

Section 4.4 Adding and subtracting decimals

An advantage of the decimal format in comparison to the fraction format is that the procedures to evaluate operations involving decimals are similar to the procedures employed when working with whole numbers. In this section, decimals are added and subtracted applying the same technique used to add and subtract whole numbers in chapter one. Below the whole numbers 683 and 52 and the decimals 6.83 and 0.52 are added. Notice the similarity in the procedures when adding whole numbers and when adding decimals. The key step is lining up the place values which when working with decimals is done by simply lining up the decimal points. Thus, decimals are much simpler to add or subtract than unlike fractions which required finding the find least common denominators and creating equivalent fractions whose denominators are the LCD.

	hundreds		tens		ones
	1				
	6	8		3	
+		5		2	
	7	3		5	

	ones		tenths		hundredths
	1				
	6	.8		3	
+	0	.5		2	
	7	.3		5	

To add decimals

Line up the decimal points (while automatically lines up the place values) and then add the digits of the same place value numbers carrying when necessary. To ensure that all the place values are lined up correctly, if the decimals do not have the same ending place value create like decimals by inserting zero digits at the end of the shorter decimals.

Example 1 Add the following: $24.74 + 9.35$ $0.532 + 0.09$ $8 + 7.3$

To ensure that all the place values are lined up correctly, if the decimals do not have the same ending place value create like decimals by inserting zero digits at the end of the shorter decimal.

	1	1	
	2	4	.74
+		9	.35
	3	4	.09

	1			
	0	.5	3	2
+	0	.0	9	0
	0	.6	2	2

	8	.0
+	7	.3
	1	5.3

This process of adding two decimals can be extended to adding three or more decimals by simply lining up all the decimal points which in effect lines up all the digits in the same place value in all the numbers. To ensure that all the place values are lined up correctly, if all the decimals do not have the same ending place value insert zeros at the end of the shorter decimals so that all the decimals have the same ending place value.

Example 2 Find the sum of 8.2, 5.43, 0.29, and 0.7

To ensure that all the place values are lined up correctly create like decimals by inserting zero digits at the end of the shorter decimals so that all the decimals have the same ending place value, in this case the hundredths place.

$$\begin{array}{r}
 8 2 \\
 5 4 \\
 2 \\
 + 7 \\
 \hline
 1 4 6
 \end{array}$$

Example 3 At the local grocery store the price of the store brand peanut butter is \$1.76 while a similar size container of the national brand peanut butter cost \$0.89 more. Find the price of the national brand peanut butter at this grocery?

The unknown quantity, the price of the national brand peanut butter, is \$0.89 **more than** the \$1.76 price of the store brand. To find the price of the national brand peanut butter the \$0.89 additional cost is added to the \$1.76 price of the store brand. The price of the national brand peanut butter is \$2.65 as shown below.

$$\begin{array}{r}
 1 7 \\
 + 0 8 \\
 \hline
 2 6
 \end{array}$$

Example 4 Tim's checking account balance was \$635.19 on Monday. During the week, he made two deposits one for \$120 and another for \$115.84 and no withdrawals. What is Tim's balance at the end of the week?

The unknown quantity is the balance at the end of the week which is found by adding the deposits of \$120 and \$115.84 to the beginning balance of \$635.19 as shown on the right. Tim's balance at the end of the week is \$871.03

$$\begin{array}{r}
 6 3 1 \\
 1 2 0 \\
 + 1 1 8 \\
 \hline
 8 7 1 0
 \end{array}$$

Below the whole numbers 767 and 294 and the decimals 7.67 and 2.94 are subtracted. Notice the similarity in the procedures when subtracting whole numbers and when subtracting decimals.

hundreds	tens	ones		ones	tenths	hundredths
6				6		
7	¹ 6	7		7	¹ 6	7
-	2	9	4	-	2	9
4	7	3		4	7	3

To subtract two decimals

Line up the decimal points (while automatically lines up the place values) and then subtract the digits of the same place value numbers borrowing when necessary. To ensure that all the place values are lined up correctly, if the decimals do not have the same ending place value create like decimals by inserting zero digits at the end of the shorter decimal.

Example 5 Subtract the following: $13.59 - 7.46$ $0.847 - 0.29$ $7 - 5.8$

To ensure that all the place values are lined up correctly, if the decimals do not have the same ending place value create like decimals by inserting zero digits at the end of the shorter decimals. To check, add the difference with the subtrahend to obtain the minuend.

$$\begin{array}{r} \overset{1}{1}3.59 \\ - 7.46 \\ \hline 6.13 \end{array}$$

Check

$$\begin{array}{r} 6.13 \\ + 7.46 \\ \hline 13.59 \end{array}$$

$$\begin{array}{r} \overset{7}{0}.847 \\ - 0.29\mathbf{0} \\ \hline 0.557 \end{array}$$

Check

$$\begin{array}{r} \overset{1}{0}.557 \\ + 0.29\mathbf{0} \\ \hline 0.847 \end{array}$$

$$\begin{array}{r} 7.\overset{1}{0} \\ - 5.8 \\ \hline 1.2 \end{array}$$

Check

$$\begin{array}{r} 1 \\ 1.2 \\ + 5.8 \\ \hline 7.0 \end{array}$$

Example 6 Evaluate $76.7 - 29.42$ and show check

To ensure that all the place values are lined up correctly create like decimals by inserting zero digits at the end of the shorter decimal so that all the decimals have the same ending place value, in this case the hundredths place. To check add the difference 47.28 with the subtrahend 29.42 to obtain the minuend 76.7

$$\begin{array}{r} ^6 ^6 \\ 76.7 \\ - 29.42 \\ \hline 47.28 \end{array}$$

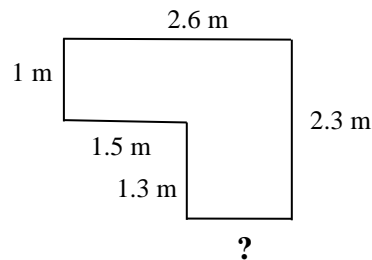
$$\begin{array}{r} ^1 ^1 \\ 47.28 \\ + 29.42 \\ \hline 76.70 \end{array}$$

Example 7 In 2012 Olympics, the gold medal winner of the women's 100 meter race completed the race in 10.75 seconds and the second place runner silver medalist finished in 10.78 seconds. By how many seconds did the gold medalist win the race?

The unknown quantity, the time in seconds that the gold medalist won the race by, is determined by the finding difference in times between the first and second place finishers. As shown below the difference of 10.78 and 10.75 is 0.03 seconds, so the gold medalist won the race by three hundredths of a second.

$$\begin{array}{r} 10.78 \\ - 10.75 \\ \hline 0.03 \end{array}$$

Example 8 Find the length of the missing side and then find the perimeter of the following figure.



First, find the length of the missing bottom side. The missing horizontal bottom side is found by taking the difference of the horizontal sides 2.6 and 1.5 meters which is 1.1 meters. To find the perimeter sum the lengths of the six sides by adding 2.6, 2.3, 1.1, 1.3, 1.5 and 1 meters which equals 9.8 meters as shown below.

$$\begin{array}{r} 2.6 \\ - 1.5 \\ \hline 1.1 \end{array}$$

$$\begin{array}{r} 1 \\ 2.6 \\ 2.3 \\ 1.1 \\ 1.3 \\ 1.5 \\ + 1.0 \\ \hline 9.8 \end{array}$$

Exercises 4.4

1-10 Add the following decimals

- | | | | |
|----|---------------------|-----|----------------------|
| 1. | $23.15 + 7.93$ | 2. | $0.521 + 0.806$ |
| 3. | $11.5 + 6.25$ | 4. | $19.35 + 8.087$ |
| 5. | $0.75 + 0.039$ | 6. | $13.128 + 18.6$ |
| 7. | $1.23 + 4.7 + 0.98$ | 8. | $0.57 + 0.3 + 0.374$ |
| 9. | $28.65 + 14 + 1.85$ | 10. | $6 + 3.9 + 0.96$ |

11-18 Subtract the following decimals. **Show checks.**

- | | | | |
|-----|----------------|-----|-----------------|
| 11. | $13.75 - 4.67$ | 12. | $0.713 - 0.549$ |
| 13. | $12.1 - 9.28$ | 14. | $11.25 - 4.8$ |
| 15. | $18.15 - 13$ | 16. | $9.6 - 7$ |
| 17. | $14 - 8.23$ | 18. | $5 - 0.92$ |

19-24 Evaluate the following using the order of operations.

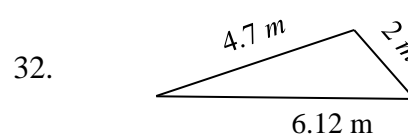
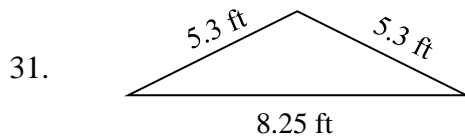
- | | | | |
|-----|--------------------|-----|--------------------|
| 19. | $4.7 - 2.1 + 1.23$ | 20. | $4.7 + 2.1 - 1.23$ |
| 21. | $15 - 5.3 + 6.2$ | 22. | $15 - (5.3 + 6.2)$ |
| 23. | $8.2 - (3.75 + 2)$ | 24. | $8.2 - 3.75 + 2$ |

25-30. Solve the following application problems. Show the calculations.

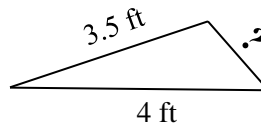
25. Lola's checking account balance was \$932.32 on Monday. During the week, she made two withdrawals one for \$60 and another for \$89.63 and no deposits. What is Lola's balance at the end of the week?
26. Tre's checking account balance was \$1123.65 on Friday. During the weekend, he made two withdrawals one for \$80 and another for \$120.31 and a deposit of \$423.62. What is Tre's checking account balance on Monday morning?
27. April purchases a gift for \$28.63. If she pays with two twenty dollar bills, how much does April receive in change?

28. The distance Jose commutes to work is 2.8 miles each way and the distance between his job and the community college he attends is 1.7 miles. On a work day Jose drives to work, takes a class at the college during his long lunch break, returns to work and at the end of the day drives home. How far does Jose drive on a work day?
29. Sam initially weighs 82.3 kilograms. During a three week period, he gain 0.9 kilograms in weight the first week, loses 1.3 kilograms the second week, and loses 1.8 kilograms the third week. Find Sam's weight at the end of the three week period.
30. As a surprise Daevon is purchasing some jewelry for his wife. He purchases a pair of earrings which each contain 0.4 carats of diamonds and a ring with 0.75 carats of diamonds. Find the total diamonds carats in this jewelry?

31-32 Find the perimeter of the following triangles.



33. Find the missing side of the following triangle whose perimeter is 9.1 feet.



34. Find the length of the missing side and the perimeter of the following shape.

