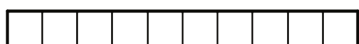


# Lesson 2: Using Diagrams to Represent Addition and Subtraction

Let's represent addition and subtraction of decimals.

## 2.1: Changing Values

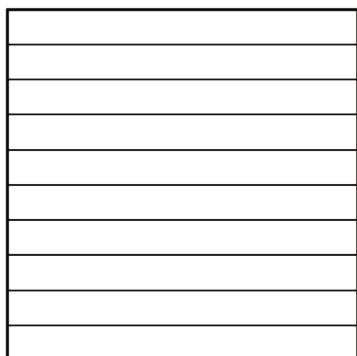
1. Here is a rectangle.



What number does the rectangle represent if each small square represents:

- a. 1
- b. 0.1
- c. 0.01
- d. 0.001

2. Here is a square.



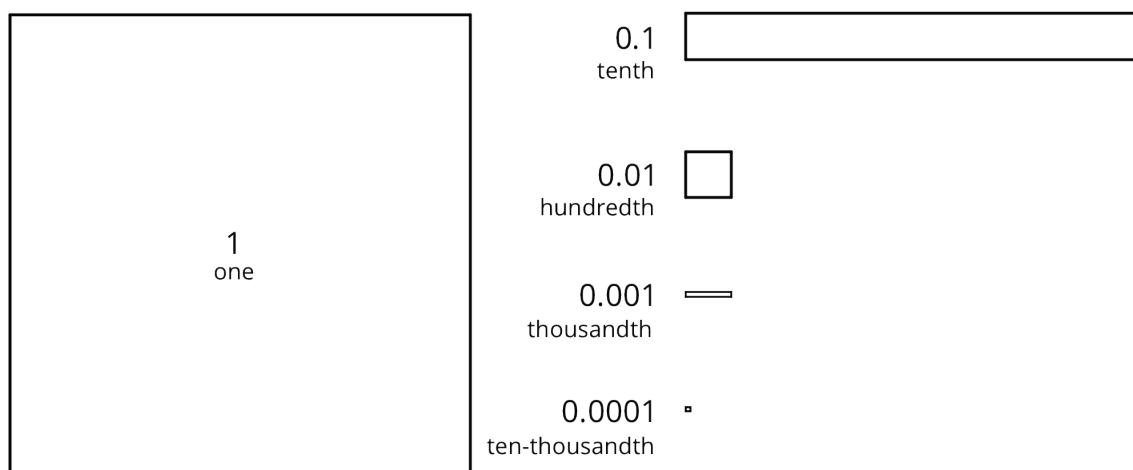
What number does the square represent if each small rectangle represents:

- a. 10
- b. 0.1
- c. 0.00001

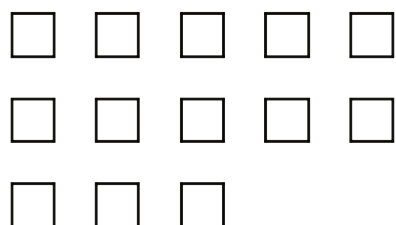
## 2.2: Squares and Rectangles

You may be familiar with base-ten blocks that represent ones, tens, and hundreds. Here are some diagrams that we will use to represent base-ten units.

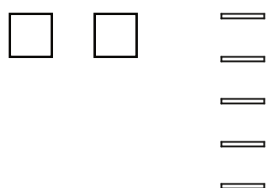
- A large square represents 1 one.
- A medium rectangle represents 1 tenth.
- A medium square represents 1 hundredth.
- A small rectangle represents 1 thousandth.
- A small square represents 1 ten-thousandth.



1. Here is the diagram that Priya drew to represent 0.13. Draw a different diagram that represents 0.13. Explain why both diagrams represent the same number.



2. Here is the diagram that Han drew to represent 0.025. Draw a different diagram that represents 0.025. Explain why both diagrams represent the same number.



3. For each number, draw or describe two different diagrams that represent it.

a. 0.1

b. 0.02

c. 0.004

4. Use diagrams of base-ten units to represent each sum. Think about how you could use as few units as possible to represent each number.

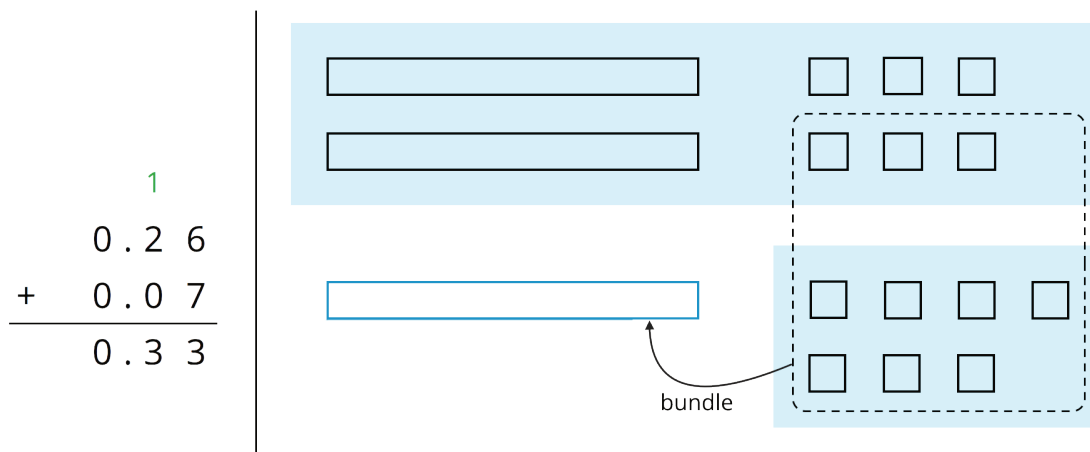
a.  $0.03 + 0.05$

b.  $0.006 + 0.007$

c.  $0.4 + 0.7$

## 2.3: Finding Sums in Different Ways

1. Here are two ways to calculate the value of  $0.26 + 0.07$ . In the diagram, each rectangle represents 0.1 and each square represents 0.01.



Use what you know about base-ten units and addition to explain:

- Why ten squares can be “bundled” into a rectangle.
  - How this “bundling” is represented in the vertical calculation.
2. Find the value of  $0.38 + 0.69$  by drawing a diagram. Can you find the sum without bundling? Would it be useful to bundle some pieces? Explain your reasoning.
3. Calculate  $0.38 + 0.69$ . Check your calculation against your diagram in the previous question.

4. Find each sum. The larger square represents 1.

a.

b.

$$\begin{array}{r} 6.03 \\ + 0.098 \\ \hline \end{array}$$

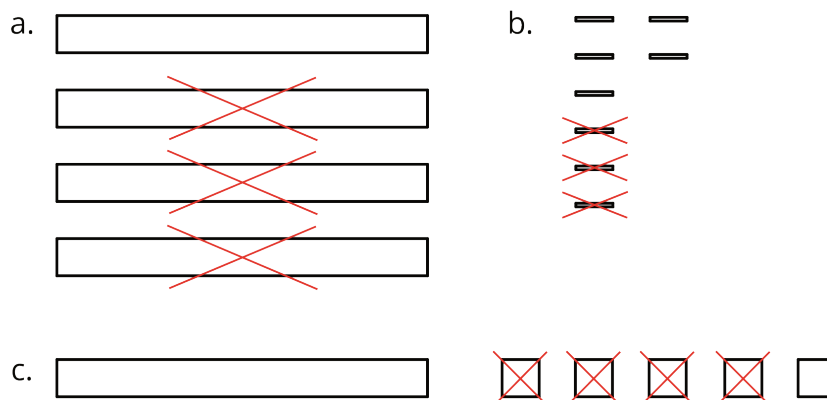
**Are you ready for more?**

A distant, magical land uses jewels for their bartering system. The jewels are valued and ranked in order of their rarity. Each jewel is worth 3 times the jewel immediately below it in the ranking. The ranking is red, orange, yellow, green, blue, indigo, and violet. So a red jewel is worth 3 orange jewels, a green jewel is worth 3 blue jewels, and so on.

1. If you had 500 violet jewels and wanted to trade so that you carried as few jewels as possible, which jewels would you have?
  
2. Suppose you have 1 orange jewel, 2 yellow jewels, and 1 indigo jewel. If you're given 2 green jewels and 1 yellow jewels, what is the fewest number of jewels that could represent the value of the jewels you have?

## 2.4: Representing Subtraction

1. Here are diagrams that represent differences. Removed pieces are marked with Xs. The larger rectangle represents 1 tenth. For each diagram, write a numerical subtraction expression and determine the value of the expression.



2. Express each subtraction in words.

a.  $0.05 - 0.02$

b.  $0.024 - 0.003$

c.  $1.26 - 0.14$

3. Find each difference by drawing a diagram and by calculating with numbers. Make sure the answers from both methods match. If not, check your diagram and your numerical calculation.

a.  $0.05 - 0.02$

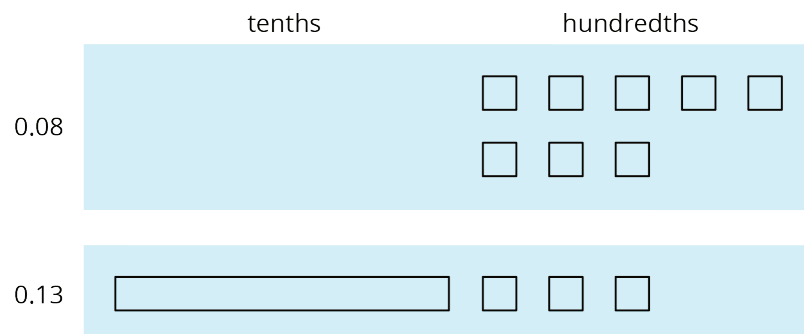
b.  $0.024 - 0.003$

c.  $1.26 - 0.14$

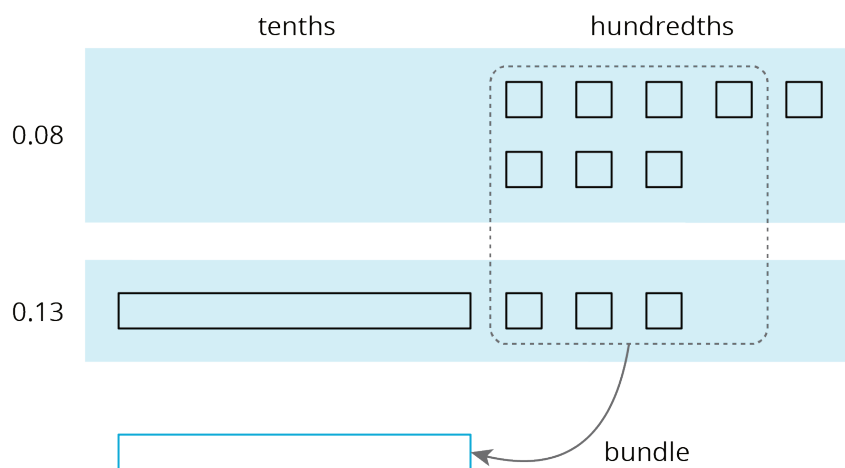
## Lesson 2 Summary

Base-ten diagrams represent collections of base-ten units—tens, ones, tenths, hundredths, etc. We can use them to help us understand sums of decimals.

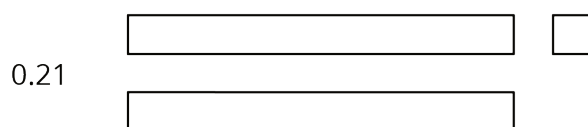
Suppose we are finding  $0.08 + 0.13$ . Here is a diagram where a square represents 0.01 and a rectangle (made up of ten squares) represents 0.1.



To find the sum, we can “bundle” (or compose) 10 hundredths as 1 tenth.



We now have 2 tenths and 1 hundredth, so  $0.08 + 0.13 = 0.21$ .

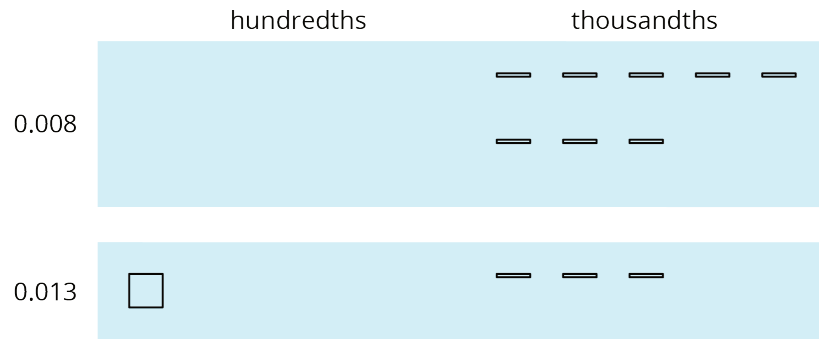


We can also use vertical calculation to find  $0.08 + 0.13$ .

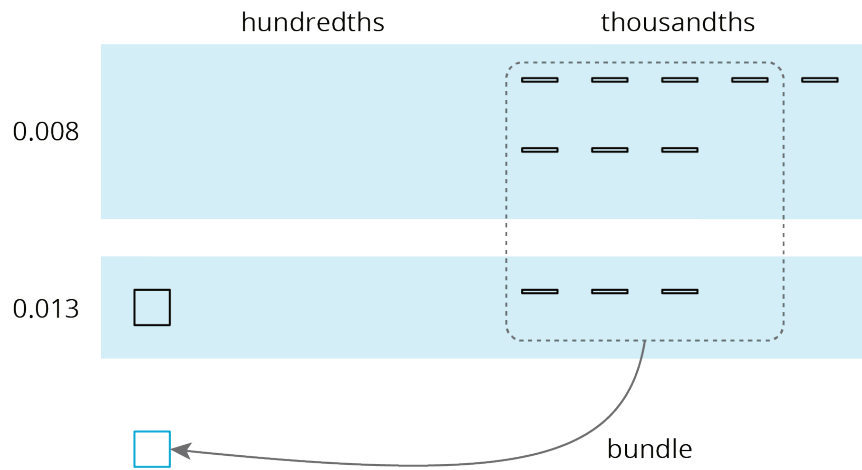
$$\begin{array}{r}
 \phantom{0.} \overset{1}{\phantom{0.}} \\
 0.13 \\
 + 0.08 \\
 \hline
 0.21
 \end{array}$$

Notice how this representation also shows 10 hundredths are bundled (or composed) as 1 tenth.

This works for any decimal place. Suppose we are finding  $0.008 + 0.013$ . Here is a diagram where a small rectangle represents 0.001.



We can “bundle” (or compose) 10 thousandths as 1 hundredth.



The sum is 2 hundredths and 1 thousandth.



Here is a vertical calculation of  $0.008 + 0.013$ .

$$\begin{array}{r}
 \phantom{0.}0\phantom{.}13 \\
 + \phantom{0.}0\phantom{.}08 \\
 \hline
 \phantom{0.}0\phantom{.}21
 \end{array}$$