

Equation

Two algebraic expressions separated by an equals sign.

EX:  $x = 2$

$$3x - 5 = 2(x + 3) - 7$$

$$4 = 7$$

$$x = x + 1$$

A solution of an equation

$$2x + 3 = 13$$

Is  $x = 5$  a solution?

$$2(5) + 3 \stackrel{?}{=} 13$$

<i>Addition (+)</i>	<i>Subtraction (-)</i>	<i>Multiplication (•)</i>	<i>Division (÷)</i>	<i>Equality (=)</i>
Sum	Difference of	Product	Quotient	Equals
Plus	Minus	Times	Divide	Gives
Added to	Subtracted from	Multiply	Into	Is/was/should be
→ More than	Less than	Twice	Ratio	Yields
Increased by	Decreased by	Of	Divided by	Amounts to
Total	Less			Represents/ Is the same as

Remember 6 more than 2  $2 + 6$

6 is more than 2  $6 > 2$

Note: subtraction & division are not commutative.

<i>Phrase</i>	<i>Translation</i>
A number decreased by 10	$x - 10$
A number subtracted from 10	$10 - x$
10 less than a number	$x - 10$
A number less 10	$x - 10$

} Notice the order.

Ex: (p 32)

66. Is 6 a solution of  $2x + 7 = 3x$ ?

$$\begin{array}{l} 2(6) + 7 \stackrel{?}{=} 3(6) \\ 12 + 7 \neq 18 \end{array} \quad \text{No!}$$

68. Is 2 a solution of  $4x + 2 = x + 8$ ?

$$\begin{array}{l} 4(2) + 2 \stackrel{?}{=} 2 + 8 \\ 8 + 2 = 2 + 8 \end{array} \quad \text{Yes}$$

Translate into symbols

76. One-half times a number  $\frac{1}{2}n$

78. The quotient of a number and 9  $\frac{x}{9}$   
 $x \div 9$

82. Four subtracted from eight is equal to two squared.

$$8 - 4 = 2^2$$

**92.** Determine whether each is an expression or an equation.

**a.**  $3x^2 - 26$

**b.**  $3x^2 - 26 = 1$

**c.**  $2x - 5 = 7x - 5$

**d.**  $9y + x - 8$

## 1.5: Adding Real Numbers

$$2 + 3 = 5$$

$$2 + (-3) = -1$$

$$-2 + 3 = 1$$

$$(-2) + (-3) = -5$$

Adding same sign

Adding different signs

Additive inverse

Ex: (p 40)

58. On January 2, 1943, the temperature was  $-4^{\circ}$  at 7:30 A.M. in Spearfish, South Dakota. Incredibly, it got  $49^{\circ}$  warmer in the next 2 minutes. To what temperature did it rise by 7:32?

$$-4^{\circ} + 49^{\circ} = 45^{\circ}$$

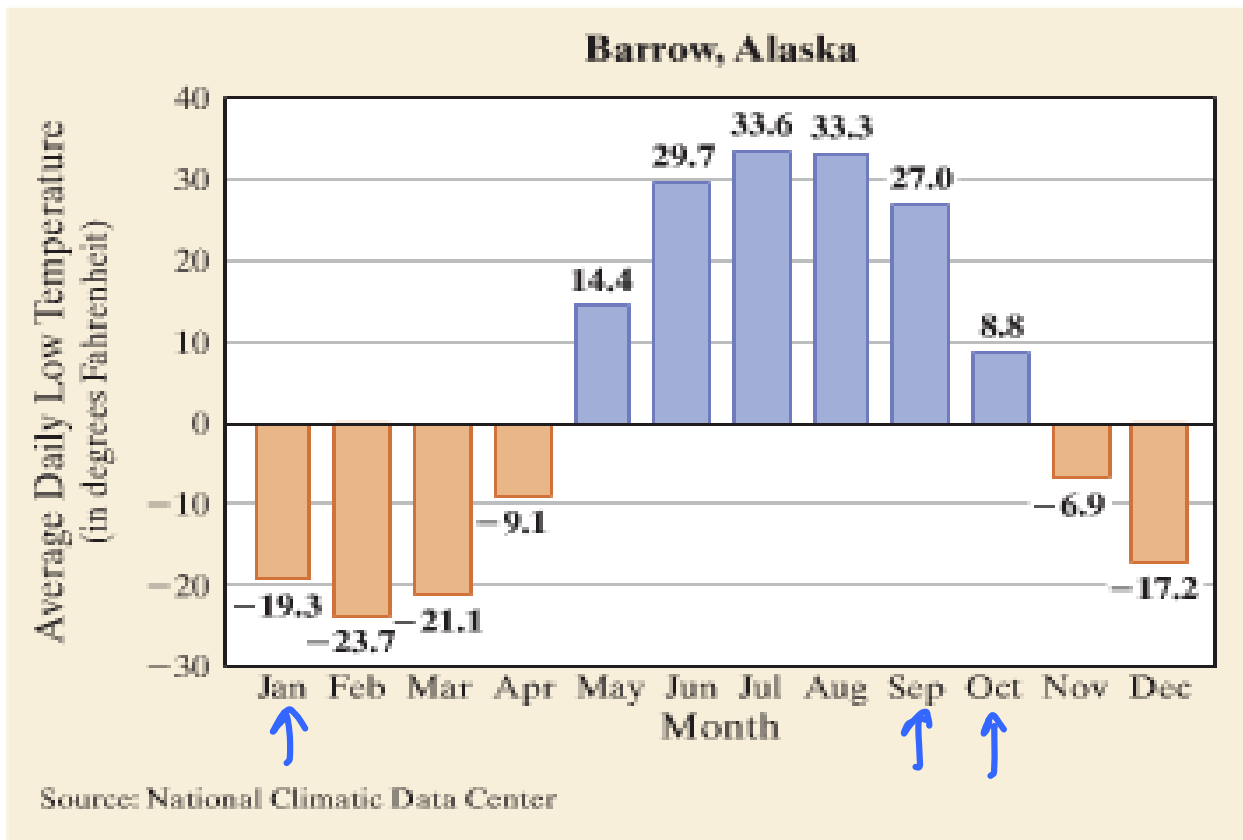
60. The lowest point in Africa is  $-512$  feet at Lake Assal in Djibouti. If you are standing at a point 658 feet above Lake Assal, what is your elevation? (*Source: Microsoft Encarta*)

$$-512 + 658 = 146$$

64. During the 2007 PGA Buick Invitational Golf Tournament, Tiger Woods won with scores of  $-6$ ,  $0$ ,  $-3$ , and  $-6$ . What was his overall score? (*Source: Professional Golf Association*)

$$-6 + 0 + (-3) + (-6) = -15$$

84. Is 10 a solution of  $7 = -x + 3$ ?



88. For what month is the graphed temperature the lowest?

90. For what month is the graphed temperature negative *and* closest to  $0^\circ$ ?

92. Find the average of the temperatures shown for the months of January, September, and October.

mean

$$\begin{aligned} & \underline{-19.3 + 27.0 + 8.8} \\ & 7.7 + 8.8 \end{aligned}$$

$$\frac{16.5}{3} = 5.5$$

*If  $a$  is a positive number and  $b$  is a negative number, fill in the blanks with the words positive or negative.*

**93.**  $-a$  is \_\_\_\_\_.

**94.**  $-b$  is \_\_\_\_\_.

**95.**  $a + a$  is \_\_\_\_\_.

**96.**  $b + b$  is \_\_\_\_\_.

## 1.6: Subtracting Real Numbers

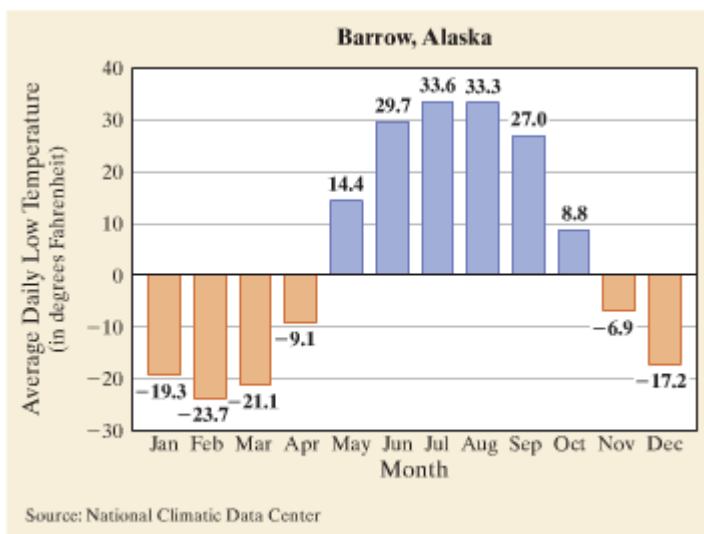
If you don't want to do subtraction

### Subtracting Two Real Numbers

If  $a$  and  $b$  are real numbers, then  $a - b = a + (-b)$ .

Ex: (p 46)

70. Much of New Orleans is below sea level. If George descends 12 feet from an elevation of 5 feet above sea level, what is his new elevation?
72. In some card games, it is possible to have a negative score. Lavonne Schultz currently has a score of 15 points. She then loses 24 points. What is her new score?
78. The airport in Bishop, California, is at an elevation of 4101 feet above sea level. The nearby Furnace Creek Airport in Death Valley, California, is at an elevation of 226 feet below sea level. How much higher in elevation is the Bishop Airport than the Furnace Creek Airport? (*Source: National Climatic Data Center*)



90. Which month had the greatest increase in temperature?
91. Which month had the greatest decrease in temperature?

## 1.7: Multiplying and Dividing Real Numbers

Two cases we'll get to  
Same sign & Different sign

### Zero as a Factor

If  $b$  is a real number, then  $b \cdot 0 = 0$ . Also,  $0 \cdot b = 0$ .

### ► Helpful Hint

You may have noticed from the example that if we multiply:

- an *even* number of negative numbers, the product is *positive*.
- an *odd* number of negative numbers, the product is *negative*.

### Helpful Hint

Be careful when identifying the base of an exponential expression.

$$\begin{array}{ccc} (-3)^2 & & -3^2 \\ \text{Base is } -3 & & \text{Base is } 3 \\ (-3)^2 = (-3)(-3) = 9 & & -3^2 = -(3 \cdot 3) = -9 \end{array}$$

### Reciprocals or Multiplicative Inverses

Two numbers whose product is 1 are called reciprocals or multiplicative inverses of each other.

### Quotient of Two Real Numbers

If  $a$  and  $b$  are real numbers and  $b$  is not 0, then

$$a \div b = \frac{a}{b} = a \cdot \frac{1}{b}$$

### Multiplying and Dividing Real Numbers

1. The product or quotient of two numbers with the *same* sign is a positive number.
2. The product or quotient of two numbers with *different* signs is a negative number.

**Zero as a Divisor or Dividend**

1. The quotient of any nonzero real number and 0 is undefined. In symbols, if  $a \neq 0$ ,  $\frac{a}{0}$  is **undefined**.
2. The quotient of 0 and any real number except 0 is 0. In symbols, if  $a \neq 0$ ,  $\frac{0}{a} = 0$ .

Ex: (p 56)

If  $x = -5$  and  $y = -3$ , evaluate each expression.

104.  $4x + 5y$

110.  $\frac{2y - 12}{x - 4}$

114. At the end of the third quarter of 2006, General Motors reported a net loss of \$115 million. If this continued, what would General Motor's income be after four more quarters?  
(Source: General Motors)

116. Is  $-4$  a solution of  $2x = x - 1$ ?

120. Is  $-4$  a solution of  $2x + 4 = x + 8$ ?

*Write each of the following as an expression and evaluate.*

**132.** The sum of 1 and the product of  $-8$  and  $-5$

**134.** 7 subtracted from the quotient of 0 and 5

## 1.8: Properties of Real Numbers

### Commutative Properties

**Addition:**  $a + b = b + a$

**Multiplication:**  $a \cdot b = b \cdot a$

### Associative Properties

**Addition:**  $(a + b) + c = a + (b + c)$

**Multiplication:**  $(a \cdot b) \cdot c = a \cdot (b \cdot c)$

### Distributive Property of Multiplication Over Addition

$$a(b + c) = ab + ac$$

**Identities for Addition and Multiplication**

0 is the identity element for addition.

$$a + 0 = a \quad \text{and} \quad 0 + a = a$$

1 is the identity element for multiplication.

$$a \cdot 1 = a \quad \text{and} \quad 1 \cdot a = a$$

**Additive or Multiplicative Inverses**

The numbers  $a$  and  $-a$  are additive inverses or opposites of each other because their sum is 0; that is,

$$a + (-a) = 0$$

The numbers  $b$  and  $\frac{1}{b}$  (for  $b \neq 0$ ) are reciprocals or multiplicative inverses of each other because their product is 1; that is,

$$b \cdot \frac{1}{b} = 1$$

Ex: (p 63)

Simplify

36.  $5(7 + 8y)$

38.  $3(8x - 1)$

40.  $2(x + 5)$

42.  $-3(z - y)$

44.  $-5(2r + 11)$

52.  $-(q - 2 + 6r)$

56.  $-\frac{1}{5}(10a - 25b)$

60.  $-11(5x + 3) + 10$