

**Math 114**  
**Scientific Notation**

**Powers of Ten**

$$10^0 = 1$$

$$10^1 = 10$$

$$10^2 = 100$$

$$10^3 = 1000$$

$$10^4 = 10000$$

*Negative powers*

$$10^{-1} = \frac{1}{10} = .1$$

$$10^{-2} = \frac{1}{10^2} = \frac{1}{100} = .01$$

$$10^{-3} = \frac{1}{10^3} = \frac{1}{1000} = .001$$

$$10^{-4} = \frac{1}{10^4} = \frac{1}{10000} = .0001$$

**Standard Scientific Notation**

$$N \times 10^n$$

*where*

$$1 \leq N < 10$$

n is an integer

**Using Scientific Notation**

The population of Mexico City is about 23,000,000

To change the number into scientific notation you move the decimal place seven places to get:  $2.3 \times 10^7$

The speed the speed of light is 30,000,000,000 m/s. Write this number in scientific notation.

Answer:  $3.0 \times 10^{10}$

Convert .00000079 to scientific notation

Answer:  $7.9 \times 10^{-8}$

Convert .000000000043

Answer:  $4.3 \times 10^{-12}$

### **Multiplication with scientific notation**

Examples

1) Simplify

$$(6.1 \times 10^6)(7.8 \times 10^7)$$

$$(6.1)(7.8) \times 10^{6+7}$$

$$47.58 \times 10^{13}$$

$$4.758 \times 10^{14}$$

2) Simplify

$$(3 \times 10^{10})(7 \times 10^7)$$

$$(3)(7) \times 10^{10+7}$$

$$21 \times 10^{17}$$

$$2.1 \times 10^{18}$$

3) Simplify

$$(5 \times 10^{10})(4 \times 10^{-6})$$

$$(5)(4) \times 10^{10-6}$$

$$20 \times 10^4$$

$$2.0 \times 10^5$$

## Division

### Examples

4) Simplify

$$\frac{4.2 \times 10^{12}}{2.1 \times 10^8}$$
$$\frac{4.2}{2.1} \times 10^{12-8}$$
$$2 \times 10^4$$

5) Simplify

$$\frac{5.8 \times 10^9}{3.5 \times 10^3}$$
$$\frac{5.8}{3.4} \times 10^{9-3}$$
$$1.66 \times 10^6$$

6) Simplify

$$\frac{(4.2 \times 10^{10})(3.4 \times 10^4)}{2 \times 10^8}$$
$$\frac{14.38 \times 10^{14}}{2 \times 10^8}$$
$$7.19 \times 10^6$$

## Sets and Set notation

### Introduction to Sets

#### Common sets

##### The natural numbers

$$N = \{1,2,3,4,5,6,\dots\}$$

##### The whole numbers

$$W = \{0,1,2,3,4,5,6,\dots\}$$

##### The integers

$$J = \{\dots,-4,-3,-2,-1,0,1,2,3,4,\dots\}$$

### Specifying a set by roster form

#### Examples

1) Specify the set {The U. S. Presidents since 1980} by roster

Answer: {Ronald Reagan, George Bush Sr., Bill Clinton, George Bush Jr. }

2) Specify the set  $\{x \mid x \text{ is an even natural number}\}$  in builder set notation by roster

Answer:  $\{2,4,6,8,10,\dots\}$

### Specifying sets by builder set notation

1) Specify the following set in builder set notation.

$$\{1,2,3,4,5,6,7,8,9,\dots\}$$

Answer :  $\{x \mid x \text{ is a counting number}\}$

2) Specifying the following set in builder set notation.

$$\{1,3,5,7,\dots\}$$

Answer:  $\{x \mid x \text{ is an odd integer}\}$

3) Specify the following set in Builder set notation.  
{Huron, Erie, Michigan, Ontario, Superior}  
{x | x is a great lake}

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Write each set in roster form

18) {Positive multiples of 3}

Answer in roster form: {3,6,9,12,15,18,21,.....}

20) {Counting numbers greater than 150}

Write each set in builder set notation.

24)

{1,11,121,1331,14641,.....}

{x | x is a power of 11}

### **Definitions**

Infinite Set: A set that has an infinite number of elements.

Finite Set: A set that has a finite number of elements.

### **Examples**

#### **Finite Sets**

{1,2,3,4,5,6,7}

{0.2.4.6.8}

{Huron, Erie, Michigan, Ontario, Superior}

## Infinite Sets

$\{1,2,3,4,5,6,\dots\}$

$\{2,4,6,8,10,12,\dots\}$

$\{x \mid x \text{ is an odd integer}\}$

## Elements of a set

The statement 3 is an element of the set  $\{1,2,3,4,5,6\}$  in symbol form is written as follows:  $3 \in \{1,2,3,4,5,6\}$

The statement 2 is not an element of  $\{1,3,5,7\}$  would be written as follows:  
 $2 \notin \{1,3,5,7\}$

True or False

1)

*Is  $5 \in \{1,2,3,4,5,6\}$ ? True*

2)

*Is Ohio  $\in \{\text{Virginia, North Carolina, Maryland, South Carolina, Pennsylvania}\}$ ?  
True*

3)

*Is  $5 \in \{2,4,6,8,10,\dots\}$ ?*

*False*

## The Empty Set

The **empty set** is a set that contains no elements. The empty set is also referred to as the **null set**.

Symbol representation  $\phi$  or  $\{\}$

## Definition

Subset: A set B is a subset of a second set B if every element of the subset B is of the second set C.

$$B \subset C$$

## Example 1

Let  $A=\{1,2,3,4,5\}$ ,  $B=\{1,3,5,7\}$ ,  $C=\{1,2,3\}$ ,  $D=\{1,2,3,4,5\}$ , and  $E=\phi$

1) Is  $C \subset A$ ?

**Answer: Yes, every element in C is contained in A**

2) Is  $B \subset A$ ?

**Answer: No, the element 7 of set B is not contained in A.**

3) Is  $D \subset A$ ?

**Answer: Yes, every element of D is in A.**

4) Is  $\phi \subset A$ ?

**Yes, the empty set is a subset of nonempty every set.**

**Note:** The empty set is a set of every nonempty set. Every nonempty set is a subset of itself.

## Example 2

List all subsets of the set  $\{1,2\}$

### Possible subsets

$$\phi, \{1\}, \{2\}, \{1,2\}$$

## Example 3

List all subsets of the set  $\{a,b,c\}$

### Possible subsets

$$\phi, \{a\}, \{b\}, \{c\}, \{a,b\}, \{b,c\}, \{a,c\}, \{a,b,c\}$$

#### Example 4

List all subsets of the set  $\{4\}$

**Possible sets:**  $\phi, \{4\}$

#### The pattern for subsets

Number of elements	Number of subsets
1	2
2	4
3	8
4	16

#### Formula to find the number of subsets $s$ of a given set $A$ with $n$ elements

$$s = 2^n$$

#### Example 5

How many subsets does a set  $A$  with 6 elements have?

$$s = 2^n$$

$$s = 2^6$$

$$s = 64$$

#### Equivalent Sets

Two sets are equivalent if they have the same number of elements.

Examples of equivalent sets

$\{1,2,3,4\}$

*and*

$\{a,b,c,d\}$

$\{john,luke,mark,mathew\}$

*and*

$\{a,b,c,d\}$

$\{Richmond,Raleigh,Charleston,Lansing,Harrisburg,Atlanta,\}$

*and*

$\{0,2,4,6,8,10\}$

7) Simplify

$$\frac{(2 \times 10^5)(1.2 \times 10^8)}{3 \times 10^{10}}$$

$$\frac{2.4 \times 10^{13}}{3 \times 10^{10}}$$

$$.8 \times 10^3$$

$$8.0 \times 10^2$$