Lesson 7 Divide Decimals by 10, 100, and 1,000 (pp. 30–33)

Think (p. 30)

Have your student write equations and attempt to find the answer. One approach they could use is to write the division problem as a fraction and then convert the fraction to a decimal.

$$231 \div 10 = \frac{231}{10} = 23\frac{1}{10} = 21.3$$

$$231 \div 100 = \frac{231}{100} = 2\frac{31}{10} = 2.13$$

$$231 \div 1{,}000 = \frac{231}{1{,}000} = 0.231$$

Your student might instead, based on the previous lesson, think about what happens to each digit when it is divided by 10.

Answers

(a) 23.1
(b) 2.31
(c) 0.231

(Continued next page.)

Learn (pp. 30–31)

If your student was able to solve Think, they should notice that the decimal "moved" one place to the left compared to its original position when dividing by 10, and 2 or 3 places when dividing by 100 or 1,000. Learn shows why this happens using place-value material. When dividing a number by 10, each digit becomes one tenth as much, and so "moves" one place to the right in the product compared to its original position. The decimal point stays in between ones and tenths. Dividing by 100 is the same as dividing by 10 twice, and dividing by 1,000 is the same as dividing by 10 three times. The number of places the digits moves corresponds to the number of 0's in 10, 100, or 1,000.

We can achieve the same effect by thinking of "moving" the decimal point to the left 1, 2, or 3 places, since this changes the value of each digit. The decimal point is always between ones and tenths. To help with potential confusion in what direction to move the decimal point in mixed problems later, point out that since we are dividing by 10, 100, or 1,000, the answer will be less than the dividend.

Have your student answer Alex's questions. In order to move the decimal (or the digits), we may need to add a 0 for the ones place and some of the decimal places. We can optionally drop trailing 0s in the product. Have your student also find 2.3 ÷ 100 (or 2.31 ÷ 100 and 2 ÷ 1,000 if they are comfortable with decimals to the fourth decimal place).

$$2.31 \div 10 = 0.231$$

$$2{,}310 \div 1{,}000 = 2.31$$

$$2.3 \div 100 = 0.023$$

Do (pp. 32–33)

1. Discuss these problems using fractions to see what happens to the digits and the decimal point when decimals are divided by a power of ten. This will help later when students learn to divide a decimal by a decimal.

   We can express division as a fraction. So we can express 0.2 ÷ 10 as $\frac{0.2}{10}$. However, fractions should only have whole numbers for the numerator or denominator, so we need to find an equivalent fraction. We can do this by multiplying the numerator and denominator by 10: $\frac{0.2}{10} = \frac{0.2 \times 10}{10 \times 10} = \frac{2}{100}$. Then we can express the fraction as a decimal: 0.02. (Essentially, we are multiplying both the dividend and the divisor by the same number, which does not change the quotient.)

$$0.2 \div 10 = \frac{0.2}{10} = \frac{0.2 \times 10}{10 \times 10} = \frac{2}{100} = 0.02$$

$$0.02 \div 10 = \frac{0.02}{10} = \frac{0.02 \times 100}{10 \times 100} = \frac{2}{1,000} = 0.002$$

$$0.2 \div 100 = \frac{0.2}{100} = \frac{0.2 \times 10}{100 \times 10} = \frac{2}{1,000} = 0.002$$

   Effectively, by dividing both the numerator and denominator by the same power of ten, we "move" the decimal point to the left by the same amount in both the dividend and the divisor. For example:

$$0.2 \div 100 = 0.002 \div 1$$

Answers (continued)

1. (a) 0.2
   (b) 0.02
   (c) 0.002
   (d) 0.002
   (e) 0.002

2. (a) 6.5 (b) 0.65
   (c) 0.065 (d) 0.65
   (e) 0.065 (f) 0.065

3. (a) 0.803 (b) 0.062
   (c) 0.091

4. (a) 0.106 (b) 0.23 (c) 0.009
   (d) 0.635 (e) 3.046 (f) 0.007
   (g) 0.021 (h) 0.08 (i) 0.3

5. (a) Division is the same as a fraction.
   (b) $36 \div 1,000 = \frac{36}{1,000} = 0.036$
   (c) $36 \div 10 = \frac{36}{10} = 3\frac{6}{10} = 3.6$

5. This may have been how your student approached the problems in Think.

Lesson 4 Multiplying by a Decimal (pp. 56–61)

Think (p. 56)

Write the problem on a separate sheet of paper so students don't initially see the bar model. Have your student read the problem and write an expression. Ask them if the answer will be less than or greater than 2.5. Since we are finding a part of the entire weight, it will be less than 2.5. Ask them to find the answer. They can use fractions.

Answers

2.25 kg

(Continued next page.)

Learn (pp. 56–57)

Your student may have used a different method than the ones shown here.

Method 1 is likely easier for your student to understand. The two decimals are expressed as tenths. Multiplying the denominators gives a denominator of 100, so the product is hundredths, which can be expressed as a two-place decimal.

Method 2 is similar to the mental math strategies from Chapter 1, treating the two numbers as a quantity of tenths. Students should know from the previous lesson that tenths multiplied by tenths is hundredths.

For both of these methods, point out that the number of decimal places in the product is the same as the sum of the number of decimal places in the two numbers. The two numbers are both tenths, and the product is hundredths.

Your student should have been able to multiply 25 by 9 mentally. One strategy is to know that eight 25s is 200 and one more is 225. Method 3, though, shows that we can use the algorithm and write the two numbers one above the other as if they were whole numbers, and include the decimal points. We multiply the two numbers as if they were whole numbers (it is not necessary to rewrite the algorithm using whole numbers), and then determine where the decimal point should go in the product. Here, it shows that if we multiply both numbers by 10 in order to make them whole numbers, the product will be 10 × 10 times more than the actual product, so we need to divide the product by 100. The end result for this method is the same as for the first two methods: The product has the same number of decimal places as the sum of the decimal places in the two numbers.

Write the following problems vertically for your student to solve. (They can use the answer to 25 × 9 and determine where the decimal point goes any way they want.) Point out that when we multiply decimals this way, we do not worry about aligning the digits according to their place values.

$$\begin{array}{r} 0.25 \\ \times \quad 9 \\ \hline 2.25 \end{array} \qquad \begin{array}{r} 2.5 \\ \times\ 0.09 \\ \hline 0.225 \end{array} \qquad \begin{array}{r} 0.25 \\ \times \quad 0.9 \\ \hline 0.225 \end{array}$$

Do (pp. 58–61)

1. This problem uses place-value discs in a similar way as in Lessons 6–7 of Chapter 1 (as well as Lessons 3–5 in Chapter 1 of Dimensions Math® 5A) in order to emphasize the changes in value of each digit. Students should be able to solve 34 × 2 mentally.

2. The bar model shows finding a fraction of a set, rather than having a multiplier of 0.4, which is easier for students to understand visually. Students should be comfortable with expressing decimals as fractions and fractions as decimals, and with multiplying fractions. The fractions make it easier to understand the "shift" in the decimal point.

3, 4, 5. For these problems, after making both numbers whole numbers, we are multiplying by a two-digit number. Tell your student that they do not have to be concerned about the placement of the decimal point in the partial products. Estimating the product may make it easier to be sure the answer has the decimal point in the right position, but students still need to be comfortable with multiplying decimals to have the answer to their estimate be correct with regard to the place value of each digit. Point out that the products in 3 and 4 are greater than both numbers since both numbers are greater than 1. The product in 5 is less than 38 since we are multiplying 38.7 by a number less than 1.

Answers (continued)

1. (a) 6.8
   (b) 0.68

2. (a) $= \frac{15}{10} \times \frac{4}{10} = \frac{60}{100} = 0.6$
   (b) $= \frac{15}{10} \times \frac{4}{100} = \frac{60}{1{,}000} = 0.06$

3.
$$\begin{array}{r} 280 \\ \hline 204 \\ 2720 \\ \hline 292.4 \end{array}$$

4.
$$\begin{array}{r} 28 \\ \hline 540 \\ 2700 \\ \hline 32.40 \end{array}$$ or 32.4

5.
$$\begin{array}{r} 20 \\ \hline 1935 \\ 15480 \\ \hline 17.415 \end{array}$$

6. (a) 28
   (b) 0.28
   (c) 0.112
   (d) 0.018
   (e) 64.78
   (f) 1.82
   (g) 391.2
   (h) 0.04

7. (a) 3,263.4 (b) 3,263.4
   (c) 326.34 (d) 326.34
   (e) 32.634 (f) 32.634

Extension

Students will learn to divide a decimal by a decimal in Grade 6. However, they should have no trouble learning how to do so now if you are following this guide. You may want to cover it now. Students should be comfortable with writing a division as a fraction that has a decimal in the numerator and/or denominator, and then simplifying it. They should understand that this is a way of representing the idea that if you multiply or divide the dividend and the divisor by the same number, the quotient is the same.

Write the problem 1.2 ÷ 0.4 and ask your student to solve it. If they answer 0.3, mistakenly thinking in terms of 12 tenths divided by 4, ask them to justify their answer in some way, such as with a fraction bar. Using a fraction bar or a number line, you can show that if we group 12 tenths by 4 tenths, there will be 3 such groups. You can then discuss different methods, similar to those in the textbook or this guide, such as:

$$1.2 \div 0.4 = \frac{1.2}{0.4} = \frac{1.2 \times 10}{0.4 \times 10} = \frac{12}{4} = 3$$

$$1.2 \div 0.4 = \frac{12}{10} \div \frac{4}{10} = \frac{12}{10} \times \frac{10}{4} = \frac{12}{4} = 3$$

Your student should realize they can divide a decimal by a decimal in the same way as they would divide a whole number by a decimal: move the decimal point in both the dividend and the divisor by the same number of places until the divisor is a whole number.

Discuss an additional example, and also write the problem using the long division symbol.

$$3.7 \div 0.02 = \frac{3.7}{0.02} = \frac{3.7 \times 100}{0.02 \times 100} = \frac{370}{2} = 185$$

$$\begin{array}{r} 1\ 8\ 5 \\ 0\cancel{.}0\ 2\overline{)3\cancel{.}7\ 0.} \end{array}$$

Discuss the problem 9.42 ÷ 0.4, where moving the decimal point results in dividing a decimal by a whole number. Then, have your student solve 5.94 ÷ 0.7 and give the answer correct to two decimal places.

$$\begin{array}{r} 2\ 3.5\ 5 \\ 0\cancel{.}4\overline{)9\cancel{.}4.2\ 0} \end{array} \qquad 9.42 \div 0.4 = 23.55$$

$$\begin{array}{r} 2\ 8.4\ 8\ 5\ldots \\ 0\cancel{.}7\overline{)5\cancel{.}9.4\ 0\ 0} \end{array} \qquad 5.94 \div 0.7 \approx 8.49$$

You can write a few additional expressions for your student to solve. They should express the values correct to at most 3 decimal places.

- 48.9 ÷ 0.3 = 163
- 3.5 ÷ 0.06 ≈ 58.333
- 0.33 ÷ 1.2 = 0.275
- 8.925 ÷ 0.35 = 25.5

Lesson 2 Equivalent Ratios (pp. 165–168)

Think (p. 165)

Have your student read the problems and find the answers (without seeing Learn). You can write the recipe on paper and ask the questions out loud. (The serving size does not include the crushed ice.) Have counters available so your student can act out the situations, using one color to represent the lemonade and another the iced tea, if needed. Most students should be able to solve this problem easily, though, and should be able to say that for (a), the total servings is doubled, so they need to double the ingredients. For (b) they are halved, so they need to halve the ingredients.

Answers

1. (a) 6 : 9
   (b) 2 : 3
   (c) 2 : 3
2. (a) 12 : **16** (b) **6** : 8
3. 5 : 4
4. 4 : 3
5. (a) **7** : 21 (b) 3 : **4**
   (c) 15 : **6** (d) **4** : 5
6. (a) 2 : 1 (b) 5 : 1
   (c) 3 : 4 (d) 2 : 3

Learn (pp. 165–166)

The ratio given for (a) of 8 : 12 and for (b) of 2 : 3 are for when the value of a unit is 1 cup. The images should make it easy to see that for each of these, as well as for the ratio of 4 : 6 for the recipe, there are always 2 units of lemonade for 3 units of iced tea. Students should see an analogy between finding equivalent ratios and finding the simplest form of a ratio to doing the same thing with fractions. You can point out that in the recipe, there is always $\frac{2}{3}$ as much lemonade as iced tea, whether the ratio of lemonade to iced tea is 2 : 3, 4 : 6, or 8 : 12, and that $\frac{2}{3}$, $\frac{4}{6}$, and $\frac{8}{12}$ are equivalent fractions. As with fractions, we simplify a ratio such as 8 : 12 by looking for common factors. When there is no common factor for all the terms other than 1, the ratio is in simplest form.

Do (pp. 167–168)

1. You can do this activity with your student using counters, before looking at the textbook.
2. The process for finding equivalent ratios is similar to the process for finding equivalent fractions.
3. 4. As with fractions, we can simplify a ratio to its simplest form in one step using the greatest common factor, or in more than one step using any common factor. Your student can keep track of their calculations by crossing out terms in a similar manner as they did with fractions, crossing out the terms and writing the quotients.

$$\overset{\overset{4}{\cancel{28}}}{\cancel{56}} : \overset{\overset{3}{\cancel{21}}}{\cancel{42}}$$

Lesson 5 Word Problems (pp. 177–180)

Think (p. 177)

Write the problem on a separate sheet of paper and have your student solve it. Encourage them to draw a bar model. They should not have much difficulty.

Learn (p. 177)

Since we have equal units, the method of solution is similar to what students have already used in solving other word problems involving multiplication and division or fractions. Your student can compare their solution to the one shown here.

All of the problems in this lesson can be solved using a unitary approach, that is, by finding the value of 1 unit. Waiting until the final step to find the value of the division and expressing the division as a fraction can sometimes lead to being able to simplify calculations and is a good habit for capable students. In this case there isn't any advantage, but they could write 11 units $\longrightarrow 11 \times \frac{189}{3} = 11 \times 63 = 693$.

Do (pp. 178–180)

If your student is struggling, you may want to write the problems on a separate sheet of paper and guide them in drawing a model, or let them attempt to solve the problem on their own and then compare their solution to the ones in the textbook.

Answers

693

1. $135
   1 unit $\longrightarrow \frac{540}{12}$
   3 units $\longrightarrow 3 \times \frac{540}{12} = \frac{540}{4} = 135$

2. **72 silver coins**
   3 units $\longrightarrow 54$
   4 units $\longrightarrow 4 \times \frac{54}{3} = 4 \times 18 = 72$

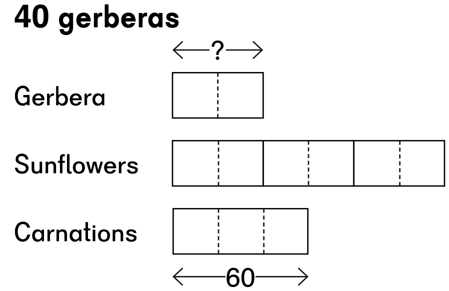
3. **210 children**
   4 units $\longrightarrow 84$
   10 units $\longrightarrow 10 \times \frac{84}{4} = 5 \times 42 = 210$

4. **30 lb**
   2 units $\longrightarrow 15$
   4 units $\longrightarrow 2 \times 15 = 30$

5. **96 cm**
   7 units $\longrightarrow 84$
   8 units $\longrightarrow 8 \times \frac{84}{7} = 8 \times 12 = 96$

6. **$68.25**
   13 units $\longrightarrow 295.75$
   1 unit $\longrightarrow 295.75 \div 13 = 22.75$
   3 units $\longrightarrow 3 \times 22.75 = 68.25$

7. **40 gerberas**



   3 units $\longrightarrow 60$
   2 units $\longrightarrow 2 \times \frac{60}{3} = 2 \times 20 = 40$

Chapter 13 Workbook Answers

❺ (a) 3 : 2 : 1 (b) 5 : 1 : 4
(c) 15 : 9 : 7 (d) 2 : 7 : 3
(e) 2 : 4 : 3 (f) 2 : 1 : 3

❻ **2 : 6 : 1**
4 tablespoons = 12 teaspoons
4 : 12 : 2 = 2 : 6 : 1

❼ **9 : 30 : 16**
$\frac{3}{4} = \frac{9}{12}$ $\quad 2\frac{1}{2} = \frac{30}{12}$ $\quad 1\frac{1}{3} = \frac{16}{12}$

9 twelfths : 30 twelfths : 16 twelfths

Exercise 5 pp. 146–149

❶ **120 red game pieces**
2 units ⟶ 48
5 units ⟶ $5 \times \frac{48}{2} = 5 \times 24 = 120$

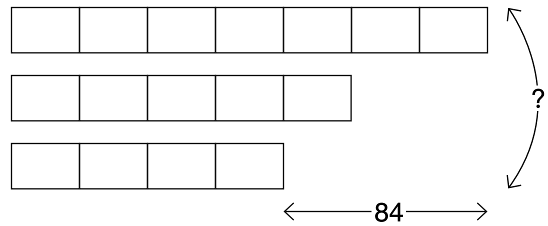
❷ (a) 4 : 6 : 5

(b) **30 dimes, 25 quarters**
4 units ⟶ 20
1 unit ⟶ 20 ÷ 4 = 5
dimes: 6 units ⟶ 6 × 5 = 30
quarters: 5 units ⟶ 5 × 5 = 25

(c) **$9.45**
(20 × 0.01) + (30 × 0.10) + (25 × 0.25)
= 0.20 + 3.00 + 6.25
= 9.45

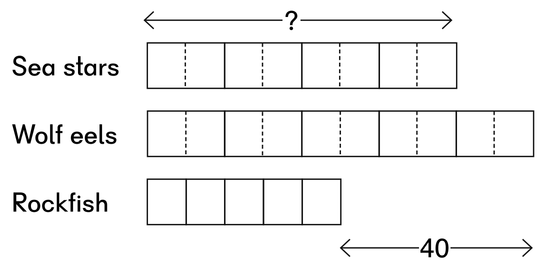
❸ **$122.50**
4 units ⟶ 98
1 unit ⟶ 98 ÷ 4 = 24.50
5 units ⟶ 5 × 24.50 = 122.50

❹ **4 m 48 cm**



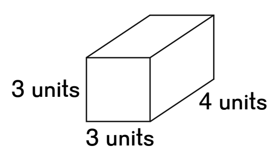
3 units ⟶ 84
16 units ⟶ $16 \times \frac{84}{3} = 16 \times 28 = 448$

❺ **64 sea stars**



5 units ⟶ 40
8 units ⟶ $8 \times \frac{40}{5} = 64$

❻ **972 cm³**
An area of 81 cm² means that the square face has sides equal to 9 cm.



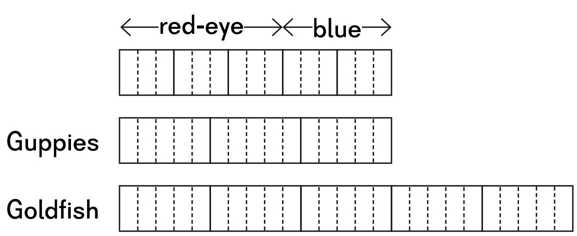
3 units ⟶ 9
4 units ⟶ $4 \times \frac{9}{3} = 12$
81 cm² × 12 cm = 972 cm³

❼ **8 cm**
Area of Triangle ABC: $\frac{1}{2} \times 6 \times 6 = 18$
9 : 10 = 18 : 20
Area of Triangle DEF: $\frac{1}{2} \times 5 \times \text{height} = 20$
5 × height = 40
height = 8

Chapter 13 Workbook Answers

8 **9 : 6 : 25**

The ratio of the two kinds of guppies is 3 : 2, which is a total of 5 units. The ratio of total guppies to goldfish is 3 : 5. We need to divide up the 5 units for the total guppies and the 3 units of guppies in the total guppies to goldfish to have equal units. We can use a common multiple of 5 and 3, 15. Then the total guppies is 15 units.



guppies : goldfish = 3 : 5 = 15 : 25
red-eye : blue = 3 : 2 = 9 : 6 (total is 15)
red-eye : blue : goldfish = 9 : 6 : 25

Exercise 6 pp. 150–154

1
(a) 6 : 19
(b) 6 : 25
(c) 6 : 7 : 12
(d) **5 : 6 : 3**
10 : 12 : 6 = 5 : 6 : 3

2
(a) 21 : **18**
(b) **16** : **32** : 48
(c) 28 : **48**
(d) **8** : 11 : **4**

3 **28 : 35**

Find simplest form of each to compare.

63 : 84	51 : 68	28 : 35	75 : 100
= 3 : 4	= 3 : 4	= 4 : 5	= 3 : 4

4
(a) 8 : 3
(b) 5 : 2 : 4
(c) 13 : 5
(d) 13 : 41 : 7

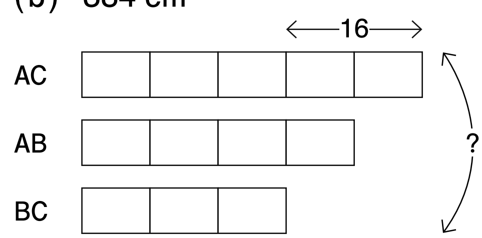
5 **Mixture A**
It has less blue paint for equal parts white paint than Mixture B.
Mixture A:
blue : white = 4 : 5 = 8 : 10
Mixture B:
blue : white = 9 : 10

6 **$5\frac{1}{3}$ c of water**

$4 \times 1\frac{1}{3} = 4 + \frac{4}{3} = 5\frac{1}{3}$

7 **156,000 kg**
30 units ⟶ 360,000
1 unit ⟶ 360,000 ÷ 30 = 12,000
13 units ⟶ 13 × 12,000 = 156,000
30 : 13 = 360,000 : 156,000

8
(a) 96 cm
(b) 384 cm²



2 units ⟶ 16
1 unit ⟶ 16 ÷ 2 = 8
Perimeter: 12 units ⟶ 12 × 8 = 96
BC: 3 units ⟶ 3 × 8 = 24
AB: 4 units ⟶ 4 × 8 = 32
Area: $\frac{1}{2} \times 32 \times 24 = 384$

Notes

Rate

A rate is used to express the relative sizes of two or more quantities when the units of measurement are not the same. Rates are often expressed as one quantity per unit of another quantity. If that is the case, the rate is called a unit rate. Examples of unit rates include miles per hour, dollars per hour, gallons per mile, and dollars per kilogram. Rate does not have to be expressed as a unit rate. A cost of $50 per 20 pounds is a rate, but finding another value at the same rate generally involves finding the unit rate.

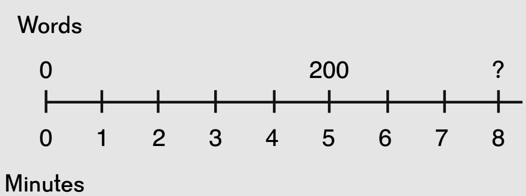
Students have already seen many examples of rate, particularly in word problems that involve multiplication or division. Conversion factors are essentially rates, e.g. 12 inches per foot. The cost of items can be expressed as a rate. For example, monthly car payments of $324 is a rate of $324 per month. Often earlier experience with rate problems involved cases where the quantity for each unit is a constant. There are 12 inches in every foot, or the payment is $324 every month. Some of the rates that students will encounter in this chapter involve average rates. For example, speed is given as an average rate. A speed of 100 kilometers per hour means that the speed were averaged over the time period, not that every hour the car goes exactly 100 kilometers. Students will cover average speed more fully in Grade 6.

Word Problems

For whole numbers, fractions, and ratio problems, students learned to draw bar models to diagram the pertinent information. Often, the solution involved initially finding the value of 1 unit. This unitary approach will also be used in solving rate problems in this chapter. Rather than drawing bar models, though, students will learn they can use a simplified double number line where they show the relationship they know and the one they need to find. This line model should help students keep track of the information in the problem, set up the problem correctly, and see if their answer makes sense.

For the following problem, a double number line is used to model the information.

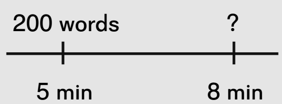
Simon can type 200 words in 5 minutes. How many words can he type in 8 minutes?



In order to solve this problem, we need to determine the interval, or value of 1 unit, for the top number line (the number of words for 1 minute). To do this, we divide 200 by 5. Then we can find the missing value (the number of words for 8 minutes) by multiplying that unit value by 8.

Students are already familiar with this unitary approach. Instead of a detailed number line, though, they can draw a simple line model to help them keep track of the relationship they know, and what they need to find. It is also more feasible for greater numbers. They can use the familiar "arrow" expression (units $\longrightarrow$) to help determine what calculations to perform.

Simon can type 200 words in 5 minutes. How many words can he type in 8 minutes?



5 min $\longrightarrow$ 200 words
1 min $\longrightarrow$ $200 \div 5 = 40$ words
8 min $\longrightarrow$ $8 \times 40 = 320$
Simon can type 320 words in 8 minutes.

Since we know the number of words for 5 minutes and need to find the number of words for 8 minutes, we start with the relationship 5 min $\longrightarrow$ 200 words. The number of minutes is on the left-hand side of the arrow "expression," since we need to find a number of words for 1 minute. That way it is easier to write the calculations for the value we need to find.

Although the unknown value is often shown in the textbook at the top of the number line, it is not required. For example:

A machine can produce 65 cans of soda in 4 minutes. How long will it take to produce 1,300 cans?

65 cans $\longrightarrow$ 4 min
1 can $\longrightarrow$ $\frac{4}{65}$ min
1,300 cans $\longrightarrow$ $1{,}300 \times \frac{4}{65} = 80$ min
It will take 80 minutes to produce 1,300 cans.

We know both values for the number of cans. To find the unknown value, we need to find the number of minutes for 1 can. So we put the number of cans on the left-hand side of the arrow.

In the U.S., textbooks often teach students to set up this type of problem as a proportion, and then to "cross multiply" before they have even learned to solve algebraic fractions. Using a unitary approach allows students a better understanding of the concepts and provides continuity with the approach used in solving other word problems, including percentage problems in the next chapter. It lays a foundation for proportional reasoning in later grades.

Lesson 2 Rate Problems — Part 1 (pp. 187–189)

Think (p. 187)

Have your student read the problems and attempt to find the answer (without seeing Learn) any way they want. Mei is giving them a hint: find how much Jessica is paid per hour first.

Answers

$896

(Continued next page.)

Learn (p. 187)

To find how much Jessica would earn working 40 hours, we need to find how much she earns per hour. Your student should see a similarity to many problems they have done before. If they find the value for 1 unit, in this case pay per hour, they can find the value of any number of units.

Tell your student that drawing a quick line model can help keep track of the relationships between quantities and what we know and what we want to find. A bar model is not as feasible, since that would require drawing 40 units in this case. Discuss the model in the textbook. One type of value (dollars) goes on one side of the line and the other (hours) on the other side. We start with a tick mark for the relationship between the two numbers we know ($560 and 25 h). Since we want to find the value for 40 h, we draw another tick mark to the right of the first tick mark. This model also shows a tick mark for 1 h to the left, since we need to find that first (later, students won't need to draw this tick mark). We don't need to worry about the distance between the values, just that greater values are to the right of lesser values.

Since we need to find the dollars for 1 hour, we write the number of hours on the left side of the arrow and the number of dollars on the right side for the relationship we know. We do the same calculations for both sides, first to find the number of dollars for 1 hour and then for 40 hours (but we don't need to show the expressions for the left side).

$$\begin{tikzcd}
25\text{ h} \arrow[r] \arrow[d, bend right, "\div 25"'] & \$560 \arrow[d, bend left, "\div 25"] \\
1\text{ h} \arrow[r] \arrow[d, bend right, "\times 40"'] & \$22.40 \arrow[d, bend left, "\times 40"] \\
40\text{ h} \arrow[r] & \$896
\end{tikzcd}$$

Dion is combining steps in one expression, and not finding the value for 1 hour immediately, which allows him to simplify the calculation. Encourage your student to write the division as a fraction.

You can tell (or remind) your student that they can show intermediate steps as a fraction and simplify, even if the numerator is not a whole number. For example:

$$\begin{aligned} 12 &\longrightarrow 3.6 \\ 2 &\longrightarrow 2 \times \frac{3.6}{12} = \frac{3.6}{6} = 0.6 \end{aligned}$$

<u>Do</u> (pp. 188–189)

1 2 These problems are similar to the one in <u>Learn</u>. Since we need to find the values for 1 min or for 1 gal, we write minutes or gallons on the left side of the arrow, first writing the relationship we know.

3 Emma is thinking of a simple line model which shows what information she knows, what she needs to find, and the relationship between the numbers, but does not include a tick mark for 1 second. We need to find the number of beats for 60 seconds, so we can use the number of beats for 15 seconds to first find the number of beats for 1 second. In setting up the arrow diagram, we put seconds on the left for the relationship we know, since we will find the unit value for seconds. In this case, it does not make sense to convert $\frac{19}{15}$ to a mixed number first (or try to first divide 19 by 15, which is a non-terminating decimal).

5 You may want to have your student solve 5 before 4, since a line model is provided and no conversion is needed. We know the dollars for 40 hours and need to find the dollars for 35 hours. Line models are similar to number lines, and the values should increase when going to the right. Unlike the previous problems in this lesson, the unknown is now on the left, rather than the right. Drawing the line model can help students know if their answer makes sense. The value they find needs to be less than \$750.

Answers (continued)

1 **25** words

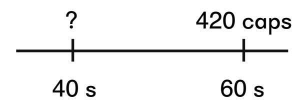
15 × **25** = **375** words

2 **41** mi

17.4 × **41** = **713.4** miles

3 **76** beats

4 **280 bottle caps**



$$\begin{aligned} 60\text{ s} &\longrightarrow 420\text{ caps} \\ 1\text{ s} &\longrightarrow \frac{420}{60}\text{ caps} \\ 40\text{ s} &\longrightarrow 40 \times \frac{420}{60} = 280\text{ caps} \end{aligned}$$

5 **\$656.25**

$$\begin{aligned} 40\text{ h} &\longrightarrow \$750 \\ 1\text{ h} &\longrightarrow \$\frac{750}{40} \\ 35\text{ h} &\longrightarrow 35 \times \frac{750}{40} \\ &= 7 \times \frac{750}{8} \\ &= 7 \times 93.75 \\ &= \$656.25 \end{aligned}$$

4 Have your student draw a line model for this problem. They have to realize that they need to convert 1 minute to seconds. 40 seconds is less than 1 minute, so if they first draw a tick mark for 420 caps and 60 s, the one for 40 s should go to the left of that. The unit rate they need is bottle caps per second, as Alex is hinting. They can find the unit rate of 7 caps per second, which is an easy calculation, or simplify $40 \times \frac{420}{60}$ to 2×140.

Chapter 14 Workbook Answers

Exercise 1 pp. 155–157

1. **90** pages
   90 ÷ 5 = **18** pages
   18 pages per minute

2. **69** mm
   69 mm
   69 ÷ 30 = **2.3** mm
   2.3 mm per day

3. **42 words per minute**
   $630 \div 15 = \frac{630}{15} = \frac{126}{3} = 42$

4. **35 miles per gallon**
   $210 \div 6 = \frac{210}{6} = \frac{70}{2} = 35$

5. **$22.50 per hour**
   $900 \div 40 = \frac{90}{4} = \frac{45}{2} = 22.50$

6. **0.08 miles per minute**
   5 h 25 min = 325 min
   $26 \div 325 = \frac{26}{325} = 0.08$

7. **Shampoo B**
   1 pt = 16 fl oz
   Shampoo A:
   38 ÷ 16 = 2.375; About $2.38 per ounce
   Shampoo B:
   9 ÷ 4.5 = 2; $2 per ounce

8. **24 gallons per minute**
   $\frac{3}{4} \times 11{,}840 = 3 \times 2{,}960 = 8{,}880$
   6 h 10 min = 370 min
   $\frac{8{,}880}{370} = \frac{888}{37} = 24$

Exercise 2 pp. 158–160

1. (a) **336** pages
   $\frac{\mathbf{336}}{12} = \mathbf{28}$ pages
   $50 \times \mathbf{28} = 1{,}400$
   $\left(\frac{336}{12} = \frac{168}{6} = \frac{84}{3} = 28\right)$

   (b) **675** pages
   $\frac{\mathbf{675}}{30}$ pages
   $\frac{\mathbf{675}}{30} \times 12 = 270$
   $\left(\frac{675}{30} \times 12 = \frac{675}{5} \times 2 = 135 \times 2\right)$

   (c) The laser printer is faster. It prints more pages in 12 minutes.

2. **240 flashes**
   4 × 60 = 240

3. **21 mi**
   4 h $\longrightarrow$ 14 mi
   1 h $\longrightarrow \frac{14}{4}$
   6 h $\longrightarrow 6 \times \frac{14}{4} = 21$ mi

4. **21 mi**
   25 min $\longrightarrow$ 400 bags
   1 min $\longrightarrow \frac{400}{25}$
   120 min $\longrightarrow 120 \times \frac{400}{25} = 1{,}920$ bags

5. **$160**
   3.5 h $\longrightarrow$ $70
   1 h $\longrightarrow \$70 \div 3.5 = \frac{700}{35} = \frac{100}{5} = \$20$
   8 h $\longrightarrow 8 \times \$20 = \$160$

Chapter 14 Workbook Answers

6 **9 cm**

21 h 36 min = 1,296 min

$4 \text{ min} \longrightarrow 1{,}000 \text{ mL}$

$1{,}296 \text{ min} \longrightarrow 1{,}296 \times \frac{1{,}000}{4}$

$= 324 \times 1{,}000$

$= 324{,}000 \text{ mL}$

base area:

$100 \text{ cm} \times 90 \text{ cm} = 9{,}000 \text{ cm}^2$

height of water:

$\frac{324}{9} = 36 \text{ cm}$

45 cm – 36 cm = 9 cm

Exercise 3 pp. 161–163

1 (a) **144** hours

144 hours

$\mathbf{\frac{144}{8}} = \mathbf{18}$ hours

$(\frac{144}{8} = \frac{72}{4} = \frac{36}{2} = 18)$

(b) **8** cars

$\mathbf{\frac{8}{6}} = \mathbf{\frac{4}{3}}$ cars

$15 \times \mathbf{\frac{4}{3}} = 20$ cars

2 $\mathbf{\frac{3}{4}}$ **hours or 45 minutes**

$6 \text{ miles} \longrightarrow 1 \text{ h}$

$1 \text{ mile} \longrightarrow \frac{1}{6} \text{ h}$

$4\frac{1}{2} \text{ miles} \longrightarrow 4\frac{1}{2} \times \frac{1}{6} = \frac{3}{4} \text{ h} = 45 \text{ min}$

or:

$6 \text{ miles} \longrightarrow 60 \text{ min}$

$1 \text{ mile} \longrightarrow 10 \text{ min}$

$4\frac{1}{2} \text{ miles} \longrightarrow \frac{9}{2} \times 10 = 45 \text{ min}$

3 $\mathbf{\frac{3}{4}}$ **pounds**

$\$16 \longrightarrow 1 \text{ pound}$

$\$\ 1 \longrightarrow \frac{1}{16} \text{ pound}$

$\$12 \longrightarrow 12 \times \frac{1}{16} = \frac{3}{4} \text{ pound}$

4 (a) **80 ft**

$\$12.50 \longrightarrow 50 \text{ ft}$

$\$\ 1 \longrightarrow \frac{50}{12.50} = \frac{500}{125} = 4 \text{ ft}$

$\$20 \longrightarrow 20 \times 4 = 80 \text{ ft}$

(b) **$164**

$50 \text{ ft} \longrightarrow \$12.50$

$1 \text{ ft} \longrightarrow \frac{12.50}{50} = \frac{125}{500} = \frac{1}{4}$

$656 \text{ ft} \longrightarrow 656 \times \frac{1}{4} = \$164$

5 (a) $\mathbf{3\frac{1}{3}}$ **s**

300,000,000 m = 300,000 km

$300{,}000 \text{ km} \longrightarrow 1 \text{ s}$

$100{,}000 \text{ km} \longrightarrow \frac{1}{3}\text{s}$

$1{,}000{,}000 \text{ km} \longrightarrow 10 \times \frac{1}{3} = 3\frac{1}{3}\text{s}$

(b) **8 min 20 s**

$1 \text{ million km} \longrightarrow \frac{10}{3} \text{ s}$

$150 \text{ million km} \longrightarrow 150 \times \frac{10}{3} = 500 \text{ s}$

$60 \text{ s} \longrightarrow 1 \text{ min}$

$500 \text{ s} \longrightarrow \frac{500}{60} = 8\frac{1}{3} \text{ min}$

$8\frac{1}{3} \text{ min} = 8 \text{ min } 20 \text{ s}$

6 (a) **7.5 h**

It takes 1 worker 9 times as long to finish a job as 9 workers. 12 workers will take one twelfth as long as 1 worker.

$9 \text{ workers} \longrightarrow 10 \text{ hours}$

$1 \text{ worker} \longrightarrow 9 \times 10 \text{ hours} = 90 \text{ h}$

$12 \text{ workers} \longrightarrow \frac{90}{12} = 7.5 \text{ h}$

(This is an inverse relationship rather than a direct relationship.)

(b) **15 workers**

$90 \text{ h} \longrightarrow 1 \text{ worker}$

$1 \text{ h} \longrightarrow 90 \text{ workers}$

$6 \text{ h} \longrightarrow \frac{90}{6} = 15 \text{ workers}$