# Day 5

# Subtracting Real Numbers

**Subtracting Real Numbers**

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

$$\left.\begin{aligned} 10 - 4 &= 10 + (-4) = 6 \\ -10 - 4 &= -10 + (-4) = -14 \end{aligned}\right\}$$ Subtracting 4 is the same as adding $-4$.

$$\left.\begin{aligned} 10 - (-4) &= 10 + (4) = 14 \\ -10 - (-4) &= -10 + (4) = -6 \end{aligned}\right\}$$ Subtracting $-4$ is the same as adding 4.

$$\frac{3}{20} - \left(-\frac{4}{15}\right)$$

$$-2.3 - 6.04$$

**Skill Practice** Write an algebraic expression for each phrase and then simplify.

**7.** 8 less than –10

**Answer**

**8.** –7.2 subtracted from –8.2

**Answer**

**9.** 10 more than the difference of –2 and 3

**Answer**

**10.** Two-fifths decreased by four-thirds

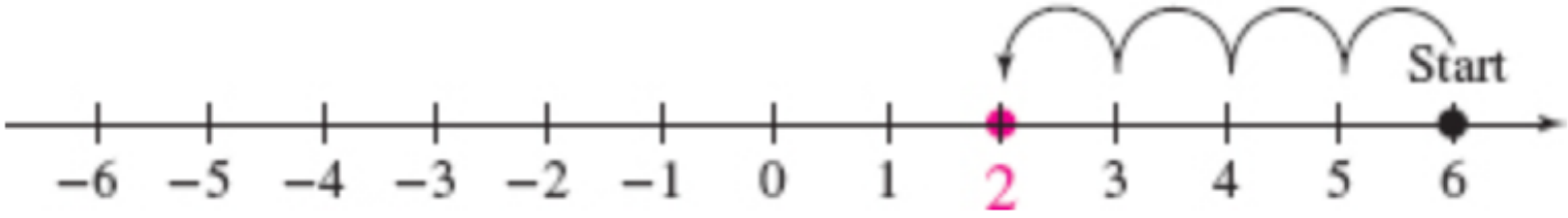
**Answer**

## Skill Practice

**12.** The record high temperature for the state of Montana occurred in 1937 and was 117°F. The record low occurred in 1954 and was –70°F. Find the difference between the highest and lowest temperatures.

# Example of Subtraction Using the Number Line

$$6 - 4 = 2 \quad \Leftrightarrow \quad 6 + (-4) = 2$$



# Inequalities

| Mathematical Expression | Translation | Example |
|---|---|---|
| $a < b$ | $a$ is less than $b$. | $2 < 3$ |
| $a > b$ | $a$ is greater than $b$. | $5 > 1$ |
| $a \leq b$ | $a$ is less than or equal to $b$. | $4 \leq 4$ |
| $a \geq b$ | $a$ is greater than or equal to $b$. | $10 \geq 9$ |
| $a = b$ | $a$ is equal to $b$. | $6 = 6$ |
| $a \neq b$ | $a$ is not equal to $b$. | $7 \neq 0$ |
| $a \approx b$ | $a$ is approximately equal to $b$. | $2.3 \approx 2$ |

# Examples

3 □ 4

¾ □ 9/12

6 □ 3.3

# Multiplication of Real Numbers Review

- Multiplication can be interpreted as repeated addition, or adding groups of the same term together.

$3(4) = 4 + 4 + 4 = 12$ Add 3 groups of 4.

$3(-4) = -4 + (-4) + (-4) = -12$ Add 3 groups of –4.

## Multiplying Real Numbers

- The product of two real numbers with the *same* sign is positive.

  Examples: $(5)(6) = 30$

  $(-4)(-10) = 40$

- The product of two real numbers with *different* signs is negative.

  Examples: $(-2)(5) = -10$

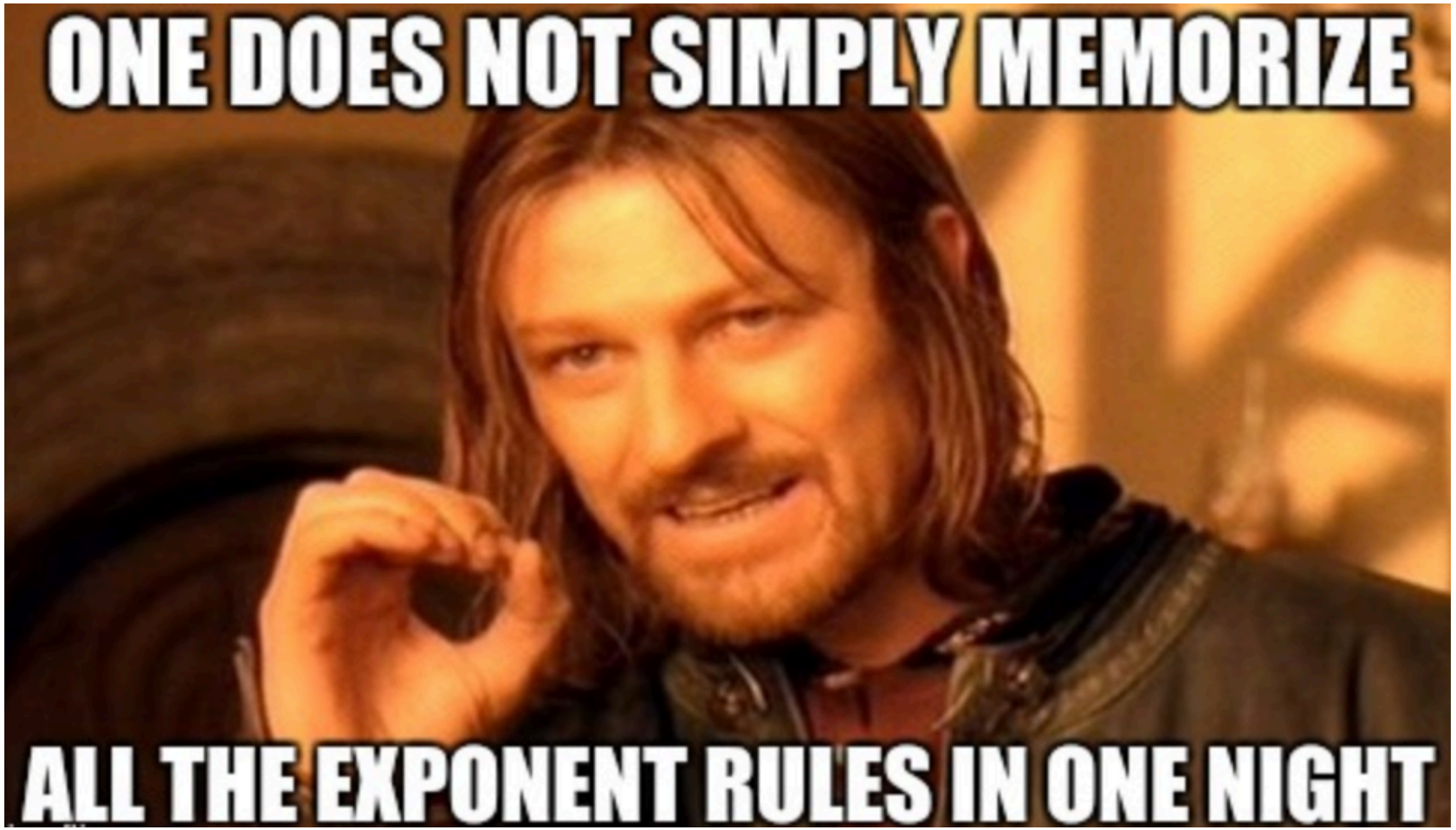
  $(4)(-9) = -36$

- The product of any real number and zero is zero.

  Examples: $(8)(0) = 0$

  $(0)(-6) = 0$

# Exponent Review



# Rules of Exponents

$a^{-b}=1/(a^{b})$

$a^{b}a^{c}=a^{b+c}$

$a^{b}/a^{c}=a^{b-c}$

# Rules of Exponents(cont.)

$(a^b)^c=a^{bc}$

$a^{1/b}=\sqrt[b]{a}=c$

(Why is this special? Because $a=c^b$ )

$(a/b)^c=a^c/b^c$

## Avoiding Mistakes

The negative sign is not part of the base unless it is in parentheses with the base. Thus, in the expression $-5^2$, the exponent applies only to 5 and not to the negative sign.

$(-0.4)^3 = (-0.4)(-0.4)(-0.4) = -0.064$ Multiply three factors of –0.4.

$-0.4^3 = -1(0.4)(0.4)(0.4) = -0.064$ Multiply –1 by three factors of 0.4.

$\left(-\frac{1}{2}\right)^3 = \left(-\frac{1}{2}\right)\left(-\frac{1}{2}\right)\left(-\frac{1}{2}\right) = -\frac{1}{8}$ Multiply three factors of $-\frac{1}{2}$.

# Division of Real Numbers

**The Reciprocal of a Real Number**

Let $a$ be a nonzero real number. Then, the **reciprocal** of $a$ is $\frac{1}{a}$.

## Dividing Real Numbers

- The quotient of two real numbers with the *same* sign is positive.

  Examples: $24 \div 4 = 6$

  $-36 \div (-9) = 4$

- The quotient of two real numbers with *different* signs is negative.

  Examples: $100 \div (-5) = -20$

  $-12 \div 4 = -3$

# Examples

Divide the real numbers.

**a.** $200 \div (-10)$

**b.** $\dfrac{-48}{16}$

**c.** $\dfrac{-6.25}{-1.25}$

**d.** $\dfrac{-9}{-5}$

## Skill Practice Divide.

15. $12 \div (-18)$

Answer

16. $\frac{3}{4} \div \left(-\frac{9}{16}\right)$

Answer

## Division Involving Zero

Let $a$ represent a nonzero real number. Then,

1. $\frac{0}{a} = 0$
2. $\frac{a}{0}$ is undefined

# More Examples of the Orders of Operations

**Example 5** **Applying the Order of Operations**

Simplify. $-8 + 8 \div (-2) \div (-6)$

**Solution:**

$$-8 + 8 \div (-2) \div (-6)$$

$= -8 + (-4) \div (-6)$ Perform division before addition.

$= -8 + \frac{4}{6}$ The quotient of $-4$ and $-6$ is positive $\frac{4}{6}$ or $\frac{2}{3}$.

$= -\frac{8}{1} + \frac{2}{3}$ Write $-8$ as a fraction.

$= -\frac{24}{3} + \frac{2}{3}$ Get a common denominator.

$= -\frac{22}{3}$ Add.

## Example 6 Applying the Order of Operations

Simplify. $\dfrac{24-2[-3+(5-8)]^2}{2|-12+3|}$

**Solution:**

$\dfrac{24-2[-3+(5-8)]^2}{2|-12+3|}$ Simplify numerator and denominator separately.

$=\dfrac{24-2[-3+(-3)]^2}{2|-9|}$ Simplify within the inner parentheses and absolute value.

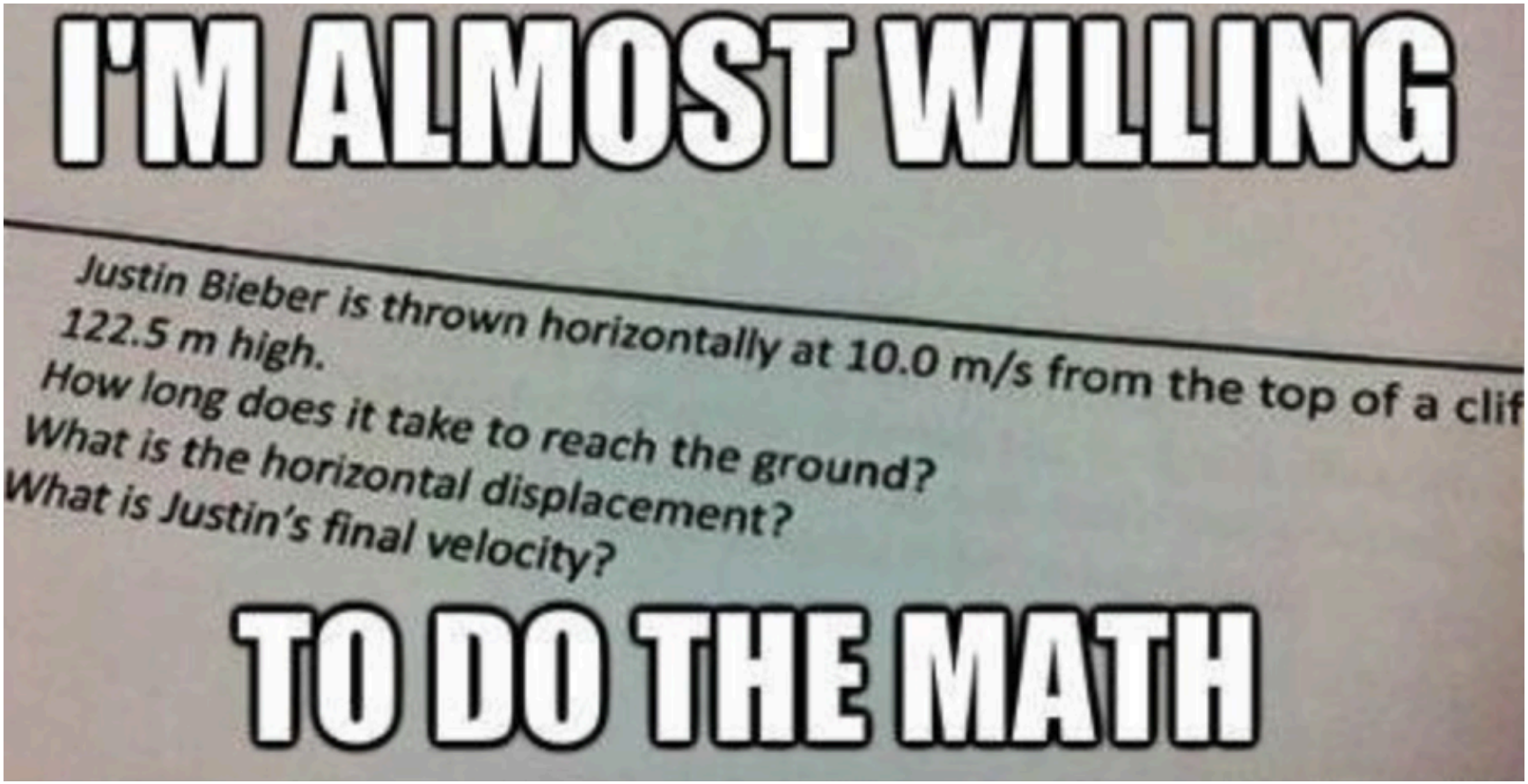
$=\dfrac{24-2[-6]^2}{2(9)}$ Simplify within brackets, [ ]. Simplify the absolute value.

$=\dfrac{24-2(36)}{2(9)}$ Simplify exponents.

$=\dfrac{24-72}{18}$ Perform multiplication before subtraction.

$=\dfrac{-48}{18}$ or $-\dfrac{8}{3}$ Simplify to lowest terms.

# Properties of Operations with Real Numbers



## Commutative Properties of Real Numbers

If $a$ and $b$ are real numbers, then

1. $a + b = b + a$ **commutative property of addition**
2. $ab = ba$ **commutative property of multiplication**

## Associative Properties of Real Numbers

If $a$, $b$, and $c$ represent real numbers, then

| | |
|---|---|
| **1.** $(a + b) + c = a + (b + c)$ | **associative property of addition** |
| **2.** $(ab)c = a(bc)$ | **associative property of multiplication** |

**Distributive Property of Multiplication over Addition**

If $a$, $b$, and $c$ are real numbers, then

$$a(b + c) = ab + ac \text{ and } (b + c)a = ab + ac$$

## Identity Properties of Real Numbers

If $a$ is a real number, then

| | |
|---|---|
| **1.** $a + 0 = 0 + a = a$ | **identity property of addition** |
| **2.** $a \cdot 1 = 1 \cdot a = a$ | **identity property of multiplication** |

## Inverse Properties of Real Numbers

If $a$ is a real number and $b$ is a nonzero real number, then

1. $a + (-a) = -a + a = 0$ **inverse property of addition**
2. $b \cdot \frac{1}{b} = \frac{1}{b} \cdot b = 1$ **inverse property of multiplication**

| Number | Additive Inverse (Opposite) | Sum |
|---|---|---|
| 9 | –9 | 9 + (–9) = 0 |
| –21.6 | 21.6 | –21.6 + 21.6 = 0 |
| $\frac{2}{7}$ | $-\frac{2}{7}$ | $\frac{2}{7}+\left(-\frac{2}{7}\right)=0$ |

| Number | Multiplicative Inverse (Reciprocal) | Product |
|---|---|---|
| 7 | $\frac{1}{7}$ | $7 \cdot \frac{1}{7} = 1$ |
| 3.14 | $\frac{1}{3.14}$ | $3.14\left(\frac{1}{3.14}\right) = 1$ |
| $-\frac{3}{5}$ | $-\frac{5}{3}$ | $-\frac{3}{5}\left(-\frac{5}{3}\right) = 1$ |

# Review Topics

What do y’all feel like you need to review?