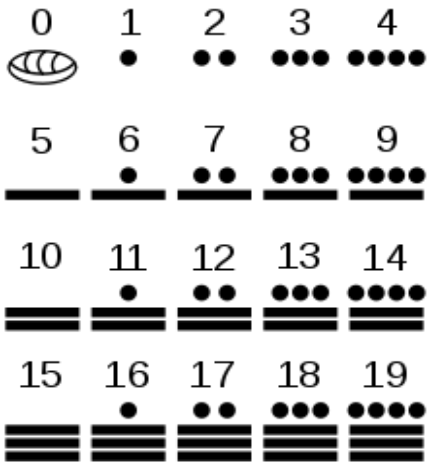
Section 1.1 Whole Numbers

Numbers arose out of our ancestors need to count. **Numbers** are an abstract concept that represents a quantity while **numerals** are the symbols used to represent individual numbers. Below are some of the numerals used by two ancient civilizations, the Mayans and the Romans.

Mayan Numerals *



Roman Numerals

1	2	3	4
I	**II**	**III**	**IV**
5	6	7	8
V	**VI**	**VII**	**VIII**
9	10	11	12
IX	**X**	**XI**	**XII**
13	14	15	16
XIII	**XIV**	**XV**	**XVI**

Our current number system is the Hindu-Arabic system. It is a positional **base ten system** which uses only the ten **digits** 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 along with a positional place value system. The place values starts on the right with the ones place value and each successive place value is ten times the value of the place value located to its immediate right. The **place values** are the ones, tens, hundreds, thousands, ten-thousands, hundred-thousands, millions, …

$10 \times 100{,}000 =$ **1,000,000** **millions**	$10 \times 10{,}000 =$ **100,000** **hundred-thousands**	$10 \times 1{,}000 =$ **10,000** **ten-thousands**	$10 \times 100 =$ **1,000** **thousands**	$10 \times 10 =$ **100** **hundreds**	$10 \times 1 =$ **10** **tens**	**1** **ones**

* Mayan Image created by Bryan Derksen

Example 1 Write the numeral with a digit 5 in the hundreds place, a digit 0 in the tens place, and a digit 4 in the ones place

hundreds	tens	ones
5	0	4

504

Notice the importance of a zero digit to indicate that there are no tens in the number 504

Example 2 Identify the place value of each digit in 2375

thousands	hundreds	tens	ones
2	3	7	5

The digit 2 is located in the thousands position

The digit 3 is located in the hundreds position

The digit 7 is located in the tens position

The digit 5 is located in the ones position

To illustrate how the base ten number system works numbers can be written in **expanded form** with each digit multiplied by its place value which when added equals the original number.

Example 3 Write 379 in expanded form

379 = 3 hundreds + 7 tens + 9 ones = 3(100) + 7(10) + 9(1)

Example 4 Write 5708 in expanded form

5708 = 5 thousands + 7 hundreds + 8 ones = 5(1000) + 7(100) + 8(1)

It might be easier to visualize the expanded form of a number by using money with all the currency bills limited to place value numbers as shown below.

$1 $10 $100 $1,000 $10,000 …

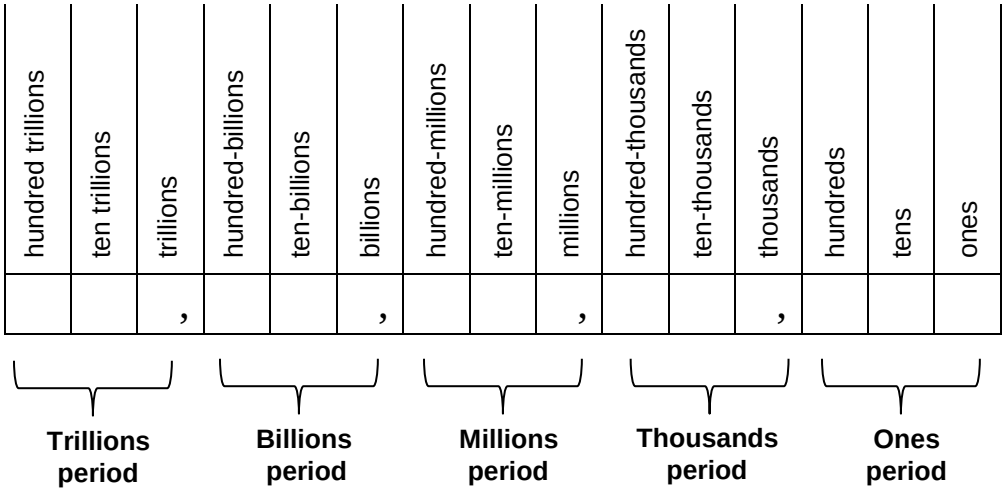
Example 5 Write $267 in expanded form

$267 consist of two $100 bills, six $10 bills, and seven $1 bills

$267 = 2 hundreds + 6 tens + 7 ones = 2($100) + 6($10) + 7($1)

The **whole numbers** { 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, … } is the set which include contains zero and all the counting numbers.

The first chapter of this textbook covers the basic arithmetic operations addition, subtraction, multiplication, and division involving whole numbers. Whole numbers do not include fractions, decimals, or negative numbers. Fractions and decimals are covered in later chapters while negative numbers are introduced in a Pre-Algebra course. To write whole numbers in standard form commas are used to break up the number into groups of three digits which are called **periods**. The ones, thousands, millions, billions, and trillions periods are shown in the diagram below.



Periods are formed by grouping three digits together which results with the period named numbers shown below containing 3, 6, 9, or 12 consecutive zeros.

A **thousand** is written 1**000** with the digit 1 followed by **3 zeros**

A **million** is written 1,**000,000** with the digit 1 followed by **6 zeros**

A **billion** is written 1,**000,000,000** with the digit 1 followed by **9 zeros**

A **trillion** is written 1,**000,000,000,000** with the digit 1 followed by **12 zeros**

Using commas to group three digits into periods allows a whole number in standard form to be easily read and written in words. To write a whole number in words start with the largest period and write the numeral in each period along with the period name except for that the ones period where ones is not written. For numbers having three zero digits in a period, that period name is not written when writing the number in words. To easily identify the period names in the problems in this section the period names are bolded but this bolding of period names will be discontinued after this section. When writing a whole number in words do not use the word "and" which is reserved to indicate a decimal point in later chapters.

Example 6 Write the following numbers in words.

893	Eight hundred ninety three
12,315	Twelve **thousand**, three hundred fifteen
932,096	Nine hundred thirty two **thousand**, ninety six
2,370,049	Two **million**, three hundred seventy **thousand**, forty nine
23,045,706	Twenty three **million**, forty five **thousand**, seven hundred six
19,175,000,000	Nineteen **billion**, one hundred seventy five **million** Notice the 3 zero digits in the thousands and ones periods, so the thousands and ones periods are not mentioned when writing this number in words.

Example 7 Write the following as numbers in standard form.

Five hundred thirty nine	539
Three **thousand**, two hundred forty eight	3248
Seventy eight **thousand**, sixty five	78,065
Two hundred **thousand**, three hundred seven	200,307
Six **million**, two hundred thirty eight **thousand**, nine hundred six	6,238,906
Four hundred fifty six **billion**	456,000,000,000

The whole number four hundred fifty six **billion** as written does not mention the millions, thousands, and ones periods so these periods are filled with zero digits. Notice the importance of zero digits in serving as place holders.

In applications involving large measured quantities, metric prefixes are shortcuts which eliminate the writing of periods consisting entirely of 0 digits. Below are some metric prefixes that indicate large quantities such as the memory size of a flash drive or the size of computer hard drive. In chapter four when decimals are covered, the metric prefixes for representing small measured quantities are defined.

The prefix **kilo** indicates the **thousands** period

The prefix **mega** indicates the **millions** period

The prefix **giga** indicates the **billions** period

The prefix **tera** indicates the **trillions** period

The metric prefixes shown above allow measured quantities with large whole numbers to be written without periods filled with 0 digits. To remove a metric prefix from a measured quantity replace the metric prefix with its equivalent period value written in words then write the number in standard form in terms of the base unit. In the following examples some of the base units are grams, meters, watts, and bytes.

Example 8 Write the following measurements without the metric prefix.

15 megawatts 103 kilograms 2 terabytes

15 **mega**watts = 15 **million** watts = 15,000,000 watts

103 **kilo**grams = 103 **thousand** grams = 103,000 grams

2 **tera**bytes = 2 **trillion** bytes = 2,000,000,000,000 bytes

In the next example, the process is reversed instead of removing a metric prefix, a metric prefix is added to the base unit to create a more compact form eliminating all the periods containing only zero digits.

Example 9 Write the following measurements with the appropriate metric prefix.

5000 meters 12,000,000,000 bytes 68,000 grams

5000 meters = 5 **thousand** meters = 5 **kilo**meters

12,000,000,000 bytes = 12 **billion** bytes = 12 **giga**bytes

68,000 grams = 68 **thousand** grams = 68 **kilo**grams

Exercises 1.1

1-6 Find the digit located in the indicated place value in the following numbers.

1.	5739	hundreds	tens	ones
2.	14,739	thousands	tens	ones
3.	591,057	thousands	hundreds	tens
4.	231,498	ten-thousands	hundreds	tens
5.	35,473,201	millions	hundred-thousands	hundreds
6.	324,980,263,000	hundred-billions	ten-millions	thousands

7-12 Write the following numbers in expanded form.

7.	945	8.	307	9.	1043
10.	5951	11.	12,305	12.	307,910

13-21 Write the following numbers in words.

13.	472	14.	781	15.	6038
16.	140,085	17.	27,351	18.	2,475,000
19.	135,098,104	20.	27,070,351,000	21.	57,812,000,000

22-32 Write the following numbers in standard form.

22. Eight hundred seventy four
23. Nine hundred three
24. Twelve thousand, three hundred forty one
25. Eight thousand, sixty five
26. Three hundred forty thousand, two hundred eleven
27. Five million, two hundred thirty seven thousand, eight hundred
28. Sixty eight million, four hundred seventy eight thousand
29. Five billion, eighty three million, two hundred forty five thousand, sixty two
30. Forty billion, three hundred million
31. Eight trillion, forty seven million, three hundred eight thousand
32. Two hundred trillion, eighty three billion

For problems #33-37 write the indicated numbers in words.

33. The median sales price for homes in Vacaville for Aug to Oct 2012 is $227,500.

34. In November 2012, Solano County voters approved Measure Q which authorizes the Solano Community College District to borrow $348,000,000.

35. The 2014 payroll for the Oakland A's is $74,765,900 and for the San Francisco Giants is $147,738,612.

The population estimates in 2013 of the seven countries in Central America

Country	Population
Belize	334,300
Costa Rica	4,696,000
El Salvador	6,109,000

Country	Population
Guatemala	14,373,000
Honduras	8,448,000
Nicaragua	5,789,000
Panama	3,560,000

36. Write in words the population the two largest countries in Central America.

37. Write in words the population the two smallest countries in Central America.

38-44 Write the number in the following measurements in words and then substitute the appropriate metric prefix (*see example 9 on page 5*)

38. 10,000 meters

39. 230,000 grams

40. 15,000,000 watts

41. 3,000,000,000,000 bytes

42. The speed of light is approximately 300,000,000 meters per second. Write 300,000,000 meters using the appropriate metric prefix.

43. A 150 pound person weighs approximately 68,000 grams. Write 68,000 grams using the appropriate metric prefix.

44. In 2013 the worldwide the production of electricity from wind powers was approximately 318,000,000,000 watts. Write 318,000,000,000 watts using the appropriate metric prefix.

45-50 Write the numbers in the following measurements in words without the metric prefix and then in number form (*see example 8 on page 5*)

45. 47 kilograms

46. 750 megabytes

47. 2 megawatts

48. 9 kilometers

49. 8 gigabyte smart phone

50. 2 terabyte hard drive