

SECTION

1.1

Introduction to Whole Numbers

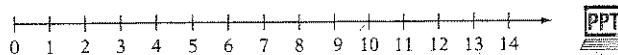
OBJECTIVE A

To identify the order relation between two numbers

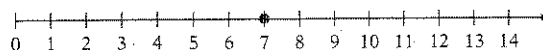
The **whole numbers** are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, ...

The three dots mean that the list continues on and on and that there is no largest whole number.

Just as distances are associated with the markings on the edge of a ruler, the whole numbers can be associated with points on a line. This line is called the **number line**. The arrow on the number line below indicates that there is no largest whole number.

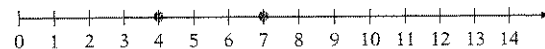


The **graph of a whole number** is shown by placing a heavy dot directly above that number on the number line. Here is the graph of 7 on the number line:

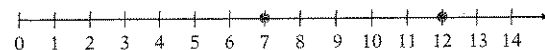


The number line can be used to show the order of whole numbers. A number that appears to the left of a given number is **less than** ($<$) the given number. A number that appears to the right of a given number is **greater than** ($>$) the given number.

Four is less than seven.
 $4 < 7$



Twelve is greater than seven.
 $12 > 7$



EXAMPLE 1

Graph 11 on the number line.

Solution

YOU TRY IT 1

Graph 6 on the number line.

Your solution

EXAMPLE 2

Place the correct symbol, $<$ or $>$, between the two numbers.

- a. 39 24
b. 0 51

Solution

- a. 39 24
b. 0 51

YOU TRY IT 2

Place the correct symbol, $<$ or $>$, between the two numbers.

- a. 45 29
b. 27 0

Your solution

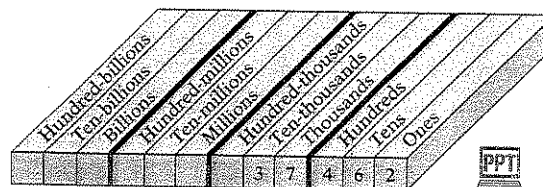
- a.
b.

OBJECTIVE B**To write whole numbers in words and in standard form****Point of Interest**

The Babylonians had a place-value system based on 60. Its influence is still with us in angle measurement and time: 60 seconds in 1 minute, 60 minutes in 1 hour. It appears that the earliest record of a base-10 place-value system for natural numbers dates from the 8th century.

When a whole number is written using the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9, it is said to be in **standard form**. The position of each digit in the number determines the digit's **place value**. The diagram below shows a **place-value chart** naming the first 12 place values. The number 37,462 is in standard form and has been entered in the chart.

In the number 37,462, the position of the digit 3 determines that its place value is ten-thousands.



When a number is written in standard form, each group of digits separated from the other digits by a comma (or commas) is called a **period**. The number 3,786,451,294 has four periods. The period names are shown in red in the place-value chart above.

To write a number in words, start from the left. Name the number in each period. Then write the period name in place of the comma.

3,786,451,294 is read “three billion seven hundred eighty-six million four hundred fifty-one thousand two hundred ninety-four.”

To write a whole number in standard form, write the number named in each period, and replace each period name with a comma.

Four million sixty-two thousand five hundred eighty-four is written 4,062,584. The zero is used as a place holder for the hundred-thousands place.

EXAMPLE 3

Write 25,478,083 in words.

Solution

Twenty-five million four hundred seventy-eight thousand eighty-three

YOU TRY IT 3

Write 36,462,075 in words.

Your solution**EXAMPLE 4**

Write three hundred three thousand three in standard form.

Solution

303,003

YOU TRY IT 4

Write four hundred fifty-two thousand seven in standard form.

Your solution

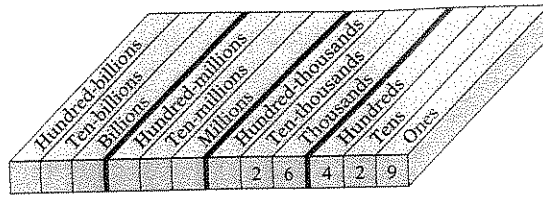
Solutions on p. S1

OBJECTIVE C**To write whole numbers in expanded form**

The whole number 26,429 can be written in **expanded form** as

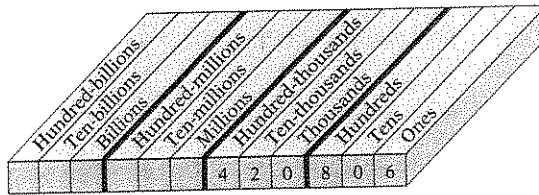
$$20,000 + 6000 + 400 + 20 + 9.$$

The place-value chart can be used to find the expanded form of a number.



$$\begin{array}{r}
 \boxed{2} \\
 \text{Ten-} \\
 \text{thousands} \\
 20,000
 \end{array}
 +
 \begin{array}{r}
 \boxed{6} \\
 \text{Thousands} \\
 6000
 \end{array}
 +
 \begin{array}{r}
 \boxed{4} \\
 \text{Hundreds} \\
 400
 \end{array}
 +
 \begin{array}{r}
 \boxed{2} \\
 \text{Tens} \\
 20
 \end{array}
 +
 \begin{array}{r}
 \boxed{9} \\
 \text{Ones} \\
 9
 \end{array}$$

The number 420,806 is written in expanded form below. Note the effect of having zeros in the number.



$$\begin{array}{r}
 \boxed{4} \\
 \text{Hundred-} \\
 \text{thousands} \\
 400,000
 \end{array}
 +
 \begin{array}{r}
 \boxed{2} \\
 \text{Ten-} \\
 \text{thousands} \\
 20,000
 \end{array}
 +
 \begin{array}{r}
 \boxed{0} \\
 \text{Thousands} \\
 0
 \end{array}
 +
 \begin{array}{r}
 \boxed{8} \\
 \text{Hundreds} \\
 800
 \end{array}
 +
 \begin{array}{r}
 \boxed{0} \\
 \text{Tens} \\
 0
 \end{array}
 +
 \begin{array}{r}
 \boxed{6} \\
 \text{Ones} \\
 6
 \end{array}$$

or simply $400,000 + 20,000 + 800 + 6$.

EXAMPLE 5

Write 23,859 in expanded form.

Solution

$$20,000 + 3000 + 800 + 50 + 9$$

YOU TRY IT 5

Write 68,281 in expanded form.

Your solution

EXAMPLE 6

Write 709,542 in expanded form.

Solution

$$700,000 + 9000 + 500 + 40 + 2$$

YOU TRY IT 6

Write 109,207 in expanded form.

Your solution

Solutions on p. S1

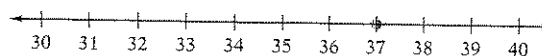
OBJECTIVE D

To round a whole number to a given place value

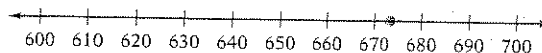
When the distance to the moon is given as 240,000 miles, the number represents an approximation to the true distance. Taking an approximate value for an exact number is called **rounding**. A rounded number is always rounded to a given place value.

E
Ro
So
525
525
530
EX
Rou
Sol
197
197

37 is closer to 40 than it is to 30. 37 rounded to the nearest ten is 40.



673 rounded to the nearest ten is 670. 673 rounded to the nearest hundred is 700.



A whole number is rounded to a given place value without using the number line by looking at the first digit to the right of the given place value.

HOW TO 1 Round 13,834 to the nearest hundred.

13,834
 ┌─── Given place value
 │
 └─── 3 < 5

• If the digit to the right of the given place value is less than 5, that digit and all digits to the right are replaced by zeros.

13,834 rounded to the nearest hundred is 13,800.

HOW TO 2 Round 386,217 to the nearest ten-thousand.

386,217
 ┌─── Given place value
 │
 └─── 6 > 5

• If the digit to the right of the given place value is greater than or equal to 5, increase the digit in the given place value by 1, and replace all other digits to the right by zeros.

386,217 rounded to the nearest ten-thousand is 390,000.

EXAMPLE 7

Round 525,453 to the nearest ten-thousand.

Solution

525,453
 ┌─── Given place value
 │
 └─── 5 = 5

525,453 rounded to the nearest ten-thousand is 530,000.

YOU TRY IT 7

Round 368,492 to the nearest ten-thousand.

Your solution

EXAMPLE 8

Round 1972 to the nearest hundred.

Solution

1972
 ┌─── Given place value
 │
 └─── 7 > 5

1972 rounded to the nearest hundred is 2000.

YOU TRY IT 8

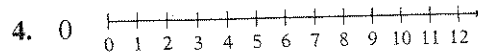
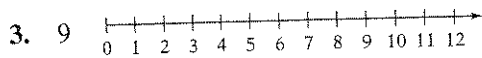
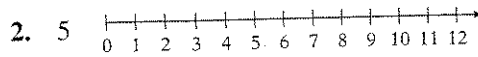
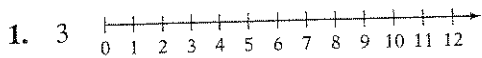
Round 3962 to the nearest hundred.

Your solution

1.1 EXERCISES

OBJECTIVE A To identify the order relation between two numbers

For Exercises 1 to 4, graph the number on the number line.



For Exercises 5 to 12, place the correct symbol, $<$ or $>$, between the two numbers.

5. 37 49

6. 58 21

7. 101 87

8. 245 158

9. 2701 2071

10. 0 45

11. 107 0

12. 815 928

13. Do the inequalities $21 < 30$ and $30 > 21$ express the same order relation?

OBJECTIVE B To write whole numbers in words and in standard form

For Exercises 14 to 17, name the place value of the digit 3.

14. 83,479

15. 3,491,507

16. 2,634,958

17. 76,319,204

For Exercises 18 to 25, write the number in words.

18. 2675

19. 3790

20. 42,928

21. 58,473

22. 356,943

23. 498,512

24. 3,697,483

25. 6,842,715

For Exercises 26 to 31, write the number in standard form.

26. Eighty-five

27. Three hundred fifty-seven

28. Three thousand four hundred fifty-six

29. Sixty-three thousand seven hundred eighty

30. Six hundred nine thousand nine hundred forty-eight
31. Seven million twenty-four thousand seven hundred nine
32. What is the place value of the first number on the left in a seven-digit whole number?

OBJECTIVE C To write whole numbers in expanded form

For Exercises 33 to 40, write the number in expanded form.

33. 5287 34. 6295 35. 58,943 36. 453,921
37. 200,583 38. 301,809 39. 403,705 40. 3,000,642

41. The expanded form of a number consists of four numbers added together. Must the number be a four-digit number?

OBJECTIVE D To round a whole number to a given place value

For Exercises 42 to 53, round the number to the given place value.

42. 926 Tens 43. 845 Tens 44. 1439 Hundreds
45. 3973 Hundreds 46. 43,607 Thousands 47. 52,715 Thousands
48. 389,702 Thousands 49. 629,513 Thousands 50. 647,989 Ten-thousands
51. 253,678 Ten-thousands 52. 36,702,599 Millions 53. 71,834,250 Millions

54. True or false? If a number rounded to the nearest ten is less than the original number, then the ones digit of the original number is greater than 5.

Applying the Concepts

55. If 3846 is rounded to the nearest ten and then that number is rounded to the nearest hundred, is the result the same as what you get when you round 3846 to the nearest hundred? If not, which of the two methods is correct for rounding to the nearest hundred?