

## REVIEW

### Chapter 1 – The Real Number System

**In class work:** Complete all statements. Solve all exercises.

(Section 1.4)

Definition    **A set** is a collection of objects (elements).

The Set of Natural Numbers  $\mathbb{N}$

$$\mathbb{N} = \underline{\hspace{10em}}$$

The Set of Whole Numbers  $\mathbb{W}$

$\mathbb{N}$  \_\_\_\_  $\mathbb{W}$

$$\mathbb{W} = \underline{\hspace{10em}}$$

The Set of Integers  $\mathbb{Z}$

$\mathbb{N}$  \_\_\_\_  $\mathbb{W}$  \_\_\_\_  $\mathbb{Z}$

$$\mathbb{Z} = \underline{\hspace{10em}}$$

The Set of Rational Numbers  $\mathbb{Q}$

$\mathbb{N}$  \_\_\_\_  $\mathbb{W}$  \_\_\_\_  $\mathbb{Z}$  \_\_\_\_  $\mathbb{Q}$

$$\mathbb{Q} = \underline{\hspace{10em}}$$

The Set of Irrational Numbers

Examples:

The Set of Real Numbers  $\mathbb{R}$

$\mathbb{N}$  \_\_\_\_  $\mathbb{W}$  \_\_\_\_  $\mathbb{Z}$  \_\_\_\_  $\mathbb{Q}$  \_\_\_\_  $\mathbb{R}$

$$\mathbb{R} = \underline{\hspace{10em}}$$

**Exercise #1** Decide whether each statement is true or false:

a) Every natural number is positive. \_\_\_\_\_

b) Every whole number is positive. \_\_\_\_\_

c) Every integer is a rational number. \_\_\_\_\_

**Exercise #2** List all numbers from the set  $\left\{-9, -\sqrt{7}, -1\frac{1}{4}, -\frac{3}{5}, 0, \sqrt{5}, 3, 5.9, 7\right\}$  that are

a) natural numbers \_\_\_\_\_

b) whole numbers but not natural numbers \_\_\_\_\_

c) odd integers \_\_\_\_\_

d) rational numbers \_\_\_\_\_

e) irrational numbers \_\_\_\_\_

(Section 1.2)

**Mathematical Symbols**

SYMBOL	MEANING	EXAMPLES
=	is equal to	
≠	is not equal to	
∈	belongs to ( about an element)	
∉	it doesn't belong to	
<	is less than	
≤	is less than or equal to	
>	is greater than	
≥	is greater than or equal to	

**Definition** A number  $a$  is **less than a number  $b$**  ( $a < b$ ) if  $a$  is to the left of  $b$  on the number line.

**Exercise #3** Write equivalent statements:

- a)  $2 \leq 3$  \_\_\_\_\_
- b)  $30 > 5$  \_\_\_\_\_
- c)  $5 > -1 \geq -6$  \_\_\_\_\_
- d)  $-4 < -2$  \_\_\_\_\_

**Exercise #4** Fill in the appropriate ordering symbol: either  $<$ ,  $>$ , or  $=$ .

- a)  $2$  \_\_\_\_\_  $-5$
- b)  $19$  \_\_\_\_\_  $24 - 10$
- c)  $4 - 4$  \_\_\_\_\_  $4 \cdot 0$

**Exercise #5** Write each word statement in symbols:

- a) Fifteen is equal to five plus ten. \_\_\_\_\_
- b) Nine is greater than five minus four. \_\_\_\_\_
- c) Sixteen is not equal to nineteen. \_\_\_\_\_
- d) Two is less than or equal to three. \_\_\_\_\_

(Section 1.7)

**Properties of Real Numbers**

PROPERTIES	ADDITION +	MULTIPLICATION •
COMMUTATIVITY		
ASSOCIATIVITY		
IDENTITY ELEMENT		
INVERSE ELEMENT		
DISTRIBUTIVE PROPERTY		

**Exercise #6** Find the opposite and the reciprocal (if any) of each number:

The Number	Its Opposite	Its Reciprocal

**The Double Negative Rule**

\_\_\_\_\_

**Exercise #7** Identify the property used in each example:

a.  $(-23) + (-11) = (-11) + (-23)$  \_\_\_\_\_

b.  $[123(-2)](-3) = 123[(-2)(-3)]$  \_\_\_\_\_

c.  $1 \cdot 23 = 23 \cdot 1$  \_\_\_\_\_

d.  $[(-29) + 17] + 54 = (-29) + [(17 + 54)]$  \_\_\_\_\_

e.  $(-101)(29) = 29(-101)$  \_\_\_\_\_

f.  $100 + 0 = 0 + 100$  \_\_\_\_\_

(Section 1.4)

## The Absolute Value of a Number

Definition (1) **The absolute value of a number** is the distance between the number and the origin on the number line.

$$|a| = \text{dist}(a, 0)$$

Property  $|a| \geq 0$  for any  $a \in R$

Definition (2) 
$$|a| = \begin{cases} a, & \text{if } a \geq 0 \\ -a, & \text{if } a < 0 \end{cases}$$

**Exercise #8** Simplify the following:

a)  $|-7|$

b)  $-(-7)$

c)  $-|-7|$

d)  $-| -(-7) |$

**Exercise #9** Fill in the appropriate ordering symbol: either  $<$ ,  $>$ , or  $=$ .

a)  $|-3|$  \_\_\_\_\_  $|-4|$

b)  $3$  \_\_\_\_\_  $|-4|$

c)  $-|-6|$  \_\_\_\_\_  $-|-4|$

d)  $-6$  \_\_\_\_\_  $-(-3)$

e)  $-|8|$  \_\_\_\_\_  $|-9|$

f)  $|6-5|$  \_\_\_\_\_  $|2-6|$

(Sections 1.2, 1.5, 1.6)

**Operations with Real Numbers**Adding Real Numbers

Same sign - Add the absolute values of the numbers.  
 - The sum has the same sign as the given numbers.

Different signs - Find the difference between the larger absolute value and the smaller.  
 - The sum has the sign of the number with the larger value.

Subtracting Real Numbers

$$a - b = a + (-b)$$

Multiplying Real NumbersDividing Real Numbers

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

Exponent      $a^n =$  \_\_\_\_\_

$a$  is called \_\_\_\_\_

$n$  is called \_\_\_\_\_

**Exercise #10** Simplify the following:

a)  $5^2$

e)  $2^3$

i)  $\left(\frac{1}{3}\right)^2$

b)  $(-5)^2$

f)  $(-2)^3$

j)  $\left(-\frac{3}{4}\right)^3$

c)  $-5^2$

g)  $-2^3$

k)  $-\left(-\frac{1}{2}\right)^4$

d)  $-(-5)^2$

h)  $-(-2)^3$

**Order of Operations** If grouping symbols are present, simplify within them, innermost first, in the following order:

Step 1 \_\_\_\_\_

Step 2 \_\_\_\_\_

Step 3 \_\_\_\_\_

**Exercise #11** Simplify the following:

a)  $|7 \cdot 2 - 8^2|$

b)  $(-5)^2 - 3^2 + |10 - 2 \cdot 3|$

c)  $-18 \div (-3)^2 + |-8| - |-4|$

d)  $\frac{(-4)^2 - |1 - 2^3|}{-(-2)^3 + (-1)^{125}}$

e)  $\frac{|-8 - 4| \div (2 - 2^2)}{-18 \div (-3)^2 + |-8| - |-4|}$

f)  $238 \cdot 0 - 230 \div 10 + 999 \div 9 - 31 \cdot 100$

g)  $-2(-5)^2 + 10 \div (2) - (-3)^2(2) + 4^2 \div (-2)$

h)  $(4 - 7)(20 - 21)^3 - 2[-10(-3) + 2(-1 - 3)]$

i)  $-2(-1)(-7)(-6) + (-2)(-1 - 7) - 3(2 - 5)$

j)  $|2 - 5| + |7 + 10| - |9 - 12| + |0 - 9|$

**Exercise #12** Translate each phrase into a mathematical statement:

a) The sum of  $-5$  and  $12$  and  $6$  \_\_\_\_\_

b)  $14$  added to the sum of  $-19$  and  $-4$  . \_\_\_\_\_

c) The difference between  $4$  and  $-8$  \_\_\_\_\_

d) The sum of  $9$  and  $-4$ , decreased by  $7$ . \_\_\_\_\_

e)  $12$  less than the difference between  $8$  and  $-5$ . \_\_\_\_\_

f) The product of  $-9$  and  $2$ , added to  $9$ . \_\_\_\_\_

g) Twice the product of  $-1$  and  $6$ , subtracted from  $-4$ . \_\_\_\_\_

h) The quotient of  $-12$  and the sum of  $-5$  and  $-1$  . \_\_\_\_\_

**Sums, Terms, Products, and Factors**  
**Prime and Composite Numbers**

**Sum** is the word we use for \_\_\_\_\_.

**The numbers to be added in the sum** are called \_\_\_\_\_.

**Product** is the word we use for \_\_\_\_\_.

**The numbers being multiplied** are called \_\_\_\_\_.

Definition      **$a$  is divisible by  $b$  ( $a:b$ ) or  $b$  divides  $a$  ( $b|a$ )** if, when dividing  $a$  by  $b$ ,  
\_\_\_\_\_.

<u>Equivalent statements</u>	$a$ is divisible by $b$	
	$a$ is a multiple of $b$	
	$b$ divides $a$	
	$b$ is a factor of $a$	
	$b$ is a divisor of $a$	

**Exercise #13** List all the factors of:

20: \_\_\_\_\_

5: \_\_\_\_\_

12: \_\_\_\_\_

17: \_\_\_\_\_

Property     The number \_\_\_\_\_ is a factor of any number. \_\_\_\_\_

Any nonzero number is a factor of \_\_\_\_\_. \_\_\_\_\_

Definition     A prime number is a natural number (excluding 1) that is divisible only by \_\_\_\_\_

A natural number greater than 1 that is not prime is called \_\_\_\_\_

The Set of Prime Numbers: \_\_\_\_\_

Tests for divisibility:

A number is divisible by

2 if its last digit is divisible by 2.

3 if the \_\_\_\_\_ is divisible by 3.

4 if the number formed by its \_\_\_\_\_ is divisible by 4.

5 if the \_\_\_\_\_ is \_\_\_\_\_.

8 if the last three digits form a number divisible by 8.

9 if the sum of its digits is divisible by 9.

10 if its \_\_\_\_\_ is \_\_\_\_\_.

**Exercise #14**

- a) List all the factors of 24:
- b) List all the prime factors of 24:
- c) List some multiples of 2:
- d) List all the factors of 2:
- e) Find the prime factorization of each number: 15, 28, 108, 1200"

(Section 1.3)

## Algebraic Expressions

Definition A **variable** is a symbol (usually a letter) that stands for a number (or numbers).

**Variables** can be **used**:

- (1) in equations      - variables represents unknown quantities  
                                  - the variable is holding the place of a particular number (or numbers) that has not yet been identified but which needs to be found.
- \_\_\_\_\_

- (2) in general statements - the variable describes a general relationship between numbers and/or arithmetic operations.
- \_\_\_\_\_

Definition A **constant** is a symbol whose value is fixed.

Definition An algebraic expression is a finite number of additions, subtractions, multiplications, and divisions of \_\_\_\_\_.

Note: An algebraic expression DOES NOT contain the \_\_\_\_\_ sign.

Definition An **equation** is a statement that two algebraic expressions are equal.

Definition The process of replacing the variable(s) in an algebraic expression with specific values and evaluating the result is called **algebraic substitution**.

**Exercise #15** Evaluate the following expressions if  $x = 2, y = -3, z = -1$ :

- a)  $\frac{|xy|}{3z}$
- b)  $\frac{3y^2 - x^2 + 1}{y|z|}$
- c)  $yz^3 - (xy)^3$

**Exercise #16**

Translate each of the following algebraically:

1) Eight more than three times a number.

Choose a variable to represent  
the unknown \_\_\_\_\_

Translate: \_\_\_\_\_

Identify the statement:

Algebraic Expression  or Equation

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2) Three times the sum of eight and a number.

Choose a variable to represent  
the unknown \_\_\_\_\_

Translate: \_\_\_\_\_

Identify the statement:

Algebraic Expression  or Equation

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3) Two less than five times a number is 18.

Choose a variable to represent  
the unknown \_\_\_\_\_

Translate: \_\_\_\_\_

Identify the statement:

Algebraic Expression  or Equation

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4) The sum of two numbers is four less than their product.

Choose a variable to represent  
the unknown(s) \_\_\_\_\_

Translate: \_\_\_\_\_

Identify the statement:

Algebraic Expression  or Equation

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5) Two less than five times a number is 18.

Choose a variable to represent  
the unknown \_\_\_\_\_

Translate: \_\_\_\_\_

Identify the statement:

Algebraic Expression  or Equation

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6) Four more than a number.

Choose a variable to represent  
the unknown \_\_\_\_\_

Translate: \_\_\_\_\_

Identify the statement:

Algebraic Expression  or Equation

Equivalent phrase: \_\_\_\_\_

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7) Four less than a number is 12.

Choose a variable to represent  
the unknown \_\_\_\_\_

Translate: \_\_\_\_\_

Identify the statement:

Algebraic Expression  or Equation

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8) The product of a number and seven more than the number.

Choose a variable to represent  
the unknown \_\_\_\_\_

Translate: \_\_\_\_\_

Identify the statement:

Algebraic Expression  or Equation

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9) The product of two more than a number and six less than the number.

Choose a variable to represent  
the unknown \_\_\_\_\_

Translate: \_\_\_\_\_

Identify the statement:

Algebraic Expression  or Equation

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