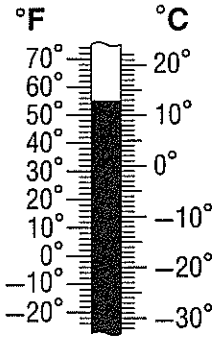
Positive and Negative Numbers

Our number system uses both positive and negative numbers.

- **Positive numbers** are greater than zero.
- **Negative numbers** are less than zero.
- **Zero** is neither positive nor negative.

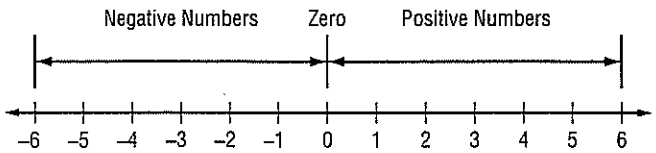


A thermometer shows both positive and negative temperatures.

A thermometer shows both positive and negative temperatures. As seen on the thermometer, negative values are always preceded by a negative (minus) sign "−".

- 20° below 0° is written as −20°.
- A 3.5% drop in a stock value is written as −3.5%.
- 85 feet below sea level is written as an altitude of −85 feet.

A **number line** shows both positive and negative numbers. On a **horizontal number line,** negative numbers are to the left of zero; positive numbers are to the right.



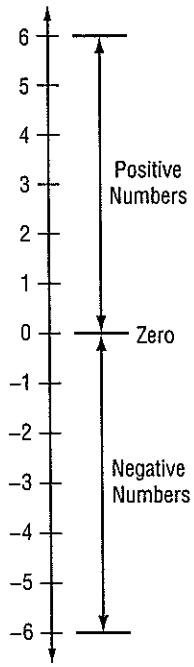
Horizontal Number Line

On a **vertical number line,** negative numbers are below zero; positive numbers are above. Numbers on a number line get greater in value as you move from negative numbers to positive numbers.

- Every negative number is less than zero.
- Every positive number is greater than zero.
- Every positive number is greater than every negative number.

A negative number can be read in any of three ways. You can read −5 as

- negative 5
- minus 5
- 5 below zero

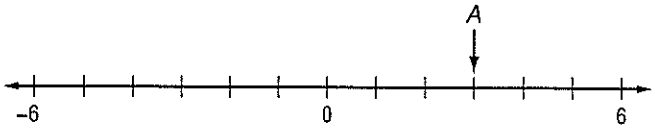


Vertical Number Line

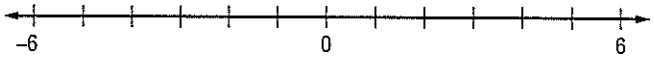
1. Write letters above the number line to show where each number belongs. Point A is done as an example.

Point A 3 | Point B -4 | Point C $1\frac{1}{2}$ | Point D 5.25

Point E $-3\frac{1}{2}$ | Point F 0.75 | Point G -5.55



2. a. Write the letter H above the point -2 on the number line below.



b. Write the letter I above the point that is 4 units to the right of point H.

c. Write the letter J above the point that is 3 units to the right of point I.

d. Write the letter K above the point that is 9 units to the left of point J.

e. What number does each letter represent?

Point I is _____ Point J is _____ Point K is _____

3. Circle the greatest number in each group.

a. $-3, 0, -2$ | $4, 0, -2$ | $5, 3, -7$ | $-4, -2, -8$

b. $-1, -5, -6$ | $3, -1, -5$ | $-6, -2, 0$ | $-5, 3, -1$

4. Circle the least number in each group.

a. $-8, -10, 0$ | $7, 0, 2$ | $8, -1, 0$ | $-2, 6, -4$

b. $-4, 7, -5$ | $0, 3, -2$ | $-2, 4, 0$ | $0, 1, -1$

Applying Your Skills: Operations with Numbers

The four basic operations in mathematics are addition, subtraction, multiplication, and division. Addition is always shown by a plus sign (+) and subtraction by a minus sign (−). Multiplication and division can be shown in more than one way.

ADDITION		SUBTRACTION	
Symbol	**Example**	**Symbol**	**Example**
+	4 + 5	−	6 − 3

MULTIPLICATION		DIVISION	
Symbol	**Example**	**Symbol**	**Example**
×	7 × 3	÷	12 ÷ 4
•	7 • 3	/	12/4
( )	7(3) or (7)3	—	$\frac{12}{4}$

Order of Operations

In multistep problems, the order in which you perform operations is important.

- First, perform operations within parentheses.
- Second, multiply or divide, working from left to right.
- Third, add or subtract, working from left to right.

EXAMPLE 1 Simplify 6 + 8 ÷ 4.

STEP 1 Divide first: 8 ÷ 4 = 2

STEP 2 Add: 6 + 2 = **8**

ANSWER: **8**

(**Note:** If you add as your first step, you will get 14 ÷ 4 = 3.5, which is incorrect.)

EXAMPLE 3 Simplify 12 × 3 − 20.

STEP 1 Multiply first: 12 × 3 = 36

STEP 2 Subtract: 36 − 20 = **16**

ANSWER: **16**

EXAMPLE 2 Simplify 3(7 − 2).

STEP 1 Subtract the numbers inside the parentheses: 7 − 2 = 5

STEP 2 Multiply: 3(5) = **15**

ANSWER: **15**

EXAMPLE 4 Simplify 7(5 + 3) − 10/2.

STEP 1 Add the numbers inside the parentheses: 5 + 3 = 8

STEP 2 Multiply: 7(8) = 56

STEP 3 Divide: 10/2 = 5

STEP 4 Subtract: 56 − 5 = **51**

ANSWER: **51**

Simplify each product or quotient.

1. $5(3) =$ $\quad 8 \cdot 3 =$ $\quad (6)3 =$ $\quad 5 \times 7 =$ $\quad 9 \cdot 2 =$

2. $30 \div 6 =$ $\quad 12/6 =$ $\quad \frac{28}{7} =$ $\quad 45 \div 9 =$ $\quad 33/11 =$

3. $9 \cdot 6 =$ $\quad 21/7 =$ $\quad 4(2) =$ $\quad 18 \div 9 =$ $\quad 5 \times 8 =$

Show three ways to write each expression.

4. 12 times 9 _____ _____ _____

5. 24 divided by 6 _____ _____ _____

Simplify. The first one in each row is started for you.

6. $5 + 9 \times 2$ $\quad 12 \times 4 - 6$ $\quad 25 - 15 \div 3$ $\quad 14 \div 2 + 6$

   $5 + 18$

7. $2(5 + 3)$ $\quad 5(12 - 3)$ $\quad (25 + 5) \div 6$ $\quad (42 - 24) \div 6$

   $2(8)$

8. $(6 \times 2) + (3 \times 2)$ $\quad (36 \div 4) - (3 \times 2)$ $\quad (4 \times 3) - (15 \div 5)$

   $12 + 6$

9. $4(3 + 2) - (3 \times 2)$ $\quad 5(12 - 8) + (5 \times 3)$ $\quad (12 \div 6) + 2(8 - 5)$

   $4(5) - 6$

Relating Fractions, Decimals, and Percents

Fractions, decimals, and percents can be changed into one another.

- A fraction can be changed to a percent by multiplying by 100%. EXAMPLE $\frac{1}{4} \times 100\% = 25\%$
- A decimal can be changed to a percent by moving the decimal point two places to the right. EXAMPLE $0.37 = 37\%$
- Percent has the same value as a fraction with a denominator of 100. EXAMPLE $37\% = \frac{37}{100}$
- Percent has the same value as a two-place decimal. EXAMPLE $37\% = 0.37$

Did You Know ...?

$\frac{1}{3} = 33\frac{1}{3}\%$

$\frac{2}{3} = 66\frac{2}{3}\%$

You'll want to remember these.

Write each fraction as a percent.

1. $\frac{3}{4}$ $\frac{1}{2}$ $\frac{7}{10}$ $\frac{4}{5}$ $\frac{7}{20}$

Write each decimal as a percent.

2. 0.13 0.25 0.37 0.82 0.5

Write each percent as a fraction in lowest terms.

3. 17% 35% 40% 75% 82%

Write each percent as a decimal.

4. 30% 50% 42% 60% 95%

Answer each question.

5. One meter is equal to 100 centimeters.

a. What fraction of 1 meter is 35 centimeters? _____

b. What percent of 1 meter is 58 centimeters? _____

6. A sale advertises 30% off all sweaters.

a. Write the discount percent as a fraction. _____

b. Write the discount percent as a decimal. _____

Reviewing Computation Skills

FRACTIONS

Add or subtract.

1. $\begin{array}{r} \frac{1}{3} \\ +\ \frac{1}{3} \\ \hline \end{array}$ $\begin{array}{r} \frac{3}{5} \\ +\ \frac{2}{5} \\ \hline \end{array}$ $\begin{array}{r} \frac{7}{8} \\ +\ \frac{5}{8} \\ \hline \end{array}$ $\begin{array}{r} \frac{1}{2} \\ +\ \frac{1}{4} \\ \hline \end{array}$ $\begin{array}{r} \frac{3}{4} \\ +\ \frac{5}{8} \\ \hline \end{array}$

2. $\begin{array}{r} \frac{7}{8} \\ -\ \frac{2}{8} \\ \hline \end{array}$ $\begin{array}{r} \frac{3}{4} \\ -\ \frac{1}{4} \\ \hline \end{array}$ $\begin{array}{r} \frac{5}{6} \\ -\ \frac{1}{2} \\ \hline \end{array}$ $\begin{array}{r} 1\frac{1}{4} \\ -\ \frac{3}{4} \\ \hline \end{array}$ $\begin{array}{r} 1\frac{3}{8} \\ -\ \frac{1}{2} \\ \hline \end{array}$

Multiply.

3. $\frac{1}{2} \times \frac{1}{2} =$ $\frac{1}{3} \times \frac{3}{5} =$ $\frac{3}{4} \times \frac{2}{3} =$ $\frac{7}{8} \times \frac{3}{2} =$

4. $\frac{1}{2} \times 5 =$ $6 \times \frac{2}{3} =$ $1\frac{1}{2} \times 3 =$ $3 \times 2\frac{1}{3} =$

Divide.

5. $\frac{1}{2} \div \frac{1}{4} =$ $\frac{1}{3} \div \frac{1}{2} =$ $\frac{3}{4} \div \frac{2}{3} =$ $\frac{1}{8} \div \frac{1}{8} =$

6. $\frac{1}{4} \div 2 =$ $\frac{1}{2} \div 3 =$ $4 \div \frac{1}{2} =$ $6 \div \frac{2}{3} =$

Comparing Numbers: Inequalities

An **inequality** is a comparison of two or more numbers.

Five comparison symbols are used with inequalities.

Symbol	Meaning	Example	Read as
$<$	is less than	$n < 8$	n is less than 8.
$>$	is greater than	$m > 10$	m is greater than 10.
$\leq$	is less than *or* equal to	$r \leq 12$	r is less than *or* equal to 12.
$\geq$	is greater than *or* equal to	$s \geq 15$	s is greater than *or* equal to 15.
$\neq$	is not equal to	$p \neq 7$	p is not equal to 7.

In each inequality, the letter can be *any value* that makes the inequality true.

- $n < 8$ n can be any value less than 8.
  Example values: $n = 5$, $n = 0$, or $n = -7.5$
- $m > 10$ m can be any value greater than 10.
  Example values: $m = 10.5$, $m = 11$, or $m = 21\frac{1}{4}$
- $r \leq 12$ r can be any value less than *or* equal to 12.
  Example values: $r = 12$, $r = 9$, or $r = -2.75$
- $s \geq 15$ s can be any value greater than *or* equal to 15.
  Example values: $s = 15$, $s = 20$, or $s = 30\frac{1}{2}$

Did You Know...?
In an inequality, the allowed values include whole numbers, decimals, and fractions.

For each inequality, circle any allowed value for the letter. Two problems are done as examples.

1. a. $n < 9$ (−4) (0) (6) 9 10 12

b. $p < 11$ −1 0 4 10 12 14

2. a. $t > 10$ −3 1 7 10 13 25

b. $x > 7$ −2 0 7 9 18 26

3. a. $m \leq 15$ (−3) (1) (15) 18 27 39

[m can be equal to 15 *or* any number less than 15.]

b. $n \leq 5$ −6 1 4 5 7 10

[n can be equal to 5 *or* any number less than 5.]

4. a. $y \geq 12$ −3 1 12 18 27 39

[y can be equal to 12 *or* any number greater than 12.]

b. $x \geq 8$ −9 4 8 13 18 21

[x can be equal to 8 *or* any number greater than 8.]

Range of Values

Two comparison symbols can be used together to describe a range of values. The lower end of the range is usually written as the first number of the inequality.

Inequality	Meaning	Example Values
$5 < n < 8$	n is greater than 5 *and* less than 8.	$n = 6, n = 7, n = 7.5$
$-3 \leq m < 2$	m is greater than or equal to -3 *and* less than 2.	$m = -3, m = 0, m = 1$
$0 < x \leq 5$	x is greater than 0 *and* less than or equal to 5.	$x = \frac{3}{4}, x = 1, x = 4.2, x = 5$
$-6 \leq y \leq 6$	y is greater than or equal to -6 *and* less than or equal to 6.	$y = -6, y = 0, y = 2.9, y = 6$

Write the meaning of each inequality.

5. $-3 < x < 7$ _____

6. $-4 \leq y < 20$ _____

7. $6 < p \leq 17$ _____

8. $-9 \leq x \leq 13$ _____

For each inequality, three possible values are given. If the value is correct (makes the inequality a true statement), circle *Yes*. If not, circle *No*.

9. $-1 < x < 6$	**a.** $x = 4$	Yes	No	**b.** $x = -1$	Yes	No	**c.** $x = 0$	Yes	No
10. $-3 \leq n < 0$	**a.** $n = 0$	Yes	No	**b.** $n = 1$	Yes	No	**c.** $n = -4$	Yes	No
11. $1 < m \leq 9$	**a.** $m = -2$	Yes	No	**b.** $m = 0$	Yes	No	**c.** $m = 5$	Yes	No
12. $-7 \leq p \leq 7$	**a.** $p = -3$	Yes	No	**b.** $p = 0$	Yes	No	**c.** $p = 3$	Yes	No

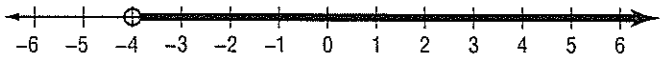
Graphing an Inequality

An inequality can be graphed on a number line.

- An open circle, ○, means that a number is not a correct value.
- A solid circle, ●, means that a number is a correct value.
- A solid line is drawn through all correct values.

EXAMPLE 1 Inequality: $n > -4$

Values of n

Graph: 

Meaning: n is greater than -4. (n cannot have the value of -4.)

EXAMPLE 2 Inequality: $x \geq 0$

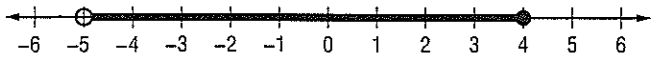
Values of x

Graph: 

Meaning: x is greater than *or* equal to 0. (x can have the value of 0.)

EXAMPLE 3 Inequality: $-5 < s \leq 4$

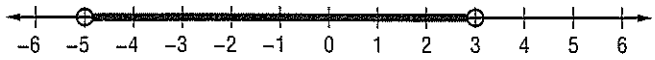
Values of s

Graph: 

Meaning: s is greater than -5 *and* less than *or* equal to 4.

EXAMPLE 4 Inequality: $-5 < v < 3$

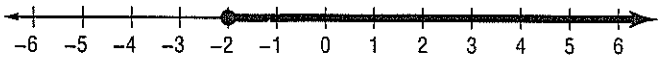
Values of v

Graph: 

Meaning: v is greater than -5 *and* less than 3.

Choose the inequality that is graphed on each number line.

1. Values of t



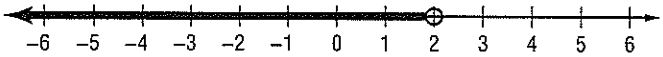
a. $t < -2$ **b.** $t > -2$ **c.** $t \geq -2$

2. Values of w

a. $-5 < w < 1$ **b.** $-5 < w \leq 1$ **c.** $-5 \leq w < 1$

Write the inequality that is graphed on each number line.

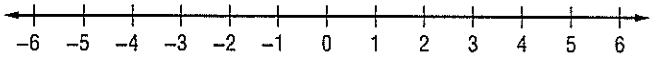
3. Values of n



4. Values of s

Graph each inequality on the number line.

5. $x > -1$ Values of x



6. $-3 < y \leq 4$ Values of y