CHAPTER 2
SETS AND WHOLE-NUMBER OPERATIONS AND PROPERTIES

Section 2.4
Numeration

ESSENTIAL CONCEPTS
* A digit times its place value gives the value of the digit.
* Each place value to the left of another is 10 times greater than the one to the right.
* The structure of the base-ten numeration system produces many numerical patterns.
* Place-value periods (thousands, millions, billions, etc.) are used to read and write numbers.
* Whole numbers can be named in equivalent ways using place value.
* Whole numbers can be compared by analyzing corresponding place values.

NUMERATION
*A written symbol, such as 2, that represents a number is called a __________, and is referred to as a name for a number.*
*A numeration _______ is an accepted collection of properties and symbols that enables people to systematically write numerals to represent numbers.*

OUR NUMERATION SYSTEM
*The __________ numeration system, developed by ancient Indian and Arabic cultures, is still in widespread use today.*
*Some important features include a symbol for __________ and a way to represent any whole number using some combination of ten digits.*
*The ideas of __________ by tens and place value provide the cornerstones of this system.*

Example: 125 =

HINDU-ARABIC NUMERATION SYSTEM
*To know what quantity is being represented by a place-value numeral, you must know the sizes of the _______ on which the numeral is based. The group size used determines the base of the numeration system.*
*For example, groups of 2 would mean base 2.*
*Successive groups of three digits, called __________, are used to express numerals in base-ten notation.*

EXAMPLE: 389,764,100,528
List the digits in the each period.

a) Thousands
b) Billions
c) Ones
d) Millions
EXAMPLES • SEE EXAMPLE 2.15 ON PG 108
* Express the quantity 156 as the equivalent numeral in each base given.
  * Base five
  * Base two

EXAMPLES
* Express the quantity 2341 five in base ten.

CLASS ACTIVITY
* Represent 1,208 with:
  a) base-ten blocks (proportional model)
  b) colored chips or ??? (non-proportional model)

CLASS ACTIVITY
* Represent 1,208 using expanded notation:
  c) without exponents
  d) with exponents

HISTORICAL NUMERATION SYMBOLS
* See Examples on pages 114-120.

<table>
<thead>
<tr>
<th>Egyptian symbol</th>
<th>Corresponding whole number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reed</td>
<td>One</td>
</tr>
<tr>
<td>Heel bone</td>
<td>Ten</td>
</tr>
<tr>
<td>Coiled rope</td>
<td>One hundred</td>
</tr>
<tr>
<td>Bent reed</td>
<td>One thousand</td>
</tr>
<tr>
<td>Pointed finger</td>
<td>Ten thousand</td>
</tr>
<tr>
<td>Burbot fish</td>
<td>One hundred thousand</td>
</tr>
<tr>
<td>Astonished man</td>
<td>One million</td>
</tr>
</tbody>
</table>

Example
Write 1,278,153 in Egyptian numerals.

FIGURE 2.37
Egyptian hieroglyphs for whole numbers.
Example
Write 113 in Babylonian numerals.

ROMAN NUMERALS (PG 118)

Another numeration system, the __________ numeration system, was developed between 500 B.C. and A.D. 100 by the Romans, and is still in use today to a certain extent.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Whole Number</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1</td>
<td>Write 1967 using Roman numerals.</td>
</tr>
<tr>
<td>V</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>1000</td>
<td></td>
</tr>
</tbody>
</table>

EXAMPLES

Translate each of the following into Roman numerals.

• 125
• 672
• 2003

MORE EXAMPLES

Write the Hindu-Arabic numerals for the numbers represented by each of the following.

• MCMLIX
• IX