# 2.1 The Real Number Line

## What was the coldest temperature in Nome, Alaska?

### Goal
Graph, compare, and order real numbers.

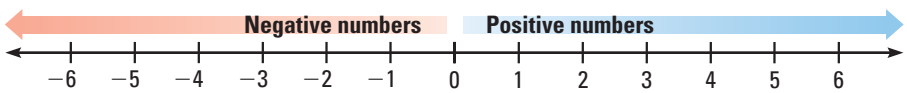
### Key Words
- real number
- real number line
- positive number
- negative number
- integer
- whole number
- graph of a number


In meteorology, temperatures that are above zero are represented by *positive* numbers and temperatures that are below zero are represented by *negative* numbers. In Example 5 you will compare low temperatures for Nome, Alaska.

The numbers used in this book are **real numbers**. Real numbers can be pictured as points on a line called a **real number line**, or simply a number line.

Every real number is either **positive**, **negative**, or zero. Points to the left of zero represent the negative real numbers. Points to the right of zero represent the positive real numbers. Zero is neither positive nor negative.

**REAL NUMBER LINE**




The scale marks on the real number line are equally spaced and represent **integers**. An integer is either negative, zero, or positive. Zero and the positive integers are also called **whole numbers**.

| . . . , −3, −2, −1, | 0, | 1, 2, 3, . . . |
|---|---|---|
| Negative integers | Zero | Positive integers |

The point on a number line that corresponds to a number is the **graph** of the number. Drawing the point is called graphing the number or plotting the point.

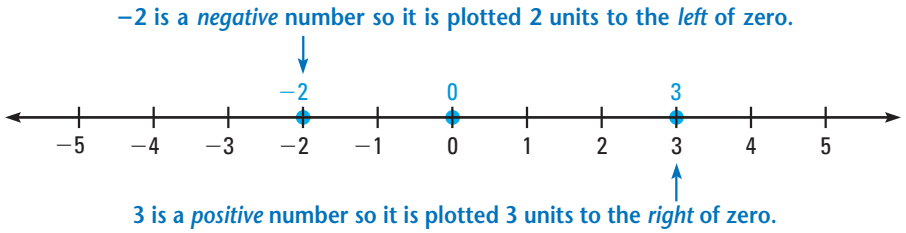
**Student Help**

**READING ALGEBRA**
In Example 1, −2 is read as "negative two," 0 is read as "zero," and 3 is read as "three" or as "positive three."

### EXAMPLE 1 Graph Integers

Graph −2, 0, and 3 on a number line.

**Solution**



On a number line, numbers that are to the left are less than numbers to the right and numbers that are to the right are greater than numbers to the left.

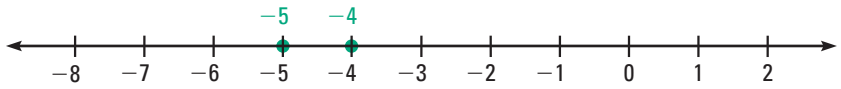
**Student Help**

**SKILLS REVIEW**
For help with comparing and ordering numbers, see pp. 770–771.

## EXAMPLE 2 Compare Integers

Graph $-4$ and $-5$ on a number line. Then write two inequalities that compare the numbers.

### Solution




On the graph, $-5$ is to the left of $-4$, so $-5$ **is less than** $-4$. You can write this using symbols:

$$-5 < -4$$

On the graph, $-4$ is to the right of $-5$, so $-4$ **is greater than** $-5$. You can write this using symbols:

$$-4 > -5$$

## Checkpoint Compare Integers

**Graph the numbers on a number line. Then write two inequalities that compare the numbers.**

**1.** $-6$ and $-2$ **2.** 2 and $-3$ **3.** 5 and 7

You can graph decimals and fractions, as well as integers, on a real number line. The scale marks on a number line do not have to be integers. They can be in units of 0.1, 0.5, 2, 5, or any other amount.

**Student Help**

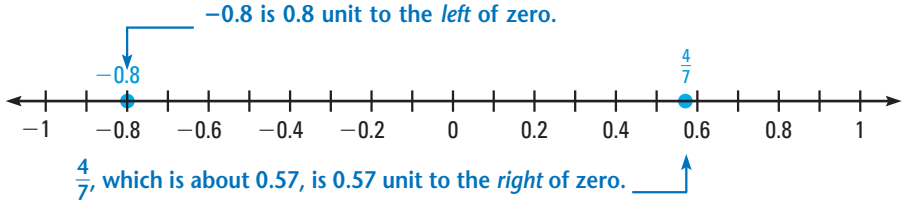
**STUDY TIP**
When you work with fractions, sometimes it is easier to first convert the fraction to a decimal. For example:
$\frac{4}{7} = 4 \div 7 \approx 0.57$

## EXAMPLE 3 Graph Real Numbers

Graph $-0.8$ and $\frac{4}{7}$ on a number line.

### Solution

Because $-0.8$ and $\frac{4}{7}$ are not integers, use a number line that has scale marks in smaller units.



**Student Help**

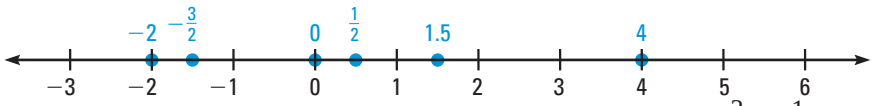
**MORE EXAMPLES**

More examples are available at www.mcdougallittell.com

## EXAMPLE 4 Order Real Numbers

Write the numbers $-2$, 4, 0, 1.5, $\frac{1}{2}$, and $-\frac{3}{2}$ in increasing order.

**Solution** Graph the numbers on a number line. Remember that $\frac{1}{2} = 0.5$ and that $-\frac{3}{2} = -1.5$.




*ANSWER* From the graph, you can see that the order is: $-2$, $-\frac{3}{2}$, 0, $\frac{1}{2}$, 1.5, 4.

## Checkpoint Order Real Numbers

**Write the numbers in increasing order.**

**4.** $-3$, 0, 4, $-\frac{5}{4}$, $\frac{3}{2}$, $-1$

**5.** $-3$, 3, 3.2, $-\frac{1}{2}$, $-8$, 4.5

**Link to Science**


**NOME, ALASKA** The coldest low temperature on record for Nome, Alaska, is $-54$°F.

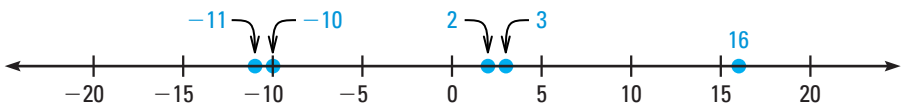
INTERNET **DATA UPDATE** of National Oceanic and Atmospheric Administration data at www.mcdougallittell.com

## EXAMPLE 5 Compare Real Numbers

**NOME, ALASKA** The table shows the low temperatures in Nome, Alaska, for five days in December. Which low temperature was the coldest?

| Date | Dec. 18 | Dec. 19 | Dec. 20 | Dec. 21 | Dec. 22 |
|---|---|---|---|---|---|
| Low Temp. | $-10$°F | $-11$°F | 16°F | 3°F | 2°F |

**Solution** First graph the temperatures on a number line.




*ANSWER* The coldest low temperature was $-11$°F.

## Checkpoint Compare Real Numbers

**6.** The table shows the low temperatures in Nome, Alaska, for five days in February. Which dates had low temperatures above 10°F?

| Date | Feb. 22 | Feb. 23 | Feb. 24 | Feb. 25 | Feb. 26 |
|---|---|---|---|---|---|
| Low Temp. | $-20$°F | $-11$°F | 20°F | 17°F | $-15$°F |

# 2.1 Exercises

## Guided Practice

### Vocabulary Check

**Complete the statement.**

**1.** On a number line, the numbers to the left of zero are __?__ numbers, and the numbers to the right of zero are __?__ numbers.

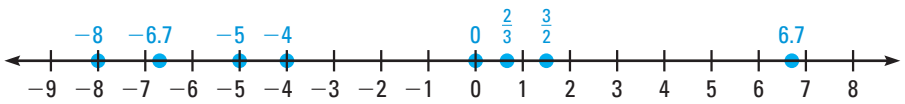
**2.** Zero and the positive integers are also called __?__ numbers.

### Skill Check

**Graph the numbers on a number line.**

**3.** $-5, -1, 4$ **4.** $-3, 0, 3$ **5.** $6, -2, 0.5$ **6.** $-1, -2, -\frac{2}{3}$

**Complete the statement using < or >. Use the number line shown.**




**7.** $-4$ ? $-5$ **8.** $0$ ? $-8$ **9.** $6.7$ ? $-6.7$ **10.** $\frac{3}{2}$ ? $\frac{2}{3}$

**Write the numbers in increasing order.**

**11.** $2, -3, -8, 1, -2$ **12.** $1.2, -4, 5, 7, -6.1$ **13.** $-7, -9, 2, \frac{5}{4}, -\frac{1}{5}$

## Practice and Applications

**GRAPHING INTEGERS** **Graph the numbers on a number line.**

**14.** $0, 2, 6$ **15.** $10, 9, 3$ **16.** $5, 2, 8$

**17.** $-7, -4, -8$ **18.** $-1, -6, -7$ **19.** $-2, -4, -6$

**20.** $1, -2, 3$ **21.** $-3, 1, 5$ **22.** $-4, 4, -5$

**COMPARING INTEGERS** **Graph the numbers on a number line. Then write two inequalities that compare the numbers.**

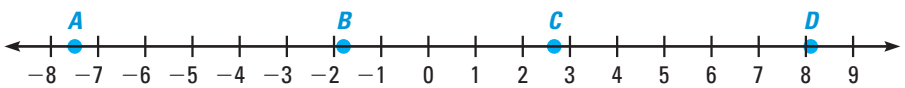
**23.** $-2, 3$ **24.** $4, -6$ **25.** $-1, -6$ **26.** $-7, -5$

**27.** $0, -4$ **28.** $8, -8$ **29.** $10, 11$ **30.** $9, -12$

**Student Help**

**HOMEWORK HELP**
**Example 1:** Exs. 14–22
**Example 2:** Exs. 23–30
**Example 3:** Exs. 31–43
**Example 4:** Exs. 44–51
**Example 5:** Exs. 52–59

**REAL NUMBERS** **Match the number with its position on the number line.**




**31.** $8.1$ **32.** $-1.8$ **33.** $\frac{8}{3}$ **34.** $-\frac{15}{2}$

**GRAPHING REAL NUMBERS** **Graph the numbers on a number line.**

**35.** 0.5, −1.5, 2.5

**36.** −5.6, −0.3, 2

**37.** 4.2, 4.4, 4.6

**38.** $-\frac{7}{8}$, 0, −0.5

**39.** 4.3, $-\frac{9}{2}$, −2.8

**40.** $\frac{3}{4}$, $-\frac{7}{3}$, −3

**41.** $\frac{1}{2}$, $-\frac{2}{3}$, $-\frac{1}{2}$

**42.** $\frac{1}{3}$, $\frac{3}{2}$, $\frac{11}{4}$

**43.** $\frac{9}{10}$, $-\frac{2}{5}$, $-\frac{8}{3}$

**Student Help**

**HOMEWORK HELP**

Extra help with problem solving in Exs. 44–49 is available at www.mcdougallittell.com

**ORDERING REAL NUMBERS** **Write the numbers in increasing order.**

**44.** 4.6, 0.7, −4, −1.8, 3, −0.6

**45.** −0.3, 0.2, 0, 2.0, −0.2, −3.0

**46.** 6.3, −6.8, −6.1, 6.1, −6.2, 6.7

**47.** $\frac{9}{2}$, 3.4, 4.1, −5.2, −5.1, $-\frac{10}{4}$

**48.** 7, $-\frac{1}{2}$, 2, $-\frac{3}{4}$, −5, $\frac{1}{6}$

**49.** 4.8, −2.6, 0, $-\frac{7}{2}$, $\frac{1}{2}$, $-\frac{1}{2}$

**LOGICAL REASONING** **Complete the statement using < or >.**

**50.** If $x > -4$, then $-4$ ? $x$.

**51.** If $3 < y$, then $y$ ? 3.

**ELEVATION** **In Exercises 52–54, write a positive number, a negative number, or zero to represent the elevation of the location.**

Elevation is represented by comparing a location to sea level, which is given a value of zero. A location above sea level has a positive elevation, and a location below sea level has a negative elevation.

**52.** Granite Peak, Montana, 12,799 feet above sea level

**53.** New Orleans, Louisiana, 8 feet below sea level

**54.** Long Island Sound, Connecticut, sea level

**Link to Science**

**ASTRONOMY** A star may appear dim because it is far from Earth. It may actually be brighter than a star that looks very bright only because it is closer to Earth.

**Science Link** **In Exercises 55–59, use the table shown which gives the apparent magnitude of several stars.**

A star's brightness as it appears to a person on Earth is measured by its *apparent magnitude*. The lesser the apparent magnitude, the brighter the star.

**55.** Graph the apparent magnitudes on a number line. Label each point with the name of the star.

**56.** Which stars have an apparent magnitude that is less than the apparent magnitude of Altair?

**57.** Which stars have an apparent magnitude that is greater than the apparent magnitude of Procyon?

**58.** Which star has the least apparent magnitude and so looks the brightest?

**59.** Which star has the greatest apparent magnitude and so looks the dimmest?

| Star | Apparent magnitude |
|---|---|
| Canopus | −0.7 |
| Procyon | 0.4 |
| Pollux | 1.1 |
| Altair | 0.8 |
| Spica | 1.0 |
| Regulus | 1.4 |
| Sirius | −1.5 |
| Deneb | 1.3 |

## Standardized Test Practice

**60. MULTIPLE CHOICE** Which inequality is true?

Ⓐ $-9 > -5$ Ⓑ $9 < 5$ Ⓒ $9 < -5$ Ⓓ $-9 < 5$

**61. MULTIPLE CHOICE** Which number is less than $-0.1$?

Ⓕ $-10$ Ⓖ $0$ Ⓗ $0.001$ Ⓙ $10$

**62. MULTIPLE CHOICE** Which set of numbers is in increasing order?

Ⓐ $-1.9, 1.8, -0.5, 0, 0.5$ Ⓑ $-1.9, -0.5, 0, 0.5, 1.8$

Ⓒ $0, -0.5, 0.5, 1.8, -1.9$ Ⓓ $-0.5, 0, 0.5, 1.8, -1.9$

## Mixed Review

**Geometry Link** **Find the area of the object.** *(Lesson 1.2)*

**63.** The top of a computer desk measures 2 feet by 2 feet.

**64.** The cover of a children's book is 4 inches long and 4 inches wide.

**65.** A square piece of construction paper has a side length of 9 centimeters.

**MENTAL MATH** **Use mental math to solve the equation.** *(Lesson 1.4)*

**66.** $9 - y = 1$ **67.** $t + 6 = 10$ **68.** $2a = 8$

**69.** $15 \div r = 3$ **70.** $\frac{k}{2} = 8$ **71.** $\frac{27}{n} = 9$

**72. BIRTHS** The table shows the number of births (in thousands) in the United States by month for 1997. Make a bar graph of the data. *(Lesson 1.7)*

| Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 305 | 289 | 313 | 342 | 311 | 324 | 345 | 341 | 353 | 329 | 304 | 324 |

**Science Link** **When it is 70°F, the function $T = 0.08H + 64.3$ gives the *apparent* temperature $T$ (in degrees Fahrenheit) based on the relative humidity $H$ (as a percent).** *(Lesson 1.8)*

**73.** Copy and complete the input-output table.

| Input $H$ | 20% | 40% | 60% | 70% | 100% |
|---|---|---|---|---|---|
| Output $T$ | ? | ? | ? | ? | ? |

**74.** Use the table to draw a graph that represents the function.

**75.** Determine the range of the function.

## Maintaining Skills

**FACTORS** **Write the prime factorization of the number if it is not a prime. If the number is a prime, write *prime*.** *(Skills Review p. 761)*

**76.** 18 **77.** 35 **78.** 47 **79.** 64

**80.** 100 **81.** 101 **82.** 110 **83.** 144