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Unit 5, Lesson 4: Adding and Subtracting Decimals with Many Non-Zero Digits

Let's practice adding and subtracting decimals.

4.1: The Cost of a Photo Print

1. Here are three ways to write a subtraction calculation. What do you notice? What do you wonder?

$$\begin{array}{ccccc} & 5 & & & \\ - & 0 & . & 1 & 7 \\ \hline \end{array} \qquad \begin{array}{ccccc} & & & 5 & \\ - & 0 & . & 1 & 7 \\ \hline \end{array} \qquad \begin{array}{ccccc} & & & & 5 \\ - & 0 & . & 1 & 7 \\ \hline \end{array}$$

2. Clare bought a photo for 17 cents and paid with a $5 bill. Look at the previous question. Which way of writing the numbers could Clare use to find the change she should receive? Be prepared to explain how you know.

3. Find the amount of change that Clare should receive. Show your reasoning, and be prepared to explain how you calculate the difference of 0.17 and 5.

4.2: Decimals All Around

1. Find the value of each expression. Show your reasoning.

   a. $11.3 - 9.5$ b. $318.8 - 94.63$ c. $0.02 - 0.0116$

2. Discuss with a partner:

   - Which method or methods did you use in the previous question? Why?
   - In what ways were your methods effective? Was there an expression for which your methods did not work as well as expected?

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3. Lin’s grandmother ordered needles that were 0.3125 inches long to administer her medication, but the pharmacist sent her needles that were 0.6875 inches long. How much longer were these needles than the ones she ordered? Show your reasoning.

4. There is 0.162 liter of water in a 1-liter bottle. How much more water should be put in the bottle so it contains exactly 1 liter? Show your reasoning.

5. One micrometer is 1 millionth of a meter. A red blood cell is about 7.5 micrometers in diameter. A coarse grain of sand is about 70 micrometers in diameter. Find the difference between the two diameters in *meters*. Show your reasoning.

4.3: Missing Numbers

Write the missing digits in each calculation so that the value of each sum or difference is correct. Be prepared to explain your reasoning.

1.
$$\begin{array}{r} 0.4\ 0\ 4 \\ +\ \square\,\square\,\square\,\square \\ \hline 1 \end{array}$$

2.
$$\begin{array}{r} 9.8\ 7\ 6\ 5 \\ +\ \square\,\square\,\square\,\square\,\square\,\square \\ \hline 1\ 0 \end{array}$$

3.
$$\begin{array}{r} 0.7 \\ -\ \square\,\square\,\square\,\square \\ \hline 0.0\ 1\ 2 \end{array}$$

4.
$$\begin{array}{r} 7 \\ -\ \square\,\square\,\square\,\square\,\square \\ \hline 3.4\ 5\ 6\ 7 \end{array}$$

5.
$$\begin{array}{r} 7\ 0 \\ -\ \square\,\square\,\square\,\square\,\square\,\square \\ \hline 0.0\ 0\ 8\ 9 \end{array}$$

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Are you ready for more?

In a cryptarithmetic puzzle, the digits 0-9 are represented using the first 10 letters of the alphabet. Use your understanding of decimal addition to determine which digits go with the letters A, B, C, D, E, F, G, H, I, and J. How many possibilities can you find?

$$\begin{array}{r} \mathrm{IHF.IJ} \\ +\,\mathrm{JII.FI} \\ \hline \mathrm{EJI.IE} \end{array}$$

Lesson 4 Summary

Base-ten diagrams work best for representing subtraction of numbers with few non-zero digits, such as $0.16 - 0.09$. For numbers with many non-zero digits, such as $0.25103 - 0.04671$, it would take a long time to draw the base-ten diagram. With vertical calculations, we can find this difference efficiently.

Thinking about base-ten diagrams can help us make sense of this calculation.

$$\begin{array}{rcccccc} & & & & & 10 & \\ & & & & 4 & \cancel{0} & 10 \\ & 0\,. & 2 & \cancel{5} & \cancel{1} & \cancel{0} & 3 \\ - & 0\,. & 0 & 4 & 6 & 7 & 1 \\ \hline & 0\,. & 2 & 0 & 4 & 3 & 2 \end{array}$$

The thousandth in 0.25103 is unbundled (or decomposed) to make 10 ten-thousandths so that we can subtract 7 ten-thousandths. Similarly, one of the hundredths in 0.25103 is unbundled (or decomposed) to make 10 thousandths.

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1. For each subtraction problem, circle the correct calculation.

a. $7.2 - 3.67$

b. $16 - 1.4$

a.

$$\begin{array}{r} 7.2 \\ -\,3.67 \\ \hline 3.05 \end{array} \qquad \begin{array}{r} 07.2 \\ -\,3.67 \\ \hline 3.05 \end{array} \qquad \begin{array}{r} 7.20 \\ -\,3.67 \\ \hline 3.53 \end{array}$$

b.

$$\begin{array}{r} 16 \\ -\;\;1.4 \\ \hline 0.2 \end{array} \qquad \begin{array}{r} 16.0 \\ -\,1.40 \\ \hline 0.20 \end{array} \qquad \begin{array}{r} 16.0 \\ -\;\;1.4 \\ \hline 14.6 \end{array}$$

2. Explain how you could find the difference of 1 and 0.1978.

3. A bag of chocolates is labeled to contain 0.384 pound of chocolates. The actual weight of the chocolates is 0.3798 pound.

   a. Are the chocolates heavier or lighter than the weight stated on the label? Explain how you know.

   b. How much heavier or lighter are the chocolates than stated on the label? Show your reasoning.

4. Complete the calculations so that each shows the correct sum.

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a.

$$\begin{array}{r} 1.0\,3\,6 \\ +\ \square\,\square\,\square\,\square \\ \hline 4 \end{array}$$

b.

$$\begin{array}{r} 0.7\,3\,8 \\ +\ \square\,\square\,\square\,\square \\ \hline 1 \end{array}$$

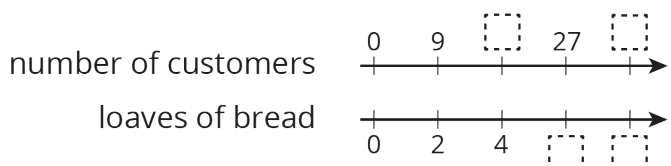
c.

$$\begin{array}{r} 0.5\,1\,3\,7 \\ +\ \square\,\square\,\square\,\square\,\square \\ \hline 1 \end{array}$$

5. A shipping company is loading cube-shaped crates into a larger cube-shaped container. The smaller cubes have side lengths of $2\frac{1}{2}$ feet, and the larger shipping container has side lengths of 10 feet. How many crates will fit in the large shipping container? Explain your reasoning.

(from Unit 4, Lesson 14)

6. For every 9 customers, the chef prepares 2 loaves of bread. Here is double number line showing varying numbers of customers and the loaves prepared.



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a. Complete the missing information.

b. The same information is shown on a table. Complete the missing information.

customers	loaves
9	2
	4
27	
	14
1	

(from Unit 2, Lesson 13)

c. Use either representation to answer these questions.

- How many loaves are needed for 63 customers?
- How many customers are there if the chef prepares 20 loaves?
- How much of a loaf is prepared for each customer?

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Unit 5, Lesson 5: Decimal Points in Products

Let's look at products that are decimals.

5.1: Multiplying by 10

1. In which equation is the value of x the largest?

   $x \cdot 10 = 810$ $\quad$ $x \cdot 10 = 81$ $\quad$ $x \cdot 10 = 8.1$ $\quad$ $x \cdot 10 = 0.81$

2. How many times the size of 0.81 is 810?

5.2: Fractionally Speaking: Powers of Ten

Work with a partner to answer the following questions. One person should answer the questions labeled "Partner A," and the other should answer those labeled "Partner B." Then compare the results.

1. Find each product or quotient. Be prepared to explain your reasoning.

   Partner A

   a. $250 \cdot \frac{1}{10}$

   b. $250 \cdot \frac{1}{100}$

   c. $48 \div 10$

   d. $48 \div 100$

   Partner B

   a. $250 \div 10$

   b. $250 \div 100$

   c. $48 \cdot \frac{1}{10}$

   d. $48 \cdot \frac{1}{100}$

2. Use your work in the previous problems to find $720 \cdot (0.1)$ and $720 \cdot (0.01)$. Explain your reasoning.

Pause here for a class discussion.

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3. Find each product. Show your reasoning.

   a. $36 \cdot (0.1)$

   b. $(24.5) \cdot (0.1)$

   c. $(1.8) \cdot (0.1)$

   d. $54 \cdot (0.01)$

   e. $(9.2) \cdot (0.01)$

4. Jada says: “If you multiply a number by 0.001, the decimal point of the number moves three places to the left.” Do you agree with her statement? Explain your reasoning.

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5.3: Fractionally Speaking: Multiples of Powers of Ten

1. Select **all** expressions that are equivalent to $(0.6) \cdot (0.5)$. Be prepared to explain your reasoning.

   a. $6 \cdot (0.1) \cdot 5 \cdot (0.1)$

   b. $6 \cdot (0.01) \cdot 5 \cdot (0.1)$

   c. $6 \cdot \frac{1}{10} \cdot 5 \cdot \frac{1}{10}$

   d. $6 \cdot \frac{1}{1,000} \cdot 5 \cdot \frac{1}{100}$

   e. $6 \cdot (0.001) \cdot 5 \cdot (0.01)$

   f. $6 \cdot 5 \cdot \frac{1}{10} \cdot \frac{1}{10}$

   g. $\frac{6}{10} \cdot \frac{5}{10}$

2. Find the value of $(0.6) \cdot (0.5)$. Show your reasoning.

3. Find the value of each product by writing and reasoning with an equivalent expression with fractions.

   a. $(0.3) \cdot (0.02)$

   b. $(0.7) \cdot (0.05)$

Are you ready for more?

Ancient Romans used the letter I for 1, V for 5, X for 10, L for 50, C for 100, D for 500, and M for 1,000.

Write a problem involving merchants at an agora, an open-air market, that uses multiplication of numbers written with Roman numerals.

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Lesson 5 Summary

We can use fractions like $\frac{1}{10}$ and $\frac{1}{100}$ to reason about the location of the decimal point in a product of two decimals.

Let's take $24 \cdot (0.1)$ as an example. There are several ways to find the product:

- We can interpret it as 24 groups of 1 tenth (or 24 tenths), which is 2.4.
- We can think of it as $24 \cdot \frac{1}{10}$, which is equal to $\frac{24}{10}$ (and also equal to 2.4).
- Multiplying by $\frac{1}{10}$ has the same result as dividing by 10, so we can also think of the product as $24 \div 10$, which is equal to 2.4.

Similarly, we can think of $(0.7) \cdot (0.09)$ as 7 tenths times 9 hundredths, and write:

$$\left(7 \cdot \frac{1}{10}\right) \cdot \left(9 \cdot \frac{1}{100}\right)$$

We can rearrange whole numbers and fractions:

$$(7 \cdot 9) \cdot \left(\frac{1}{10} \cdot \frac{1}{100}\right) = 63 \cdot \frac{1}{1{,}000} = \frac{63}{1{,}000}$$

This tells us that $(0.7) \cdot (0.09) = 0.063$.

Here is another example: To find $(1.5) \cdot (0.43)$, we can think of 1.5 as 15 tenths and 0.43 as 43 hundredths. We can write the tenths and hundredths as fractions and rearrange the factors.

$$\left(15 \cdot \frac{1}{10}\right) \cdot \left(43 \cdot \frac{1}{100}\right) = 15 \cdot 43 \cdot \frac{1}{1{,}000}$$

Multiplying 15 and 43 gives us 645, and multiplying $\frac{1}{10}$ and $\frac{1}{100}$ gives us $\frac{1}{1{,}000}$. So $(1.5) \cdot (0.43)$ is $645 \cdot \frac{1}{1{,}000}$, which is 0.645.

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Unit 5, Lesson 5: Decimal Points in Products

1. a. Find the product of each number and $\frac{1}{100}$.

   122.1 11.8 1350.1 1.704

   b. What happens to the decimal point of the original number when you multiply it by $\frac{1}{100}$? Why do you think that is? Explain your reasoning.

2. Which expression has the same value as $(0.06) \cdot (0.154)$? Select **all** that apply.

   A. $6 \cdot \frac{1}{100} \cdot 154 \cdot \frac{1}{1,000}$
   B. $6 \cdot 154 \cdot \frac{1}{100,000}$
   C. $6 \cdot (0.1) \cdot 154 \cdot (0.01)$
   D. $6 \cdot 154 \cdot (0.00001)$
   E. 0.00924

3. Calculate the value of each expression by writing the decimal factors as fractions, then writing their product as a decimal. Show your reasoning.

   a. $(0.01) \cdot (0.02)$

   b. $(0.3) \cdot (0.2)$

   c. $(1.2) \cdot 5$

   d. $(0.9) \cdot (1.1)$

   e. $(1.5) \cdot 2$

4. Write three numerical expressions that are equivalent to $(0.0004) \cdot (0.005)$.

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5. Calculate each sum.

   a. $33.1 + 1.95$　　b. $1.075 + 27.105$　　c. $0.401 + 9.28$

   (from Unit 5, Lesson 3)

6. Calculate each difference. Show your reasoning.

   a. $13.2 - 1.78$　　b. $23.11 - 0.376$　　c. $0.9 - 0.245$

   (from Unit 5, Lesson 4)

7. On the grid, draw a quadrilateral *that is not a rectangle* that has an area of 18 square units. Show how you know the area is 18 square units.

   (from Unit 1, Lesson 3)