8 rounds up to 5.}$$
$$= 60 \qquad \text{Multiply.}$$

So, 12.3×4.8 is about 60.

b. **Estimate 62.9 ÷ 7.48 by rounding to the nearest whole number.**

$$62.9 \div 7.48 \approx 63 \div 7 \qquad \text{62.9 rounds up to 63. 7.48 rounds down to 7.}$$
$$= 9 \qquad \text{Divide.}$$

So, $62.9 \div 7.48$ is about 9.

Remember

When rounding, identify the place value being rounded. Then look at the digit to the right. If the digit is 5 or greater, round *up*. If it is less than 5, round *down*.

On Your Own

Now You're Ready
Exercises 8–23

Estimate by rounding each factor to the nearest whole number.

1. 11.2×5.7 2. 15.81×3.1 3. $26.5 \div 2.5$ 4. $75.22 \div 24.61$

When rounding, you do not always get numbers that are easy to use. In this case, use *compatible numbers*.

EXAMPLE 2 **Using Compatible Numbers**

a. **Use compatible numbers to estimate 48.97 × 3.91.**

$$48.97 \times 3.91 \approx 50 \times 4 \qquad \text{50 and 4 are compatible numbers.}$$
$$= 200 \qquad \text{Multiply.}$$

So, 48.97×3.91 is about 200.

Study Tip

Compatible numbers are numbers that are easy to compute mentally.

b. **Use compatible numbers to estimate 62.45 ÷ 11.72.**

$$62.45 \div 11.72 \approx 60 \div 12 \qquad \text{60 and 12 are compatible numbers.}$$
$$= 5 \qquad \text{Divide.}$$

So, $62.45 \div 11.72$ is about 5.

Use compatible numbers to estimate the product or quotient.

5. 38.79×9.8

6. 26.025×6.12

7. $17.34 \div 2.91$

8. $136.9 \div 22.83$

EXAMPLE 3 **Real-Life Application**

7	18	31
Sec.	Row	Seat

Admission $3.75

Talent Show

The money collected from ticket sales for the talent show is $2692.50. Estimate the number of tickets sold.

The number of tickets sold is $2692.50 \div 3.75$. You can estimate this quotient using compatible numbers.

$$3.75\overline{)2692.50} \longrightarrow 4\overline{)2800}^{\,700}$$

Round 3.75 up to 4.

A number that is close to 2692.50 and easily divisible by 4 is 2800.

So, about 700 tickets were sold.

EXAMPLE 4 **Real-Life Application**

A surf shop sits 75 feet from a shoreline. Each year 6.375 feet of the beach is lost due to erosion. Your friend says the water will reach the shop within 9 years. Is your friend correct? Explain.

To find how much beach will be lost in 9 years, estimate 6.375×9. If an overestimate is less than 75, you can be sure the water will not reach the shop.

$6.375 \times 9 \approx 7 \times 9$ Round 6.375 *up* to 7.

$= 63$ Multiply. This is an overestimate, so the actual amount is less than 63.

No. Because 63 is less than 75, the water will not reach the shop.

On Your Own

9. Each ticket for a school play costs $3.25. The money collected from ticket sales is $1774.50. Estimate the number of tickets sold.

10. A home sits 100 feet from the shoreline. Each year, 11.25 feet of the beach is lost due to erosion. Will the water reach the home in the next decade? Explain.

Vocabulary and Concept Check

1. **VOCABULARY** Describe a real-life example of decimal estimation.

2. **OPEN-ENDED** Fill in the blanks for three prices: $☐.95 + $☐.95 + $☐.95 ≈ $10.00.

3. **NUMBER SENSE** Which three quotients have an estimate of 4?

$$3.9 \div 1.1 \qquad 3\frac{1}{2} \div 1\frac{1}{2} \qquad 7\frac{3}{5} \div 1\frac{7}{8} \qquad 11.3 \div 2.9$$

Tell whether you would use *rounding* or *compatible numbers* to estimate the product or quotient. Explain your reasoning.

4. $23.6 \div 4.2$
5. 33.72×18.11
6. $46.18 \div 7.57$
7. 8.5×7.83

Practice and Problem Solving

① **Estimate by rounding each factor to the nearest whole number.**

8. 3.21×8
9. 7.06×3
10. 2.8×7
11. 4.57×5

12. 7.9×12
13. 5.42×6
14. 6.11×10
15. 9.7×9

16. 5.6×7.1
17. 2.5×9.4
18. 19.8×5.7
19. $9.1 \div 1.1$

20. 10.83×7.91
21. 7.74×9.18
22. $35.71 \div 6.15$
23. $40.31 \div 19.55$

② **Use compatible numbers to estimate the product or quotient.**

24. 57.3×8.62
25. 18.6×32.7
26. $42.17 \div 3.84$
27. $179.6 \div 32.1$

28. 4.35×33.41
29. 8.73×46.9
30. $73.55 \div 2.23$
31. $87.16 \div 17.43$

32. **ANOTHER WAY** Show another way to estimate the quotient. Explain your steps.

$$42.3 \div 6.459 \approx 42 \div 7$$
$$= 6$$

33. **SAND** You use 38 buckets of sand to bury your friend at the beach. Your bucket holds 8.2 pounds of sand. Estimate how many pounds of sand you use. Is your estimate *too little* or *too much*?

34. **GEOMETRY** You want to estimate the amount of bedding you need for your hamster cage.

   a. Estimate the area A of the hamster cage floor. Is your estimate *too little* or *too much*?

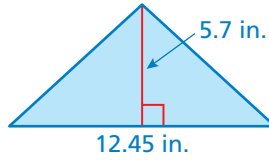   b. Use the expression $2A$ to estimate how much bedding (in cubic inches) is needed for a 2-inch layer.

17.3 in.

28.3 in.
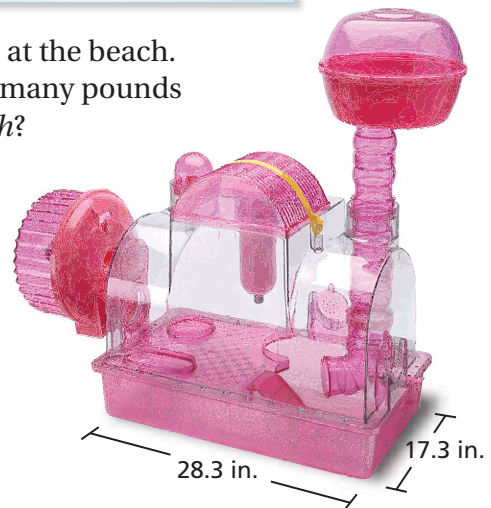
Estimate the area of the figure by rounding to the nearest whole number.

35.

4.9 m

7.3 m

36.

5.7 in.

12.45 in.

37.
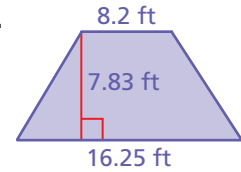

8.2 ft

7.83 ft

16.25 ft
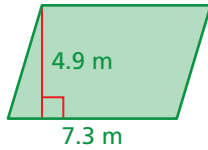
Estimate the value of the expression.

38. $6.16 \times 8.8 \div 2.91$

39. $24.45 \div 3.62 \times 5.9$

40. $35.7 \div (3.33 \times 2.37)$

41. FITNESS The table shows the number of calories burned in 5 minutes by a 90-pound person during various activities.

Activity	Calories Burned
Basketball	27.2
Inline Skating	42.6
Swimming	20.4
Tennis	23.8
Walking	21.4

a. Estimate the number of calories burned by playing basketball for 30 minutes.

b. Estimate the number of calories burned by playing tennis for 45 minutes.

c. Estimate how many more calories are burned by inline skating for 45 minutes than by walking for 60 minutes.

42. TRAVEL Your family is driving to visit friends who live about 420 miles away. Your car gets 27.3 miles per gallon of gasoline.

a. Estimate how many gallons you will use driving there *and* back.

b. **RESEARCH** Find the cost of gasoline in your neighborhood.

c. Estimate the total cost of gasoline for the trip.

43. Open-Ended Describe a real-life situation where you would want to underestimate.

![pencil icon] **Fair Game Review** What you learned in previous grades & lessons

Multiply. *(Skills Review Handbook)*

44. 21×14

45. 16×12

46. 28×11

47. 15×13

Add. *(Skills Review Handbook)*

48. $2.4 + 7.38$

49. $5.62 + 3.3$

50. $4.71 + 6.915$

51. $8.324 + 1.68$

52. MULTIPLE CHOICE A rectangular postcard measures $5\frac{3}{4}$ inches by $4\frac{1}{2}$ inches. What is the area of the postcard? *(Section 2.4)*

Ⓐ $14\frac{1}{4}$ in.^{2}

Ⓑ $14\frac{7}{8}$ in.^{2}

Ⓒ $20\frac{3}{8}$ in.^{2}

Ⓓ $25\frac{7}{8}$ in.^{2}