5.2 Decimals Operations

Let's revisit the following example from section 4.6 and compare addition of fractions to addition of decimals.

I found a dollar and one quarter in the pocket of my jacket.	⇒			⇒	$1\frac{1}{4}$	⇒	$\$1.25$
I found three dollars and 2 quarters in the pocket of my sweater.	⇒			⇒	$+\ 3\frac{2}{4}$	⇒	$+\ \$3.50$
How much money in total did I find?	⇒	4 dollars	3 quarters	⇒	$4\frac{3}{4}$	⇒	$\$4.75$

Here is another example:

Total rainfall in Tehama County in January – June of 2017	⇒	$17\frac{64}{100}$ inches	⇒	17.64
Total rainfall in Tehama County in July – December of 2017	⇒	$+\ 3\frac{91}{100}$ inches	⇒	+ 3.91
Total rainfall in Tehama County in 2017	⇒	$21\frac{55}{100}$ inches	⇒	21.55

In general, to add (or subtract) decimals, we line up like place values, add the columns and carry, if necessary. Alignment of the decimal points first will assure the other place values are properly aligned. Fill in the sum below.

thousands	hundreds	tens	ones		tenths	hundredths	thousandths
		1	7	.	6	4	
		+	3	.	9	1	
				.			

Demonstration Problems	*Practice Problems*
Simplify. **1. (a)** 1.41 + 1.35	Simplify. **1. (b)** 1.35 + 2.43
2. (a) 0.88 + 0.45	**2. (b)** 0.22 + 0.98
Simplify. **3. (a)** 256.37 – 85.49	Simplify. **3. (b)** 248.25 – 91.29
4. (a) 10 – 9.58	**4. (b)** 20 – 14.65
	Answers: **1. (b)** 3.78; **2. (b)** 1.2; **3. (b)** 156.96; **4. (b)** 5.35;

Demonstration Problems	*Practice Problems*
Simplify. **5. (a)** $4.77 - 6.3$	Simplify. **5. (b)** $2.51 - 7.4$
6. (a) $91.75 - (-10.462)$	**6. (b)** $94.69 - (-12.678)$
7. (a) $-5.2 - 9.7$	**7. (b)** $-4.2 - 9.3$
8. (a) $-32.23 + 40.1$	**8. (b)** $-51.23 + 60.1$
	Answers: **5. (b)** -4.89; **6. (b)** 107.368; **7. (b)** -13.5; **8. (b)** 8.87

Comparison of multiplying decimals with multiplying fractions:

What is the cost of $\frac{3}{10}$ pounds of bananas that costs \$0.70 per pound?

$$\Rightarrow \quad \begin{array}{r} 0.70 \\ \times \quad 0.3 \\ \hline 0.210 \end{array} \quad \Rightarrow$$

Compare with:

$$\frac{3}{10} \times \frac{7}{10}$$

$$= \frac{21}{100} = 0.21$$

$$\$0.70 \times \frac{3}{10} = \$0.21$$

How much is $\frac{1}{10}$ the dosage of 3.25 mL of an antibiotic?

$$\Rightarrow \quad \begin{array}{r} 3.25 \\ \times \quad 0.1 \\ \hline 0.325 \end{array} \quad \Rightarrow$$

Compare with:

$$\frac{325}{100} \times \frac{1}{10}$$

$$= \frac{325}{1000} = 0.325$$

$$3.25 \text{ mL} \times \frac{1}{10} = 0.325 \text{ mL}$$

In general, to multiply decimals:

1. Line up the right-most digits.

2. Multiply the numbers using the algorithm for whole numbers.

$$\begin{array}{r} 3.25 \\ \times \quad 0.1 \\ \hline 0.325 \end{array}$$

2 decimal places

1 decimal place

3 decimal places

3. Count the number of decimal places in the factors.

4. Place the decimal point in the product so that the number of decimal places is the same as the sum of decimal places in the factors.

Demonstration Problems	*Practice Problems*
Simplify. **9. (a)** 0.3 (0.4) =	Simplify. **9. (b)** 0.4 (0.7) =
10. (a) 4.5 (6.107) =	**10. (b)** 3.9 (4.075) =
11. (a) (–2.9)(4.63) =	**11. (b)** (–8.2)(5.19) =
12. (a) (0.04)(0.087) =	**12. (b)** (0.03)(0.045) =
Answers: **9. (b)** 0.28; **10. (b)** 15.8925; **11. (b)** –42.558; **12. (b)** 0.00135	

Multiplying by a power of 10

Product	1.23×10	1.23×100	1.23×1000
The first has been done for you.	$\begin{array}{r} 1.23 \\ \times\ 10 \\ \hline 000 \\ +1230 \\ \hline 12.30 \end{array}$	$\begin{array}{r} 1.23 \\ \times 100 \\ \hline \end{array}$	$\begin{array}{r} 1.23 \\ \times 1000 \\ \hline \end{array}$
Multiplied by	10	100	1000
Number of zeros	1	2	3
Number of places decimal point moved to the right	1	2	3
Using the shortcut	$1.23 \times 10 = 12.3$	$1.23 \times 100 = 123$	$1.23 \times 1000 = 1230$

Demonstration Problems	*Practice Problems*
Simplify.	Simplify.
13. (a) 2.58 (10)	**13. (b)** 5.63 (10)
14. (a) 2.58 (100)	**14. (b)** 5.63 (100)
15. (a) 2.58 (1000)	**15. (b)** 5.63 (1000)
	Answers: **13. (b)** 56.3; **14. (b)** 563; **15. (b)** 5630

Comparison of dividing fractions with dividing decimals:

Two people shared this burrito that cost $13.70. What was the cost to each person?

$$2\overline{)13.70} = 6.85 \Rightarrow \frac{13.70 \cdot 50}{2 \cdot 50} = \frac{685}{100} = 6.85$$

$13.70 ÷ 2 = $6.85

How many 7.5 mL doses are contained in a 150 mL bottle of antibiotic?

$$7.5\overline{)150.0} = 20 \Rightarrow \frac{150}{7.5} = \frac{150 \cdot 10}{7.5 \cdot 10} = \frac{1500}{75} = 20 \text{ doses}$$

150 mL ÷ 7.5 mL = 20 doses

In general, to divide decimals…

…if the divisor is a whole number:

$$2\overline{)13.70} = 6.85$$

1. Bring the decimal point straight up.
2. Divide using the algorithm for division of whole numbers.

…if the divisor is a decimal:

$$7.5\overline{)150.0} = 20$$

1. Move the decimal point in the divisor and the dividend the number of places needed to make the divisor a whole number.
2. Annex zero(s), if necessary in the placement of the decimal point.
3. Bring decimal point straight up.
4. Divide using the algorithm for division of whole numbers.

Demonstration Problems	*Practice Problems*
Simplify. **16. (a)** 0.28 ÷ 4	Simplify. **16. (b)** 0.12 ÷ 3
17. (a) \$6.99 ÷ 36	**17. (b)** \$3.99 ÷ 24
18. (a) 0.5 ÷ 0.8	**18. (b)** 0.3 ÷ 0.4
	Answers: **16. (b)** 0.04; **17. (b)** ≈\$0.17; **18. (b)** 0.75

Demonstration Problems	*Practice Problems*
Simplify. **19. (a)** –1.989 ÷ 5.1	Simplify. **19. (b)** –2.89 ÷ 3.4
20. (a) –23.492 ÷ (–0.04)	**20. (b)** –25.65 ÷ (–0.06)
21. (a) 6 ÷ 0.03	**21. (b)** 4 ÷ 0.05
	Answers: **19. (b)** –0.85; **20. (b)** 427.5; **21. (b)** 80

Dividing by a power of 10

Quotient	123.4 ÷ 10	123.4 ÷ 100	123.4 ÷ 1000
Long Division *The first has been done for you.*	$10\overline{)123.4}$ → 12.34 10 20 20 30 30 40 40 0	$100\overline{)123.4}$	$1000\overline{)123.4}$
Divided by	10	100	1000
Number of zeros	1	2	3
Number of places decimal point moved to the left	1	2	3
Using the shortcut	123.4 ÷ 10 = 12.34	123.4 ÷ 100 = 1.234	123.4 ÷ 1000 = 0.1234

Demonstration Problems	*Practice Problems*
Simplify. **22. (a)** 2.58 ÷ 10 **23. (a)** 2.58 ÷ 100 **24. (a)** 2.58 ÷ 1000	Simplify. **22. (b)** 5.63 ÷ 10 **23. (b)** 5.63 ÷ 100 **24. (b)** 5.63 ÷ 1000
	Answers: **22. (b)** 0.563; **23. (b)** 0.0563; **24. (b)** 0.00563