

# Working with Sets Guide Notes

**SET** is a collection of elements or members. Use braces, { }, to denote a set.

**ROSTER FORM** lists the elements of a set within braces.

**Example:**

- a. The set,  $S$ , that contains the elements 1, 2, 3, and 4 when written in roster form is:

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

- b. The set,  $N$ , that contains all natural numbers when written in roster form is

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

**SET-BUILDER NOTATION** describes elements of a set. It uses a variable and limits, or conditions, on the variable.

**Example:**

- a. The set  $S = \{1, 2, 3, 4\}$  when written in set-builder notation is:

$$S = \{x \mid x \text{ is a natural number and } x < 5\}$$

and read as: "the set of all values of  $x$  such that  $x$  is natural number and less than 5"

- b. The set  $N = \{1, 2, 3, 4, 5, 6, \dots\}$  when written in set-builder notation is:

$$N = \{x \mid x \text{ is a natural number}\}$$

and read as: "the set of all values of  $x$  such that  $x$  is natural number"

**Sample Problem 1:** Write each set in Roster Form and Set-Builder Notation.

- A.  $M$  is the set of even whole number less than 13

$$M = \{2, 4, 6, 8, 10, 12\}$$

$$M = \{x \mid x \text{ is an even whole number and } x < 13\}$$

- B.  $N$  is the set of natural number greater than or equal to 11

$$N = \{11, 12, 13, \dots\}$$

$$N = \{x \mid x \text{ is a natural number and } x \geq 11\}$$

- C.  $R$  is the set of negative whole number less than -3

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

$$R = \{x \mid x \text{ is a negative whole number and } x < -3\}$$

- D.  $S$  is the set of even prime number

$$S = \{2\}$$

$$S = \{x \mid x \text{ is an even prime number}\}$$

**Sample Problem 2:** Write the solutions of each inequality in set-builder notation.

- A.  $2x + 2 < 24$

$$2x + 2 < 24$$

$$2x + 2 - 2 < 24 - 2$$

$$2x < 22$$

$$\frac{2x}{2} < \frac{22}{2}$$

$$x < 11$$

$$\{x \mid x < 11\}$$

- B.  $-(3x + 5) \leq -23$

$$-(3x + 5) \leq -23$$

$$-3x - 5 + 5 \leq -23 + 5$$

$$-3x \leq -18$$

$$\frac{-3x}{-3} \geq \frac{-18}{-3}$$

$$x \geq 6$$

$$\{x \mid x \geq 6\}$$

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C.  $3(x - 5) > 10 - 6x$

$$3(x - 5) > 12 - 6x$$

$$3x - 15 > 12 - 6x$$

$$3x - 15 + 15 > 12 + 15 - 6x$$

$$3x > 27 - 6x$$

$$3x + 6x > 27 - 6x + 6x$$

$$9x > 27$$

$$\frac{9x}{9} > \frac{27}{9}$$

$$x > 3$$

$$\{x \mid x > 3\}$$

D.  $-3(x + 7) \geq 2x - 16$

$$-3(x + 7) \geq 2x - 16$$

$$-3x - 21 \geq 2x - 16$$

$$-3x + 3x - 21 \geq 2x + 3x - 16$$

$$-21 \geq 5x - 16$$

$$-21 + 16 \geq 5x - 16 + 16$$

$$-5 \geq 5x$$

$$-\frac{5}{5} \geq \frac{5x}{5}$$

$$-1 \geq x$$

$$\{x \mid -1 \geq x\}$$

**SUBSET** is consists of elements from any given set.

**NULL SET** or **EMPTY SET** is a set that contains no elements. It is a subset of every set. Use  $\{ \}$  or  $\emptyset$  to represent the null set.

**Example:** If  $A = \{3, 6, 9\}$  then its subsets are

Null set  $\{ \}$

With one element  $\{3\}$   $\{6\}$   $\{9\}$

With two element  $\{3, 6\}$   $\{3, 9\}$   $\{6, 9\}$

With the original set  $\{3, 6, 9\}$

The 8 subsets of  $A = \{3, 6, 9\}$  are  $\{ \}$ ,  $\{3\}$ ,  $\{6\}$ ,  $\{9\}$ ,  $\{3, 6\}$ ,  $\{6, 9\}$ ,  $\{3, 9\}$ , and  $\{3, 6, 9\}$ .

**Sample Problem 3:** List all possible subsets of each given set.

A.  $J = \{7, 11\}$

The 4 subsets of  $J = \{7, 11\}$  are  $\{ \}$ ,  $\{7\}$ ,  $\{11\}$ , and  $\{7, 11\}$ .

B.  $K = \{5, 9, 18\}$

The 8 subsets of  $K = \{5, 9, 18\}$  are  $\{ \}$ ,  $\{5\}$ ,  $\{9\}$ ,  $\{18\}$ ,  $\{5, 9\}$ ,  $\{5, 18\}$ ,  $\{9, 18\}$ , and  $\{5, 9, 18\}$ .

C.  $D = \{-1, 9\}$

The 4 subsets of  $D = \{-1, 9\}$  are  $\{ \}$ ,  $\{-1\}$ ,  $\{9\}$ , and  $\{-1, 9\}$ .

D.  $F = \{-5, -2, 1\}$

The 8 subsets of  $F = \{-5, -2, 1\}$  are  $\{ \}$ ,  $\{-5\}$ ,  $\{-2\}$ ,  $\{1\}$ ,  $\{-5, -2\}$ ,  $\{-5, 1\}$ ,  $\{-2, 1\}$ , and  $\{-5, -2, 1\}$ .

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**UNIVERSAL SET** is the largest set that consists of all elements from the given set.

**COMPLEMENT OF A SET** is a set that contains the elements of a universal set not contained in a given subset. Use  $A'$  to represent the complement of set  $A$ .

**Example:** If  $A = \{4, 8, 12, 20, 24, 28\}$  is the universal set and  $B = \{20, 24, 28\}$ . Find the  $B'$ .

$$B' = \{4, 8, 12\}$$

### Sample Problem 4:

- A. Given  $A \subseteq B$ ,  $B = \{1, 2, 4, 8, 16, 32\}$ , and  $A = \{2, 8, 32\}$ . Find  $A'$ .

$$A' = \{1, 4, 16\}$$

- B. Given  $J \subseteq K$ ,  $J = \{-3, 5, 9, 17, 21\}$ , and  $K = \{-3, 1, 5, 9, 13, 17, 21, 25\}$ . Find  $J'$ .

$$J' = \{1, 13, 25\}$$

- C. Given  $E \subseteq D$ ,  $D = \{-10, -8, -4, 2, 10, 20, 32\}$ , and  $E = \{-8, 10\}$ . Find  $E'$ .

$$E' = \{-10, -4, 2, 20, 32\}$$

- D. Given  $X \subseteq Y$ ,  $Y = \{2, 3, 5, 7, 11, 13, 17, 19, 23\}$ , and  $X = \{2, 5, 7, 13, 17, 19\}$ . Find  $X'$ .

$$X' = \{3, 11, 23\}$$