

Operations on Sets

① Union of Sets

A, B are sets.

Def: The union of A and B is a set whose elements are the elements of A and the elements of B .

E.g. $A = \{1, 2, 3\}$. $B = \{a, b, c, d\}$

Find the union of A and B .

Ans: the set $\{1, 2, 3, a, b, c, d\}$

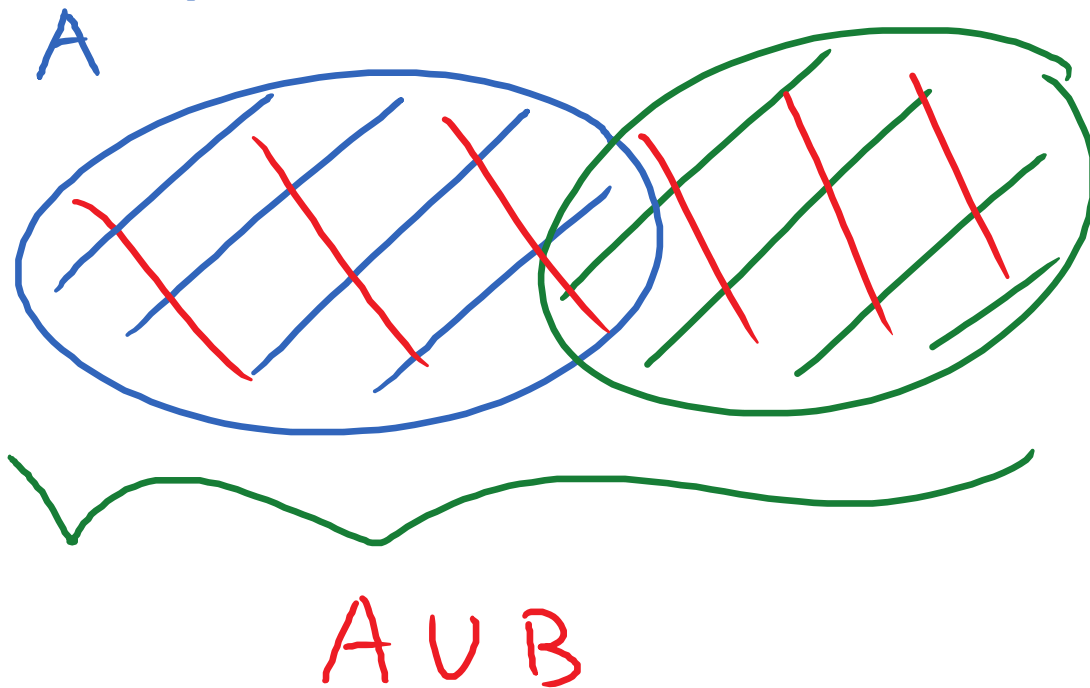
Notation for the union: $A \cup B$

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

E.g. $X = \{2, 4, 6, 8\}$

Find $A \cup X = \{1, 2, 3, 4, 6, 8\}$

Venn diagram for $A \cup B$



② Intersection of sets

The intersection of 2 sets A and B is a set of all the elements that are common to both A and B.

E.g. $A = \{1, 2, 3\}$ $B = \{a, b, c, d\}$

The intersection of A and B is the empty set

$$A \cap B = \emptyset$$

Notation for intersection: $A \cap B$

E.g. $M = \{1, 2, \dots, 10\}$

$$N = \{x \mid x \text{ is an even } \# \}$$

Find $M \cap N$.

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

Ex. $D = \{x \mid x \text{ is a month that starts with J}\}$

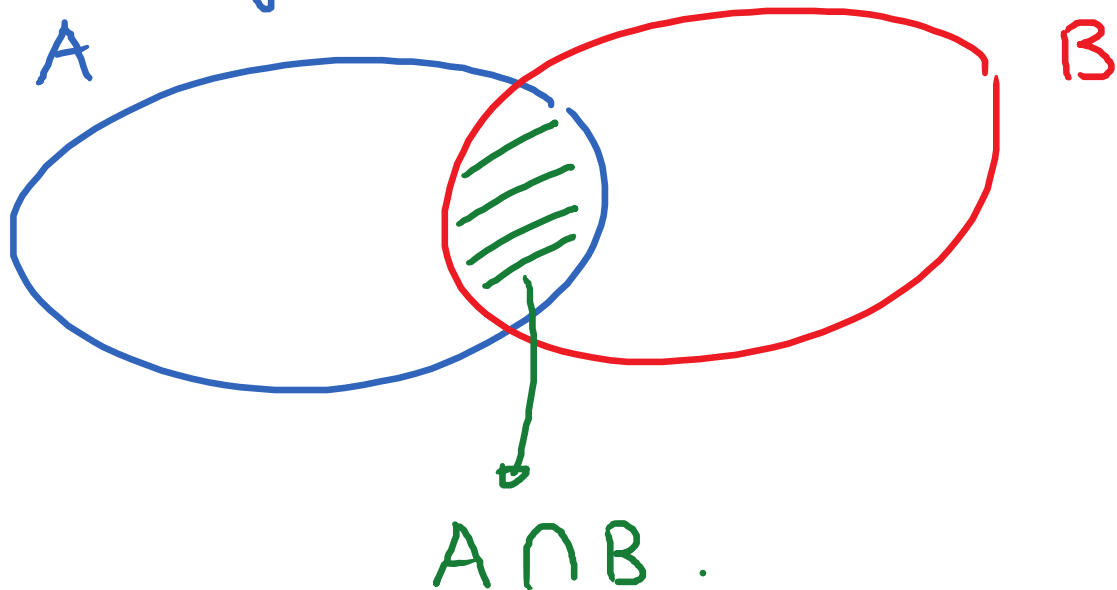
$$E = \{x \mid x \text{ is a month that ends with a Y}\}$$

Find $D \cup E$ and Find $D \cap E$.

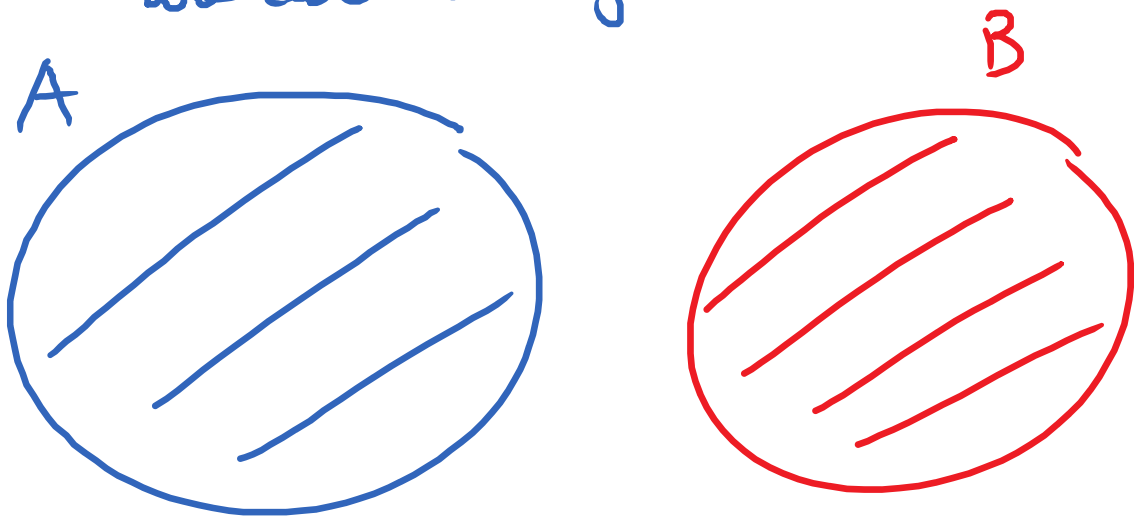
$$D \cup E = \{\text{Jan, Feb, May, July, June}\}$$

$$D \cap E = \{\text{Jan, July}\}$$

Venn Diagram to illustrate intersection



* Note: If 2 sets have empty intersection, they are called disjoint sets.



Disjoint sets . $A \cap B = \emptyset$

③ The complement of a set

A and U are sets. $A \subset U$.

The complement of A in U is the set of elements that are in U but not in A .

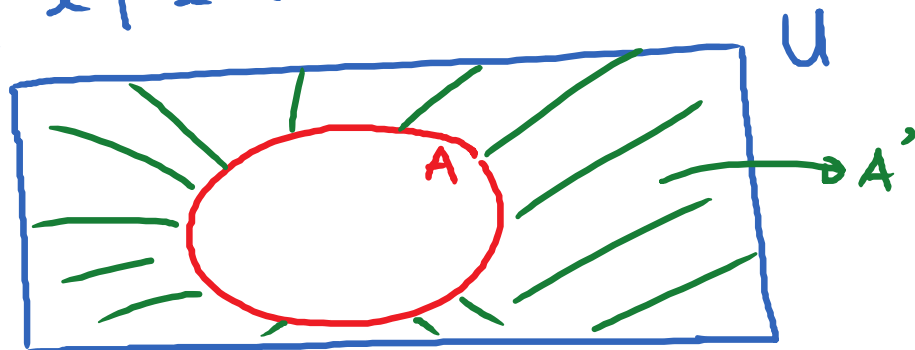
E.g. $U = \{x \mid x \text{ is a month in a year}\}$
 $A = \{x \mid x \text{ is a month that starts with J}\}$

Complement of A in $U = \{\text{Feb, Mar, Apr, May, Aug, Sept, Oct, Nov, Dec}\}$

Notation for the complement of A in U :

A' (read as A prime)

$A' = \{x \mid x \text{ is in } U \text{ but } x \text{ is not in } A\}$.



E.x. $U = \{1, 2, \dots, 10\}$

$$A = \{x \mid x \text{ is even, positive, less than } 10\}$$

Find A' . $A' = \{1, 3, 5, 7, 9, 10\}$

Notation: $n(A) = \# \text{ of elements in } A.$

E.g. $A = \{1, 2, 3, 4\}. \quad n(A) = 4$

$$B = \{a, b, c\}. \quad n(B) = 3$$

$$C = \{x \mid x \text{ is a month in a year}\}$$

$$n(C) = 12$$

E.g. $U = \{x \mid x \text{ is a state in the U.S.}\}$

$$A = \{x \mid x \text{ is a state that starts with T}\}$$

Find $n(A')$? $n(A') = 48.$

An application.

A marketing company did a survey of 1000 commuters. They found.

600 listen to the news. $\longrightarrow N$

500 listen to music $\longrightarrow M$

300 listen to both the news and music $\longrightarrow N \cap M$.

Q: (a) How many people listen to the news but not music?

(b) How many people listen to neither the news nor music?

