

Union and Intersection of Sets Guide Notes

UNION OF SETS

The union of two or more sets is the set that contains **ALL** elements of the sets.

Example:

- A. The union of the sets $A = \{a, b, c\}$ and $B = \{1, 2, 3\}$ consists of all elements belonging to **A OR** to **B**.

$$A \cup B = \{a, b, c, 1, 2, 3\}$$

- B. The union of the sets $X = \{1, 2, 3\}$, $Y = \{4, 5, 6, 7\}$ and $Z = \{8, 9, 10\}$ consists of all elements belonging to **X OR** to **Y OR** to **Z**.

$$X \cup Y \cup Z = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$$

Sample Problem 1: Find each union of the given sets.

- | | | |
|-----------------------------|--------------------------|--|
| A. $A = \{2, 10, 13, 19\}$ | $B = \{1, 4, 14, 16\}$ | $A \cup B = \{1, 2, 4, 10, 13, 14, 16, 19\}$ |
| B. $D = \{1, 2, 4, 8, 16\}$ | $E = \{2, 3, 5, 7\}$ | $D \cup E = \{1, 2, 3, 4, 5, 7, 8, 16\}$ |
| C. $J = \{7, 13, 15, 17\}$ | $K = \{13, 15, 17, 19\}$ | $J \cup K = \{7, 13, 15, 17, 19\}$ |
| D. $X = \{6, 9, 11, 18\}$ | $Y = \{5, 11, 18, 20\}$ | $X \cup Y = \{5, 6, 9, 11, 18, 20\}$ |

Sample Problem 2: An urn contains marbles colored in blue, green, yellow, and red. Another urn contains marbles colored in blue, white, and black. If the content of the two urns is mixed, then use union of sets to find the set of marbles in the vase.

$$A = \{\text{blue, green, yellow, red}\}$$

$$B = \{\text{blue, white, black}\}$$

$$A \cup B = \{\text{blue, white, black}\}$$

INTERSECTION OF SETS

The intersection of sets is the set elements that are **COMMON** to two or more sets.

Example:

- A. The intersection of the sets $A = \{10, 12, 14, 16, 18, 20\}$ and $B = \{5, 10, 15, 20, 25\}$ consists of all elements belonging to **A AND** to **B**.

$$A \cap B = \{10, 20\}$$

- B. The intersection of the sets $X = \{1, 2, 3, 4, 5, 6\}$, $Y = \{1, 3, 5, 7, 9, 11\}$ and $Z = \{2, 3, 5, 7, 11\}$ consists of all elements belonging to **X AND** to **Y AND** to **Z**.

$$X \cap Y \cap Z = \{3, 5, 7\}$$

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Sample Problem 3: Find each intersection of the given sets.

- A. $A = \{7, 11, 13, 17\}$ $B = \{x | x \text{ is an odd number less than } 16\}$ $A \cap B = \{7, 11, 15, 17\}$
 $B = \{1, 3, 5, 7, 9, 11, 13, 15\}$
- B. $D = \{1, 2, 4, 8, 16\}$ $E = \{x | x \text{ is multiple of } 2 \text{ and is less than } 5\}$ $D \cap E = \{2, 4\}$
 $E = \{2, 4\}$
- C. $J = \{3, 6, 9, 12, 15\}$ $K = \{x | x \text{ is a prime number greater than } 2\}$ $J \cap K = \{6, 12\}$
 $K = \{3, 5, 7, 11, 13, \dots\}$
- D. $X = \{7, 10, 11, 18\}$ $Y = \{x | x \text{ is an even whole number}\}$ $X \cap Y = \{10, 18\}$
 $Y = \{2, 4, 6, 8, 10, \dots\}$

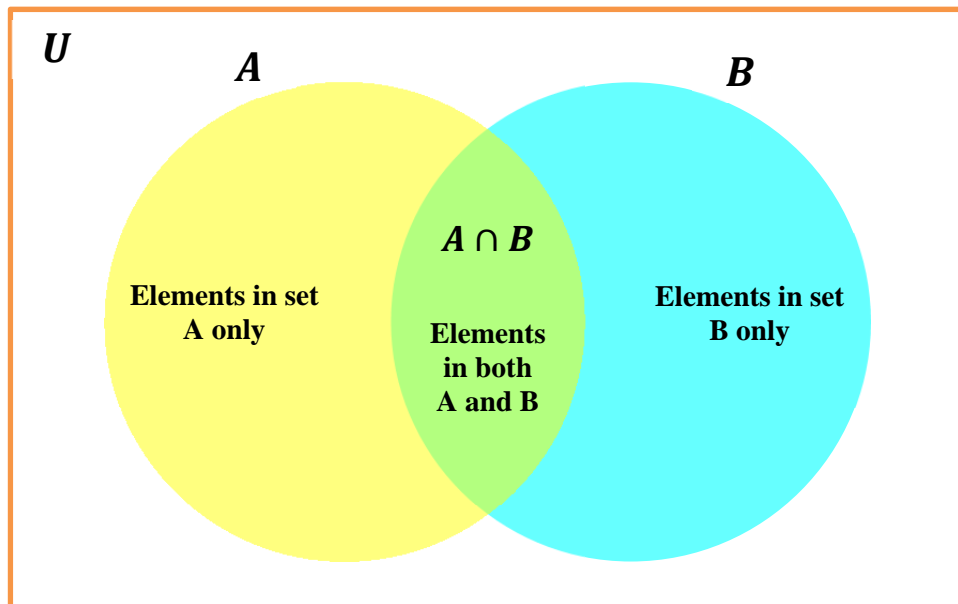
Sample Problem 4: Solve each inequality. Write the solutions as either the union or intersection of two sets.

1. $|2x - 4| \leq 10$ $2x - 4 \leq 10$ $2x - 4 \geq -10$
 $\{x | x \geq -3\} \cap \{x | x \leq 7\}$ $2x - 4 + 4 \leq 10 + 4$ $2x - 4 + 4 \geq -10 + 4$
 $2x \leq 14$ $2x \geq -6$
 $\frac{2x}{2} \leq \frac{14}{2}$ $\frac{2x}{2} \geq \frac{-6}{2}$
 $x \leq 7$ $x \geq -3$
 $\{x | x \leq 7\}$ $\{x | x \geq -3\}$
2. $44 > 7x + 9 > 23$ $44 > 7x + 9$ $7x + 9 > 23$
 $\{x | x > 2\} \cap \{x | x < 5\}$ $44 - 9 > 7x + 9 - 9$ $7x + 9 - 9 > 23 - 9$
 $35 > 7x$ $7x > 14$
 $\frac{35}{7} > \frac{7x}{7}$ $\frac{7x}{7} > \frac{14}{7}$
 $5 > x$ $x > 2$
 $\{x | x < 5\}$ $\{x | x > 2\}$
3. $-4 < -x + 5 < 13$ $-4 < -x + 5$ $-x + 5 < 13$
 $\{x | x > -8\} \cap \{x | x < 9\}$ $-4 - 5 < -x + 5 - 5$ $-x + 5 - 5 < 13 - 5$
 $-9 < -x$ $-x < 8$
 $\frac{-9}{-1} > \frac{-x}{-1}$ $\frac{-x}{-1} > \frac{8}{-1}$
 $9 > x$ $x > -8$
 $\{x | x < 9\}$ $\{x | x > -8\}$

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VENN DIAGRAM is used to show the relationships between sets. Sets are represented by circles drawn inside a rectangle (representing the universal set).

- The overlapping region of two circles represents the intersection of the two sets.
- The two circles together represent the union of two sets.



Sample Problem 5: In a survey, 100 people were asked to choose between cake or ice cream or both cake and ice cream. 52 likes cake and 27 likes cake and ice cream. How many likes cake? Draw a Venn Diagram.

Let A = for those who like cake only and B = for those who likes ice cream only .

$$A = 52$$

$$A \cup B = 27$$

$$B = 100 - (B - A \cup B) = 100 - (52 - 27) = 100 - (25) = B = 75$$

