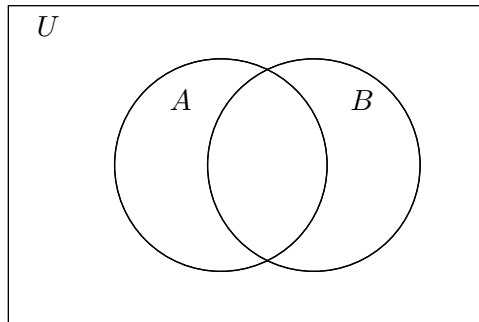

Section 2.1: Set Operations

Venn Diagrams: are diagrams used to represent the relationship between sets. (U is the universal set and it includes all items under discussion at a given time.)



Example 1: Draw a Venn Diagram to represent the following relationships between set A and set B .

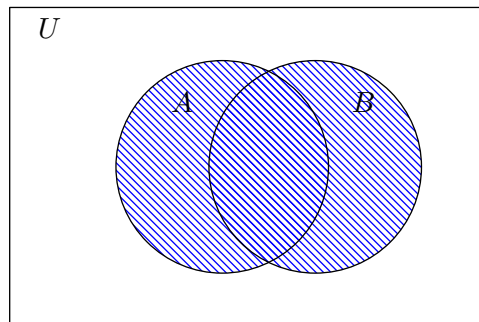
(a) $B \subset A$

(b) A and B are disjoint sets.

SET OPERATIONS:

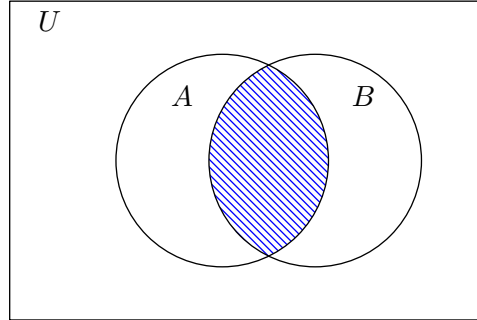
- **Union of sets:** The union of two sets A and B , denoted $A \cup B$, is the set that consists of all elements belonging either to A or to B (or both). That is,

$$A \cup B = \{x \mid x \in A \text{ or } x \in B\}$$



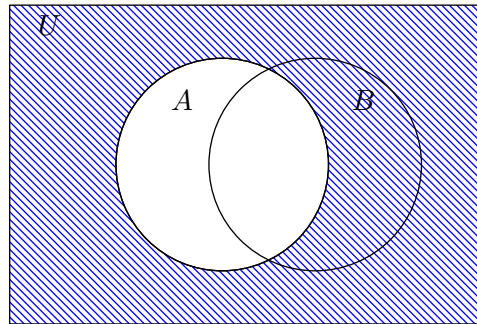
- **Intersection of sets:** The intersection of sets A and B , denoted $A \cap B$, is the set of all elements common to sets A and B . That is,

$$A \cap B = \{x \mid x \in A \text{ and } x \in B\}$$



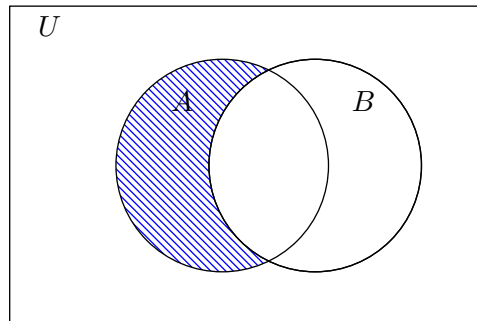
- **Complement of a set:** The complement of a set, denoted \bar{A} , is the set of all elements in the universe U that are not in A . That is,

$$\bar{A} = \{x \mid x \in U \text{ and } x \notin A\}$$



- **Difference of sets:** The set difference of set B from set A , denoted $A - B$, is the set of all elements in A that are not in B . That is,

$$A - B = \{x \mid x \in A \text{ and } x \notin B\}$$



- **Cartesian Product:** The cartesian product of set A with set B , denoted $A \times B$ and read A cross B , is the set of all ordered pairs (a, b) where $a \in A$ and $b \in B$.

Example 2: Given the following sets:

$$U = \{1, 2, 3, 4, 5, 6, 7, 8\}$$

$$A = \{1, 2, 3, 4, 5\}$$

$$B = \{1, 2, 5, 7\}$$

$$C = \{5, 6, 7\}$$

Find each of the following:

(a) $A \cup C$

(f) $\overline{B \cup C}$

(b) $B \cap A$

(g) $\overline{A} \cap \overline{C}$

(c) \overline{B}

(h) $C \times B$

(d) \overline{A}

(i) $(A \cap C) \cup \overline{B}$

(e) $C - A$

(j) $\overline{B} \cup C$

Example 3: Given the following sets:

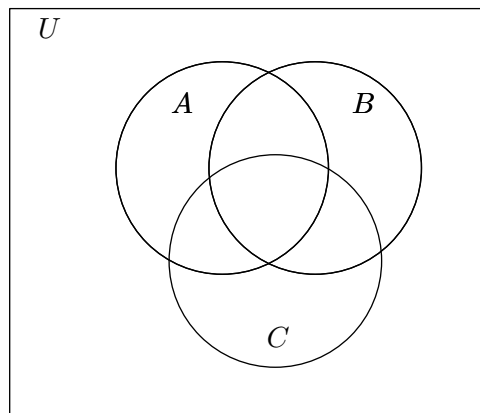
$$U = \{a, b, c, d, e, f, g, h, i, j\}$$

$$A = \{b, c, d, e, g\}$$

$$B = \{d, g, i, j\}$$

$$C = \{a, d, i, j\}$$

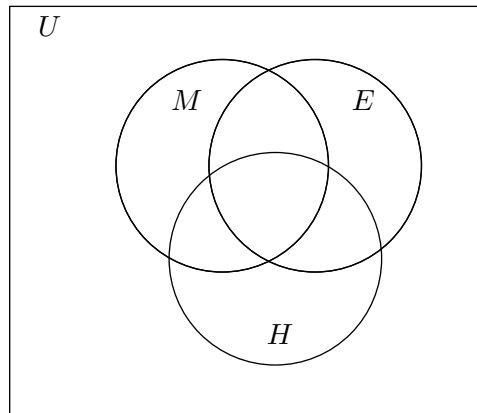
Place the elements of these sets in their proper locations on the following Venn Diagram.



Example 4: A survey of 100 randomly selected students gave the following information:

- 45 students are taking Mathematics (M)
- 41 students are taking English (E)
- 40 students are taking History (H)
- 15 students are taking Math and English
- 18 students are taking Math and History
- 17 students are taking English and History
- 7 students are taking all three (Math, English and History)

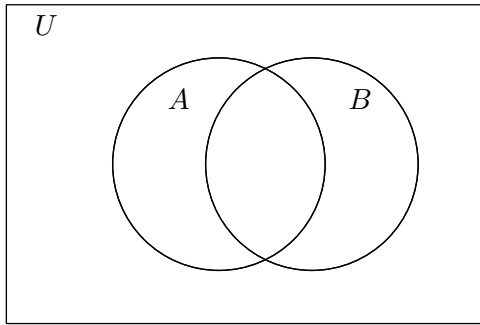
(a) Fill in the following Venn Diagram COMPLETELY using the data given above.



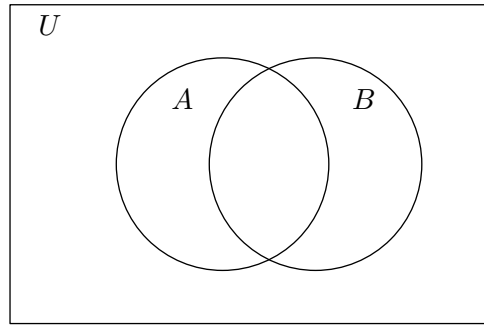
- (b) How many students are taking only Mathematics?
- (c) How many students are taking only English?
- (d) How many students are taking only History?
- (e) How many students are NOT taking any of these courses?
- (f) How many students are not taking Mathematics?
- (g) How many students are taking only 2 of these subjects (Mathematics, English, History)

Example 5: In each Venn Diagram, shade the area corresponding to the designated set.

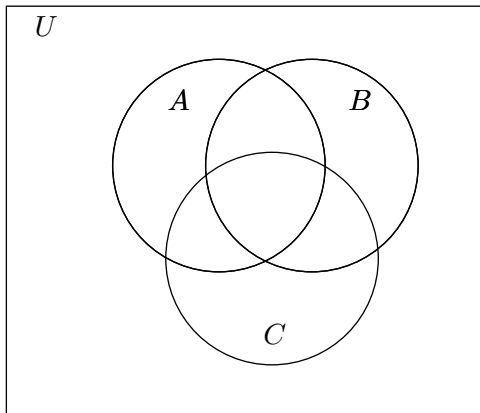
(a) $A \cap \overline{B}$



(b) $\overline{A} \cup \overline{B}$



(c) $(A \cap B) \cap C$



(d) $(A \cup B) \cap C$

