

Unit 5 Lesson 7: Using Diagrams to Represent Multiplication

1 Estimate the Product (Warm up)

Student Task Statement

For each of the following products, choose the best estimate of its value. Be prepared to explain your reasoning.

1. $(6.8) \cdot (2.3)$

- 1.40
- 14
- 140

2. $74 \cdot (8.1)$

- 5.6
- 56
- 560

3. $166 \cdot (0.09)$

- 1.66
- 16.6
- 166

4. $(3.4) \cdot (1.9)$

- 6.5
- 65
- 650

2 Connecting Area Diagrams to Calculations with Whole Numbers (Optional)

Student Task Statement

1. Here are three ways of finding the area of a rectangle that is 24 units by 13 units.

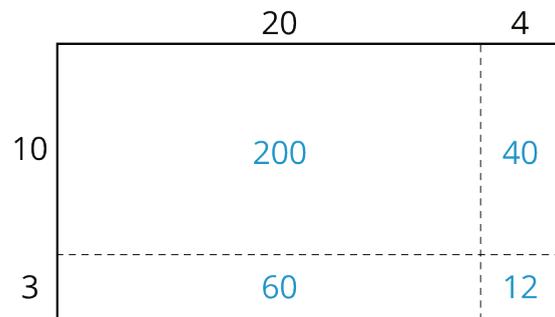


Diagram 1

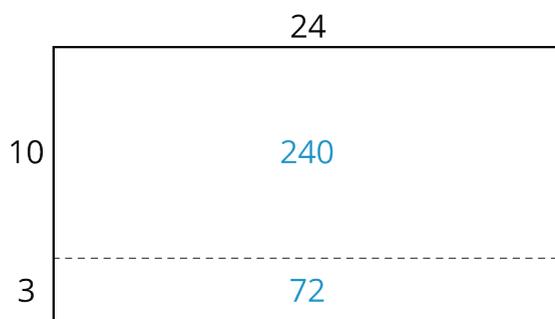


Diagram 2

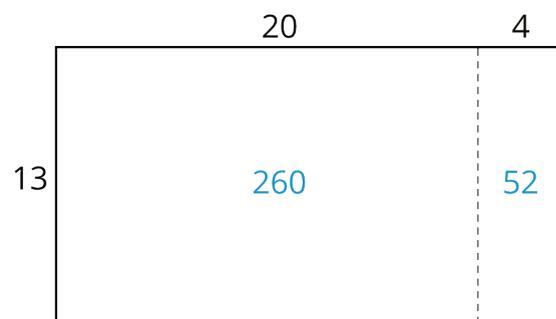


Diagram 3

- What do the diagrams have in common? How are they the same?
- How are the diagrams different?
- If you were to find the area of a rectangle that is 37 units by 19 units, which of the three ways of decomposing the rectangle would you use? Why?

2. You may be familiar with different ways to write multiplication calculations. Here are two ways to calculate 24 times 13.

$$\begin{array}{r}
 24 \\
 \times 13 \\
 \hline
 12 \\
 60 \\
 40 \\
 + 200 \\
 \hline
 312
 \end{array}
 \left. \vphantom{\begin{array}{r} 12 \\ 60 \\ 40 \\ 200 \end{array}} \right\} \text{partial products}$$

$$\begin{array}{r}
 24 \\
 \times 13 \\
 \hline
 72 \\
 + 240 \\
 \hline
 312
 \end{array}$$

Calculation A

Calculation B

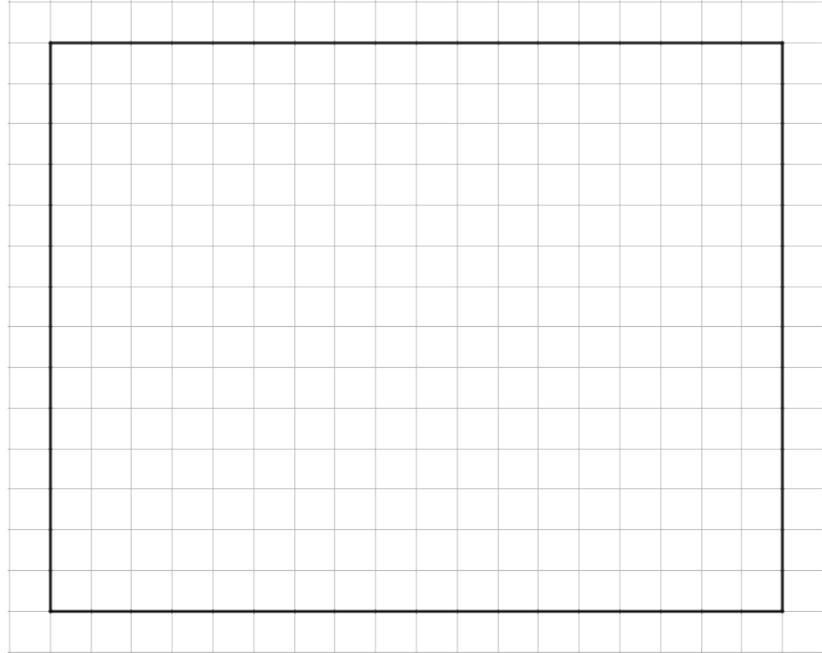
- In Calculation A, how are each of the partial products obtained? For instance, where does the 12 come from?
- In Calculation B, how are the 72 and 240 obtained?
- Look at the diagrams in the first question. Which diagram corresponds to Calculation A? Which one corresponds to Calculation B?
- How are the partial products in Calculation A and the 72 and 240 in Calculation B related to the numbers in the diagrams?

3. Use the two following methods to find the product of 18 and 14.

◦ Calculate numerically.

$$\begin{array}{r} 18 \\ \times 14 \\ \hline \end{array}$$

◦ Here is a rectangle that is 18 units by 14 units. Find its area, in square units, by decomposing it. Show your reasoning.



4. Compare the values of $18 \cdot 14$ that you obtained using the two methods. If they are not the same, check your work.

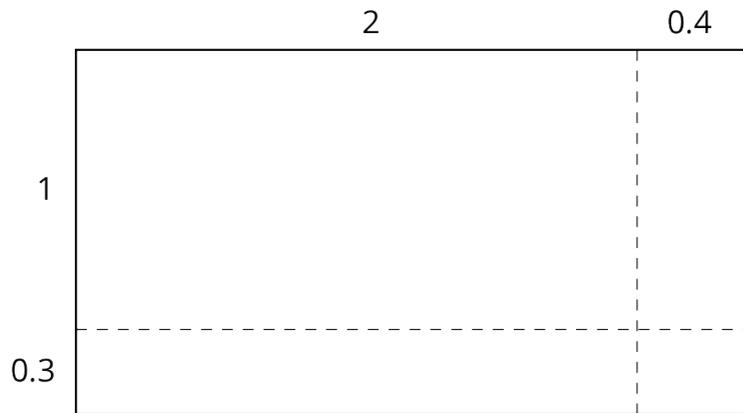
Activity Synthesis

$$\begin{array}{r} 4 \\ \times 1 3 \\ \hline 7 2 \\ + 2 4 \\ \hline 3 1 2 \end{array}$$

3 Connecting Area Diagrams to Calculations with Decimals

Student Task Statement

1. You can use area diagrams to represent products of decimals. Here is an area diagram that represents $(2.4) \cdot (1.3)$.



- Find the region that represents $(0.4) \cdot (0.3)$. Label it with its area of 0.12.
- Label the other regions with their areas.
- Find the value of $(2.4) \cdot (1.3)$. Show your reasoning.

2. Here are two ways of calculating $(2.4) \cdot (1.3)$.

$$\begin{array}{r} \\ \times 1.3 \\ \hline 0.12 \\ 0.6 \\ 0.4 \\ + 2 \\ \hline 3.12 \end{array} \left. \vphantom{\begin{array}{r} \\ \times 1.3 \\ \hline 0.12 \\ 0.6 \\ 0.4 \\ + 2 \\ \hline 3.12 \end{array}} \right\} \text{partial products}$$

Calculation A

$$\begin{array}{r} \\ \times 1.3 \\ \hline 0.72 \\ + 2.4 \\ \hline 3.12 \end{array}$$

Calculation B

Analyze the calculations and discuss these questions with a partner:

- In Calculation A, where does the 0.12 and other partial products come from?
 - In Calculation B, where do the 0.72 and 2.4 come from?
 - In each calculation, why are the numbers below the horizontal line aligned vertically the way they are?
3. Find the product of $(3.1) \cdot (1.5)$ by drawing and labeling an area diagram. Show your reasoning.
4. Show how to calculate $(3.1) \cdot (1.5)$ using numbers without a diagram. Be prepared to explain your reasoning. If you are stuck, use the examples in a previous question to help you.

Activity Synthesis

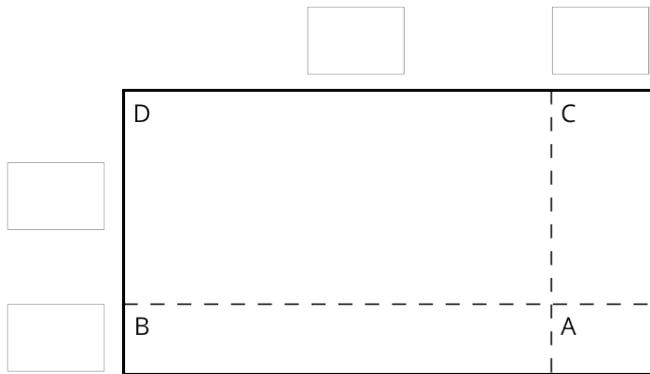
$$\begin{array}{r} 2.4 \\ \times 1.3 \\ \hline 0.12 \\ 0.6 \\ 0.4 \\ + 2 \\ \hline 3.12 \end{array}$$

$$\begin{array}{r} 24 \\ \times 13 \\ \hline 12 \\ 60 \\ 40 \\ + 200 \\ \hline 312 \end{array}$$

4 Using the Partial Products Method (Optional)

Student Task Statement

1. Label the area diagram to represent $(2.5) \cdot (1.2)$ and to find that product.



a. Decompose each number into its base-ten units (ones, tenths, etc.) and write them in the boxes on each side of the rectangle.

b. Label Regions A, B, C, and D with their areas. Show your reasoning.

c. Find the product that the area diagram represents. Show your reasoning.

2. Here are two ways to calculate $(2.5) \cdot (1.2)$. Each number with a box gives the area of one or more regions in the area diagram.

| | |
|--|--|
| $ \begin{array}{r} 2.5 \\ \times 1.2 \\ \hline 0.1 \\ 0.4 \\ 0.5 \\ + 2.0 \\ \hline 3.00 \end{array} $ <div style="display: flex; align-items: center; margin-left: 100px;"> <div style="border: 1px solid black; width: 40px; height: 20px; margin-right: 5px;"></div> <div style="border: 1px solid black; width: 40px; height: 20px; margin-right: 5px;"></div> <div style="border: 1px solid black; width: 40px; height: 20px; margin-right: 5px;"></div> <div style="border: 1px solid black; width: 40px; height: 20px;"></div> </div> | $ \begin{array}{r} 2.5 \\ \times 1.2 \\ \hline 0.5 \\ + 2.5 \\ \hline 3.00 \end{array} $ <div style="display: flex; align-items: center; margin-left: 100px;"> <div style="border: 1px solid black; width: 40px; height: 20px; margin-right: 5px;"></div> <div style="border: 1px solid black; width: 40px; height: 20px;"></div> </div> |
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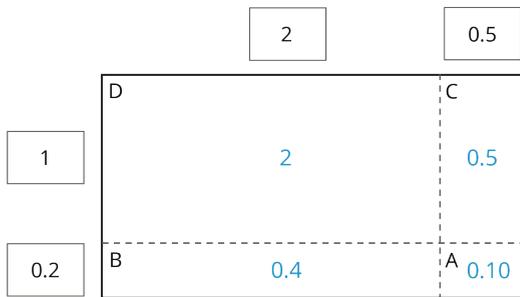
Calculation A

Calculation B

a. In the boxes next to each number, write the letter(s) of the corresponding region(s).

b. In Calculation B, which two numbers are being multiplied to obtain 0.5?
Which numbers are being multiplied to obtain 2.5?

Activity Synthesis



| | | | | | | | | | |
|---|---|--|---|---|---|---|---|-------|-------|
| $ \begin{array}{r} 2.5 \\ \times 1.2 \\ \hline 0.10 \\ 0.4 \\ 0.5 \\ + 2.0 \\ \hline 3.00 \end{array} $ | <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px;"> $\begin{array}{r} 2.5 \\ \times 1.2 \\ \hline 0.5 \\ + 2.5 \\ \hline 3.00 \end{array}$ </td> <td style="width: 50%; padding: 5px;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 2px;">A</td> </tr> <tr> <td style="width: 50%; padding: 2px;">B</td> </tr> <tr> <td style="width: 50%; padding: 2px;">C</td> </tr> <tr> <td style="width: 50%; padding: 2px;">D</td> </tr> </table> </td> </tr> <tr> <td style="width: 50%; padding: 5px;">A + B</td> <td style="width: 50%; padding: 5px;">C + D</td> </tr> </table> | $ \begin{array}{r} 2.5 \\ \times 1.2 \\ \hline 0.5 \\ + 2.5 \\ \hline 3.00 \end{array} $ | <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 2px;">A</td> </tr> <tr> <td style="width: 50%; padding: 2px;">B</td> </tr> <tr> <td style="width: 50%; padding: 2px;">C</td> </tr> <tr> <td style="width: 50%; padding: 2px;">D</td> </tr> </table> | A | B | C | D | A + B | C + D |
| $ \begin{array}{r} 2.5 \\ \times 1.2 \\ \hline 0.5 \\ + 2.5 \\ \hline 3.00 \end{array} $ | <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 2px;">A</td> </tr> <tr> <td style="width: 50%; padding: 2px;">B</td> </tr> <tr> <td style="width: 50%; padding: 2px;">C</td> </tr> <tr> <td style="width: 50%; padding: 2px;">D</td> </tr> </table> | A | B | C | D | | | | |
| A | | | | | | | | | |
| B | | | | | | | | | |
| C | | | | | | | | | |
| D | | | | | | | | | |
| A + B | C + D | | | | | | | | |

Calculation A

Calculation B