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WHOLE NUMBERS, DECIMALS, AND NEGATIVE NUMBERS

Basic Math

Starting Point

Go to www.wiley.com/college/slavin to assess your knowledge of the basics of positive integers (whole numbers), decimals, and negative integers. *Determine where you need to concentrate your effort.*

What You'll Learn in This Chapter

- How to describe whole numbers, counting numbers, and natural numbers
- How to identify decimal numbers
- How to relate the concepts of negative numbers and integers

After Studying This Chapter, You'll Be Able To

- Discuss relationship between whole numbers and counting numbers
- Describe how to add, subtract, multiply, and divide decimals
- Identify the rules of addition, subtraction, multiplication, and division of negative numbers
- Calculate problems involving negative numbers

Goals and Outcomes

- Identify whole numbers, counting numbers, natural numbers, and integers
- Evaluate the methods for solving decimal problems
- Understand the differences between calculations involving negative and positive numbers

INTRODUCTION

Before you rush headlong into business math applications, you need to first make sure you understand the foundations of basic math: whole numbers, decimals, and negative numbers.

1.1 Whole Numbers

Whole numbers are the numbers you use every day: 0, 1, 2, 3, and so on. They are also called **natural numbers** and **counting numbers.** (Note, however, that 0 is not considered a counting number because we start counting objects with the number 1.) All these terms just mean plain old numbers, such as 5 and 6,782,346,601. We assume, in this book, that you know how to add, subtract, multiply, and divide whole numbers.

Whole numbers do not include portions of whole numbers. Portions of whole numbers are expressed as decimals and fractions. For example, 20 is a whole number, but 20.25 is a decimal, and $20\frac{1}{4}$ is a fraction. Each contains the

FOR EXAMPLE

Zero, Zilch, Zip, Nil, Nada!

Zero means nothing: the absence of value. If you have zero money, you're broke. If you have two sisters, five cousins, and zero brothers, you don't have any brothers. For this reason, zero is not included in counting numbers: If you have enough of something (dollars or brothers) to be counting them, you must have at least one, so the counting starts there.

Not so with time, however. On December 31, 1999, people debated whether the next day would begin a new millennium or whether the new millennium would begin on January 1, 2001. The controversy was whether time began at zero (the ways humans celebrate age) or at 1 (the way items are counted).

Time, unlike counting, always begins at zero. For example, your birth is considered zero. A year later, you celebrate your first birthday, meaning that you have completed one year of life. Likewise, a stopwatch begins timing a race at zero, not a one second or one minute. Given that time begins at zero, when the first year ended, the first "birthday" was celebrated, and Year 1 began. A year later, Year 2 began. A decade was complete when Year 10 began (not when it ended); likewise, a millennium was complete when Year 1,000 began.

whole number 20, but the decimal or fraction (0.25 or $\frac{1}{4}$) is also a portion of a number. Decimals are discussed in the Section 1.2, and see Chapter 2 for information on fractions.

Numbers can also be negative, in which case they have values less than zero. (Section 1.3 discusses negative numbers.) When all the whole numbers are combined with all the negative whole numbers, they are called **integers.**

SELF-CHECK

- Define **whole number** and similar terms.
- Describe how fractions and decimals differ from whole numbers.
- Explain how integers differ from whole numbers.

1.2 Decimals

A decimal is a portion of a number, expressed as one or more digits to the right of a decimal point. Examples of decimals include 10.2 (1 digit to the right of the decimal point), 0.3768 (4 digits to the right of the decimal point), 1,368.58 (2 digits to the right of the decimal point), and 3.14159265358979323846 (20 digits to the right of the decimal point).

In this section, you'll discover the simplicity of adding, subtracting, multiplying, and dividing decimal numbers. Check out Chapter 2 for information on converting decimals into fractions.

1.2.1 Adding and Subtracting Decimals

You add and subtract decimals exactly the same way you add and subtract whole numbers: Line up the numbers vertically, aligned on the decimal points, and add or subtract. (Note that with whole numbers, even though you don't see a decimal point, it's implied as being to the right of the right-most number.)

A concept to remember when adding and subtracting decimals is that you can add any number of zeros *after* the decimal point without altering the value of the number. Therefore, 2 is the same as 2.0, which is the same as 2.00000.

For example, say you want to add 4.7 + 3.84 + 10. Here's how you set it up:

$$\begin{array}{r} 4.70 \\ 3.84 \\ +\ 10.00 \\ \hline 18.54 \end{array}$$

Now say you want to find the answer to 8.255 + 1 + 1.5 + 30. You do the following:

$$\begin{array}{r} 8.255 \\ 1.000 \\ 1.500 \\ +\ 30.000 \\ \hline 40.755 \end{array}$$

Next, say you want to try the decimal subtraction problem 10 − 8.5. Here's what you do:

$$\begin{array}{r} 10.0 \\ -\ 8.5 \\ \hline 1.5 \end{array}$$

Finally, you want to try a subtraction problem that involves several decimal places: 2.18 – 1.5468. Here's how you figure it out:

$$\begin{array}{r} 2.1800 \\ -\ 1.5468 \\ \hline 0.6332 \end{array}$$

Practice with the following decimal addition and subtraction problems:

1. 24.11 + 5.10 + 9.41
2. 64.20 + 11.90 + 4.01
3. 98.60 − 9.70
4. 204.90 − 193.80
5. 494.78 − 82.89
6. 64.25 + 9.75

1.2.2 Multiplying Decimals

Multiplying decimals is similar to multiplying whole numbers, except that you have to figure out what to do with the decimals. To solve multiplication problems with decimals, you follow these steps:

Step 1: Multiply the numbers as if the decimals weren't there. For example, $1.36 \times 2.4 = 136 \times 24 = 3{,}264$.

Step 2: Looking at the numbers you're multiplying, count how many numbers are to the right of the decimal. For example, if you're multiplying 1.36 × 2.4, you have three numbers (.36 and .4) that are to the right of the decimal point.

Step 3: Starting at the right of the product, count over that many numbers to the left, and add the decimal point: 3.264.

For example, to find the answer to 1.903×2.231, you do the following:

$$\begin{array}{r} 1.903 \\ \times\ 2.231 \\ \hline 4.245593 \end{array}$$

Say you now want to solve 4.7845×1.2. Here's how you do it:

$$\begin{array}{r} 4.7845 \\ \times\ 1.2 \\ \hline 5.74140 \end{array}$$

Here's how you figure out 1.5×2:

$$\begin{array}{r} 1.5 \\ \times\ 2 \\ \hline 3.0 \end{array}$$

Now say you want to multiply two numbers that have several decimal places, such as 3.876×22.49. Here's what you do:

$$\begin{array}{r} 3.876 \\ \times\ 22.49 \\ \hline 87.17124 \end{array}$$

Practice with the following decimal multiplication problems:

1. 124.9×10
2. 83.6×11.4
3. 12.6×9.1
4. 2.75×0.03
5. 1.99×0.06
6. 23.95×0.18

1.2.3 Dividing Decimals

Like adding and subtracting decimals, dividing decimals also requires that you align the decimal points. The most important rule to remember if dividing decimals by hand is that you cannot divide if there is a decimal in the divisor. If the denominator does not have a decimal but the numerator does, the problem is very simple.

For example, say you want to find the answer to $18.00 \div 9$. You simply line up the decimals and solve, like this:

$$\begin{array}{r} 2.00 \\ 9\overline{)18.00} \end{array}$$

You know that 9 goes into 18 twice, and you let the extra decimals and zeros remain where they are.

Now consider a division problem in which you have to add zeros beyond the decimal point: 30 ÷ 4. You can solve this by using remainders, as you did in general math class, or you can add a zero beyond the decimal and continue to solve:

$$
\begin{array}{r}
7.5 \\
4\overline{)30} \\
\underline{28} \\
2.0 \\
\underline{2.0} \\
0
\end{array}
$$

You know that 4 goes into 30 seven times, with a remainder of 2. Because 2 is smaller than 4, you add a zero beyond the decimal and also put a decimal at the same point in the answer. Now you solve as if the decimal weren't there: How many times does 4 go into 20? Five times. The answer is 7.5.

If the denominator has a decimal, you get rid of the decimal by moving it to the right until the denominator is a whole number. You then move the decimal point in the numerator the same number of places. Next, you put a decimal at the same place in your answer. So, for example,

$$
\begin{aligned}
25 \div 1.25 &= 1.25\overline{)25} \\
&= 125.\overline{)2500.}
\end{aligned}
$$

FOR EXAMPLE

Significant Digits

The concept of **significant digits** is used extensively in math, chemistry, physics, and engineering. Although most business applications ignore the rules of significant digits, knowing the concept can help you understand why some answers may appear to have been truncated.

Here are the basic rules of significant digits: Nonzero digits are *always* significant; zeros placed before the decimal are *not* significant, and zeros placed after the decimal or between other numbers *are* significant. So, for example, the number 102 has three significant digits, 102.3 has four significant digits, and 0.21 has two significant digits.

In multiplication, division, and so on, the number of significant digits in the answer should equal the *least* number of significant digits in the numbers being multiplied or divided. Therefore, 2.3457 × 2.68 is not 6.286476; rather, it is rounded to 6.29. The numbers being multiplied have five and three significant digits, respectively; therefore, the answer has three significant digits.

You can then solve the problem as if the decimals weren't there:

$$125.\overline{)2500.}\quad 20.$$

Here are some decimal division problems to try on your own:

1. 9.1 ÷ 0.52
2. 6 ÷ 1.33
3. 12 ÷ 10.5
4. 1.6 ÷ 0.357

SELF-CHECK

- Understand the difference between decimals and whole numbers.
- Describe how to add and subtract decimals.
- Explain how to multiply and divide decimals.

1.3 Negative Numbers

A **positive number** is any number greater than zero. Positive numbers can be whole numbers, fractions, or decimals. A **negative number** is a number that is less than zero, and a negative sign goes in front of the number to indicate that it is negative (e.g., −5). Negative numbers can be added, subtracted, multiplied, and divided, just like positive numbers.

1.3.1 Adding and Subtracting Integers

To add integers, you follow these guidelines:

- **If both numbers are positive:** Add the numbers and keep the positive sign.
- **If both numbers are negative:** Add the numbers and keep the negative sign.
- **If one number is positive and one is negative:** Subtract the smaller (disregarding the sign) from the larger and keep the sign of the larger.

To subtract integers, you change the minus sign to a plus sign and change the sign of the second number. Then you use the addition rules just described.

For example, say you want to figure out $5 - (-2)$. Here's what you do:

$$5 - (-2) = 5 + 2 = 7$$

To figure out $18 + (-8)$, you do this:

$$18 + (-8) = 18 - 8 = 10$$

You find the answer to $25 - (-10) + (-20)$ as follows:

$$25 - (-10) + (-40) = 25 + 10 - 40 = -5$$

Finally, if you want to find the answer to $8.2 - (-4.95)$, you do the following:

$$8.2 - (-4.95) = 8.20 + 4.95 = 13.15$$

Try these examples of adding and subtracting integers, which are set up as word problems:

1. Suppose you arrive at your office with $15 in your pocket. You spend $10 on your coffee break. How much do you have in your pocket?
2. If the temperature is -2 and it drops another 9 degrees, what's the temperature?
3. If you weighed 157 pounds and you lost 13 pounds, how much do you weigh now?
4. If the stock market is at 11,458 on Monday morning and drops 60 points both Monday and Tuesday, what is its opening number on Wednesday morning?

1.3.2 Multiplying Integers

You multiply two negative numbers exactly as you do positive numbers, using the following rules to determine whether the product will be positive or negative (remember, these rules only apply when multiplying *two* numbers):

- **If the signs are the same:** The answer is positive.
- **If the signs are different:** The answer is negative.

Remember from your experience multiplying positive numbers that any number multiplied by 0 is always 0. This also holds true if you're multiplying a negative number by 0.

Test these rules by trying a few examples:

1. 14×-2
2. -1.26×-2.3
3. 148×-1
4. -32×2.4578

For Example

Negative Numbers in Everyday Life

Unless you live in a warm part of the country, the most common negative numbers you see as you go about your day occur when the temperature falls below 0 (e.g., −10 degrees). Here are a couple other examples:

- In personal finance, if you're in debt (that is, you owe more than you own), your net worth is a negative number (e.g., −$12,000).
- In football, when the quarterback is sacked behind the line of scrimmage, he has a yardage loss (e.g., −4 yards).

1.3.3 Dividing Integers

The rules for division of integers are the same as those for multiplication. Remember from your experience dividing positive numbers that you cannot divide a number by zero. This, of course, holds true for negative numbers, too.

Try a few sample problems:

1. $25 \div -5$
2. $-7.29 \div -3$
3. $28 \div -1$
4. $-125 \div 5$

SELF-CHECK

- Define **negative number.**
- Describe the rules for adding and subtracting negative numbers.
- Discuss how to determine the positive or negative sign of a product.

SUMMARY

Need to brush up on some basic math concepts? This chapter provides the basics on whole numbers, natural numbers, counting numbers, decimal numbers, negative numbers, and integers. They all follow similar rules and patterns, and this chapter lays them out for you.

KEY TERMS

Counting number	A whole number other than zero.
Integer	A positive or negative whole number.
Natural number	A positive integer or zero. Also known as a *whole number*.
Negative number	A number less than zero.
Positive number	A number greater than zero.
Whole number	A positive integer or zero. Also known as a *natural number*.

ASSESS YOUR UNDERSTANDING

Go to www.wiley.com/college/slavin to evaluate your knowledge of the basics of whole numbers, decimals, and negative numbers.
Measure your learning by comparing pre-test and post-test results

Summary Questions

1. 5.25 is a whole number. True or False?
2. A negative multiplied by a negative equals a negative. True or False?
3. To add decimal numbers, you line up the decimal points. True or False?
4. You cannot divide a number by a negative number. True or False?
5. A negative multiplied by a positive equals a positive. True or False?

Review Questions

1. Explain the difference between whole numbers and counting numbers.
2. How do whole numbers and integers relate to one another?
3. Explain the difference between whole numbers and decimals.
4. Can negative numbers be decimals?

Applying This Chapter

1. Solve the following problems:
   (a) $2 + 1.375$
   (b) $102.3 - 14.5690$
   (c) 12.3×12.3
   (d) $45.75 \div 2.75$
2. Solve the following problems:
   (a) $-57 + (-21.3)$
   (b) -18×2.5
   (c) $-2.3 \times (-2.3)$
   (d) $37 \div (-2.5)$
3. Solve the following problems:
   (a) $3 + 4.56$
   (b) $497.5 - 11.5$
   (c) 7.12×10
   (d) $52 \div 6.35$

4. Solve the following problems:
- **(a)** $-5 + (-9)$
- **(b)** $12.5 + (-11)$
- **(c)** $7.6 - 3$
- **(d)** $-42.6 + (-11)$

5. Solve the following problems:
- **(a)** 3×4.81
- **(b)** $4.9 \div 2.4$
- **(c)** $98.6 - 22.8$
- **(d)** $212 - 17.4$

6. Solve the following problems:
- **(a)** $104.5 + 5.7 + 92$
- **(b)** $0.27 + 209 + 30 + 275$
- **(c)** $233.4287 - 92.476$
- **(d)** 0.335×0.44
- **(e)** 0.0001×872.6
- **(f)** $302.88 \div 6.7$
- **(g)** $165.27 \div 0.01$

7. Solve the following addition problems:
- **(a)** $-4 + (-3)$
- **(b)** $12 + (-4)$
- **(c)** $-6 + (-6)$
- **(d)** $-4 + (-18)$
- **(e)** $-14 + 5$
- **(f)** $14 + (-8)$
- **(g)** $2 + (-8)$
- **(h)** $-8 + 3$

8. Solve the following subtraction problems:
- **(a)** $-5 - 9$
- **(b)** $-5 - (-7)$
- **(c)** $2 - 9$
- **(d)** $4 - 5$
- **(e)** $-2 - (-3)$
- **(f)** $-6 - 10$
- **(g)** $9 - (-10)$
- **(h)** $-40 - 8$
- **(i)** $0 - 12$
- **(j)** $-6 - 6$

9. Solve the following multiplication and division problems:

(a) $-5 \times (-4)$

(b) $30 \times (-2)$

(c) $0 \times (-5)$

(d) $-35 \div (-7)$

(e) $7 \div (-1)$

(f) -10×10

(g) $72 \div (-8)$

(h) -10×3

(i) 9×6

(j) $-6 \div (-3)$

(k) $14.7 \div (-2.1)$

(l) $0.2 \times (-0.3)$

(m) $-12 \div 5 \times 20 \div 3$

YOU TRY IT

Freezing Temperatures

The lowest recorded temperatures in northern Europe is -47 degrees, and the lowest in Siberia is -72 degrees. How much higher is the lowest temperature in Northern Europe than the lowest temperature in Siberia?

Water Levels

The water level of a reservoir fluctuates with the amount of rainfall. Recently, during a 6-month period, the water went down 2 feet, then up 3 feet, down 5 feet, down another 1 foot, up 5 feet, and down 3 feet. How much has the water level changed over the past 6 months? (**Hint:** Add all numbers, using the sign rules.)

Sungard, Inc., Stock

One day in April, Sungard, Inc., stock started at a price of $15.23 on the New York Stock Exchange. During that day, the price rose $3.13, then dropped $6.25, and then rose $8.22. What was the value of the stock at day's end?