

10.1.2.1: Adding Whole Numbers and Applications

Learning Objectives

- Add whole numbers without regrouping.
- Add whole numbers with regrouping.
- Find the perimeter of a polygon.
- Solve application problems using addition.

Introduction

Adding is used to find the total number of two or more quantities. The total is called the **sum**, or the number that results from the addition. You use addition to find the total distance that you travel if the first distance is 1,240 miles and the second distance is 530 miles. The two numbers to be added, 1,240 and 530, are called the **addends**. The total distance, 1,770 miles, is the sum.

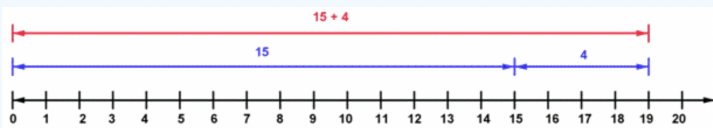
Adding Whole Numbers without Regrouping

Adding numbers with more than one digit requires an understanding of **place value**. The place value of a digit is the value based on its position within the number. In the number 492, the 4 is in the hundreds place, the 9 is in the tens place, and the 2 is in the ones place. You can use a number line to add. In the example below, the blue lines represent the two quantities, 15 and 4, that are being added together. The red line represents the resulting quantity.

✓ Example

$$15 + 4 = ?$$

Solution



On the number line, the blue line segment stretches across 15 units, representing the number 15. The second blue segment shows that if you add 4 more units, the resulting number is 19.

$$15 + 4 = 19$$

You can solve the same problem without a number line, by adding vertically. When adding numbers with more than 1 digit, it is important to line up your numbers by place value, as in the example below. You must add ones to ones, tens to tens, hundreds to hundreds, and so on.

✓ Example

$$15 + 4 = ?$$

Solution

$$\begin{array}{r} 15 \\ + 4 \\ \hline \end{array}$$

Because 5 and 4 have the same place value, make sure they are aligned when you add.

$$\begin{array}{r} 15 \\ + 4 \\ \hline 9 \end{array}$$

First, add the ones digits (the numbers on the right). The result goes in the ones place for the answer.

$$\begin{array}{r} 15 \\ + 4 \\ \hline 19 \end{array}$$

Then, add the tens digits and put the result in the tens place of the answer. In this case, there is no tens digit in the second number, so the result is the same as the tens digit of the first number (1).

$$15 + 4 = 19$$

This strategy of lining up the numbers is effective for adding a series of numbers as well.

✓ Example

$$1 + 2 + 3 + 2 = ?$$

Solution

$$\begin{array}{r} 1 \\ 2 \\ 3 \\ +2 \\ \hline 8 \end{array}$$

$$1 + 2 + 3 + 2 = 8$$

Adding Whole Numbers with Regrouping

When adding whole numbers, a place-value position can have only one digit in it. If the sum of digits in a place value position is more than 10, you have to **regroup** the number of tens to the next greater place value position.

When you add, make sure you line up the digits according to their place values, as in the example below. As you regroup, place the regrouped digit above the appropriate digit in the next higher place value position and add it to the numbers below it.

✓ Example

$$45 + 15 = ?$$

Solution

$$\begin{array}{r} 1 \\ 45 \\ +15 \\ \hline 0 \end{array}$$

Add the ones. Regroup as needed. The sum of 5 and 5 is 10. This is 1 ten and 0 ones. Write the number of ones (0) in the ones place and the 1 ten in the tens place above the 4.

$$\begin{array}{r} 1 \\ 45 \\ + 15 \\ \hline 60 \end{array}$$

Add the tens, $1 + 4 + 1$ is 6 tens. The final sum is 60.

$$45 + 15 = 60$$

You must add digits in the ones place first, the digits in the tens place next, and so on. Go from right to left.

✓ Example

$$4,576 + 698 = ?$$

Solution

$$\begin{array}{r} 4,576 \\ + 698 \\ \hline \end{array}$$

First, write the problem with one addend on top of the other. Be sure you line up the place values!

$ \begin{array}{r} 1 \\ 4,576 \\ + 698 \\ \hline 4 \end{array} $	<p>Add the numbers, 6 and 8, in the ones place. Since the sum is 14, write the ones value (4) in the ones place of the answer. Write the 1 ten in the tens place above the 7.</p>
$ \begin{array}{r} 11 \\ 4,576 \\ + 698 \\ \hline 74 \end{array} $	<p>Add the numbers in the tens place. Since the sum is 17 tens, regroup 17 tens as 1 hundred, 7 in the tens place in the answer and write the 1 hundred in the hundreds place above the 5.</p>
$ \begin{array}{r} 111 \\ 4,576 \\ + 698 \\ \hline 274 \end{array} $	<p>Add the numbers in the hundreds place, including the 1. Again, the sum is more than one digit. Rename 12 hundreds as 2 hundreds and 1 thousand. Write the 2 in the hundreds place and the 1 above the 4 in the thousands place.</p>
$ \begin{array}{r} 111 \\ 4,576 \\ + 698 \\ \hline 5,274 \end{array} $	<p>Add the numbers in the thousands place, including the 1. The final sum is 5,274.</p>

$$4,576 + 698 = 5,274$$

Adding Numbers Using the Partial Sums Method

Another way to add is the partial sums method. In the example below, the sum of $23 + 46$ is found using the partial sums method. In this method, you add together all the numbers with the same place value and record their *values* (not just a single digit). Once you have done this for each place value, add their sums together.

✓ Example

$$23 + 46 = ?$$

Solution

Step 1: Add Tens

$$\begin{array}{r}
 23 \quad 20 \\
 46 \quad +40 \\
 \hline
 60
 \end{array}$$

Let's begin by adding the values in the tens position, the 2 and 4. The values are written as 20 and 40.

Step 2: Add Ones

$$\begin{array}{r}
 23 \quad 3 \\
 46 \quad +6 \\
 \hline
 9
 \end{array}$$

Add the values in the ones place, the 3 and 6.

Step 3: Add Parts

$$\begin{array}{r}
 60 \\
 + 9 \\
 \hline
 69
 \end{array}$$

Finally, add the two sums, 60 and 9, together.

$$23 + 46 = 69$$

The next example adds a series of three numbers. Notice that hundreds is the greatest place value now, so hundreds are added before the tens. (You can add in any order that you prefer.) Also notice that in Step 3, the value in the ones column for 350 is zero,

but you still add that in to make sure everything is accounted for.

✓ Example

$$225 + 169 + 350 = ?$$

Solution

Step 1: Add Hundreds

$$\begin{array}{r} 225 \\ 169 \\ 350 \\ \hline \end{array} \begin{array}{r} 200 \\ 100 \\ +300 \\ \hline 600 \end{array}$$

Add the values represented by the digits 2, 1, and 3 in the hundreds place first. This gives a sum of 600.

Step 2: Add Tens

$$\begin{array}{r} 225 \\ 169 \\ 350 \\ \hline \end{array} \begin{array}{r} 20 \\ 60 \\ +50 \\ \hline 130 \end{array}$$

Next, add the values from the digits in the tens place, the 2, 6, and 9. The sum is 130.

Step 3: Add Ones

$$\begin{array}{r} 225 \\ 169 \\ 350 \\ \hline \end{array} \begin{array}{r} 5 \\ 9 \\ 0 \\ \hline 14 \end{array}$$

Add the values from the digits in the ones place, the 5, 9, and 0. The sum is 14.

Step 4: Add Parts

$$\begin{array}{r} 600 \\ 130 \\ + 14 \\ \hline 744 \end{array}$$

At this point, you have a sum for each place value. Add together these three sums, which gives a final value of 744.

$$225 + 169 + 350 = 744$$

? Exercise

A local company built a playground at a park. It took the company 124 hours to plan out the playground, 243 hours to prepare the site, and 575 hours to build the playground. Find the total number of hours the company spent on the project.

- A. 937 hours
- B. 812 hours
- C. 742 hours
- D. 942 hours

Answer

- A. Incorrect. You probably did not add the ones correctly. The correct answer is 942 hours.
- B. Incorrect. You probably did not add the tens correctly. The correct answer is 942 hours.
- C. Incorrect. You probably did not add the hundreds correctly. The correct answer is 942 hours.
- D. Correct. You carried out the partial sums process effectively. The parts should be $800 + 130 + 12$.

When adding multi-digit numbers, use the partial sums method or any method that works best for you.

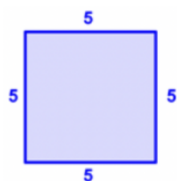
Finding the Perimeter of a Polygon

A **polygon** is a many-sided closed figure with sides that are straight line segments. Triangles, rectangles, and pentagons (five-sided figures) are polygons, but a circle or semicircle is not. The **perimeter** of a polygon is the distance around the polygon. To find the perimeter of a polygon, add the lengths of its sides, as in the example below.

✓ Example

One side of a square has a length of 5cm. Find the perimeter.

Solution



Draw the polygon and label the lengths of the sides. Since the side lengths of a square are equal, each side is 5cm.

$$\begin{array}{r} 5 \\ 5 \\ 5 \\ + 5 \\ \hline 20 \end{array}$$

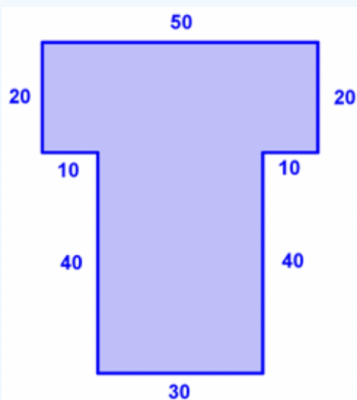
Add the lengths of each side, $5 + 5 + 5 + 5$.

The perimeter is 20cm.

The key part of completing a polygon problem is correctly identifying the side lengths. Once you know the side lengths, you add them as you would in any other addition problem.

✓ Example

A company is planning to construct a building. Below is a diagram illustrating the shape of the building's floor plan. The length of each side is given in the diagram. Measurements for each side are in feet. Find the perimeter of the building.



Solution

```

50
20
20
10
10
40
40
+30
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220

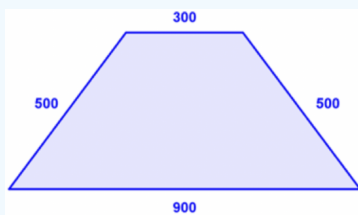
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Add the lengths of each side, making sure to align all numbers according to place value.

The perimeter is 220 feet.

? Exercise

Find the perimeter of the trapezoid in feet.



- A. 2,200 feet
- B. 1,200 feet
- C. 200 feet
- D. 3,200 feet

Answer

- A. Correct. You added the lengths of the sides together successfully.
- B. Incorrect. You probably did not add the two diagonal sides of the trapezoid. The correct answer is 2,200 feet.
- C. Incorrect. You probably subtracted the total length of the two sides, 1,000 feet, from the total length of the top and bottom, 1,200. The correct answer is 2,200 feet.
- D. Incorrect. You may have added some of the sides more than once. The correct answer is 2,200 feet.

Solving Application Problems

Addition is useful for many kinds of problems. When you see a problem written in words, look for key words that let you know you need to *add* numbers.

✓ Example

A woman preparing an outdoor market is setting up a stand with 321 papayas, 45 peaches, and 213 mangos. How many pieces of fruit in total does the woman have on her stand?

Solution

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321
45
+213
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The words “how many... in total” suggest that you need to add the numbers of the different kinds of fruits. Use any method you like to add the numbers. Below, the partial sums method is used.

Step 1: Add Hundreds

$$\begin{array}{r} 321 \\ 045 \\ 213 \\ \hline +200 \\ \hline 500 \end{array}$$

Add the numbers represented by the digits in the hundreds place first, the 3, 0 and 2. This gives a sum of 500.

Step 2: Add Tens

$$\begin{array}{r} 321 \\ 045 \\ 213 \\ \hline +10 \\ \hline 70 \end{array}$$

Next, add the numbers represented by the digits from the tens place, the 2, 4, and 1. The sum is 70.

Step 3: Add Ones

$$\begin{array}{r} 321 \\ 045 \\ 213 \\ \hline +3 \\ \hline 9 \end{array}$$

Add the numbers from the ones, the 1, 5, and 3.

Step 4: Add Parts

$$\begin{array}{r} 500 \\ 70 \\ + 9 \\ \hline 579 \end{array}$$

Add together the three previous sums. The final sum is 579.

The woman has 579 pieces of fruit on her stand.

✓ Example

Lynn has 23 rock CDs, 14 classical music CDs, 8 country and western CDs, and 6 movie soundtrack CDs. How many CDs does she have in all?

Solution

$$\begin{array}{r} 23 \\ 14 \\ 8 \\ +6 \\ \hline \end{array}$$

The words “how many... in all” suggest that addition is the way to solve this problem.
To find how many CDs Lynn has, you need to add the number of CDs she has for each music style.

$$\begin{array}{r} 2 \\ 23 \\ 14 \\ 8 \\ + 6 \\ \hline 51 \end{array}$$

Use whatever method you prefer to find the sum of the numbers.

Lynn has 51 CDs.

The following phrases also appear in problem situations that require addition.

Phrase	Example problem

Add to	Jonah was planning a trip from Boston to New York City. The distance is 218 miles. His sister wanted him to visit her in Springfield, Massachusetts, on his way. Jonah knew this would add 17miles to his trip. How long is his trip if he visits his sister?
Plus	Carrie rented a DVD and returned it one day late. The store charged \$5 for a two-day rental, plus a \$3 late fee. How much did Carrie pay for the rental?
Increased by	One statistic that is important for football players in offensive positions is <i>rushing</i> . After four games, one player had rushed 736 yards. After two more games, the number of yards rushed by this player increased by 352yards. How many yards had he rushed after the six games?
More than	Lavonda posted 38 photos to her social network profile. Chris posted 27 more photos to his than Lavonda. How many photos did Chris post?

✓ Example

Lena was planning a trip from her home in Amherst to the Museum of Science in Boston. The trip is 91 miles. She had to take a detour on the way, which added 13 miles to her trip. What is the total distance she traveled?

Solution

The word “added” suggests that addition is the way to solve this problem.

To find the total distance, you need to add the two distances.

$$\begin{array}{r} 91 \\ + 13 \\ \hline 104 \end{array}$$

The total distance is 104 miles.

It can help to seek out words in a problem that imply what operation to use. See if you can find the key word(s) in the following problem that provide you clues on how to solve it.

? Exercise

A city was struck by an outbreak of a new flu strain in December. To prevent another outbreak, 3,462 people were vaccinated against the new strain in January. In February, 1,298 additional people were vaccinated. How many people in total received vaccinations over these two months?

- A. 2,164
- B. 4,760
- C. 4,660
- D. 4,750

Answer

- A. Incorrect. You probably subtracted instead of adding. The correct answer is 4,760.
- B. Correct. You recognized this as an addition problem and successfully carried out your addition process.
- C. Incorrect. You probably did not regroup to the hundreds place, or added the hundreds places incorrectly. The correct answer is 4,760.
- D. Incorrect. You probably did not regroup to the tens place, or added the tens place incorrectly. The correct answer is 4,760.

Drawing a diagram to solve problems is very useful in fields such as engineering, sports, and architecture.

✓ Example

A coach tells her athletes to run one lap around a soccer field. The length of the soccer field is 100 yards, while the width of the field is 60 yards. Find the total distance that each athlete will have run after completing one lap around the perimeter of the field.

Solution



The words “total distance” and “perimeter” both tell you to add. Draw the soccer field and label the various sides so you can see the numbers you are working with to find the perimeter.

$$\begin{array}{r} 1 \\ 100 \\ 100 \\ 60 \\ + 60 \\ \hline 20 \end{array}$$

There is a zero in the ones place, and the sum of 6 and 6 in the tens place is 12 tens. Place 2 tens in the tens place in the answer, and regroup 10 tens as 1 hundred.

$$\begin{array}{r} 1 \\ 100 \\ 100 \\ 60 \\ + 60 \\ \hline 320 \end{array}$$

By adding the 1 hundred to the other digits in the hundreds place, you end up with a 3 in the hundreds place of the answer.

Each athlete will have run 320 yards.

Summary

You can add numbers with more than one digit using any method, including the partial sums method. Sometimes when adding, you may need to regroup to the next greater place value position. Regrouping involves grouping ones into groups of tens, grouping tens into groups of hundreds, and so on. The perimeter of a polygon is found by adding the lengths of each of its sides.

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