

Topic 3: Sets

1) The Basics:

a) Sets Symbols:

For the following symbols sets A and B are:

$$U = \{a, b, c, d, e, f, g, h, i, j, k\} \quad *U = \text{Universal Set}$$

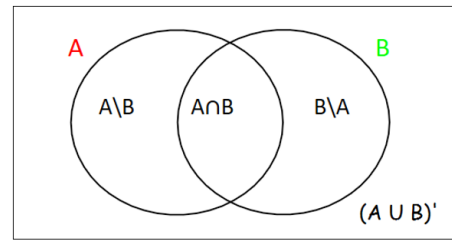
Set

$$A = \{a, c, e, f, g\} \text{ and } B = \{c, d, f, h, k\}$$

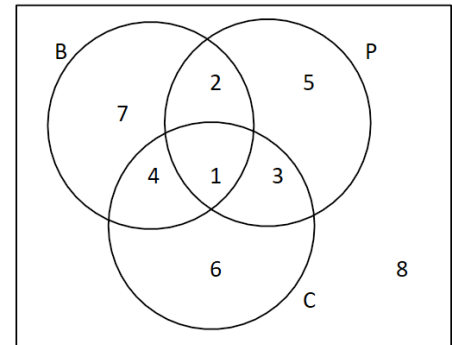
- 1) \cap : **Intersection**: elements that both sets have in common.
e.g. $A \cap B = \{c, f\}$
- 2) \cup : **Union**: the elements in both sets listed once.
e.g. $A \cup B = \{a, c, d, e, f, g, h, k\}$
- 3) \in : **is an element of**
e.g. $g \in A$ and $k \in B$
- 4) \notin : **is not an element of**
e.g. $p \notin A$ and $r \notin B$
- 5) \emptyset or $\{\}$: **null set or empty set**
e.g. if D is the set of days of the week beginning with 'G'
then $D = \{\}$ or $D = \emptyset$
- 6) \subset : **is a subset of**
If all the elements of a set are contained in another set then one set is a subset of the other.
e.g. $\{c, g\} \subset A$because c and g are in set A
- 7) $'$: **complement**: elements that are **NOT** in a set.
e.g. $A' = \{b, d, h, i, j, k\}$ and $B' = \{a, b, e, g, i, j\}$
- 8) $A \setminus B$: **Less or Set Difference (can also use $A - B$)**
 - What elements are in set A that are **NOT** in set B?
 - Order is important i.e. $A \setminus B \neq B \setminus A$
e.g. $A \setminus B = \{a, e, g\}$ and $B \setminus A = \{d, h, k\}$
- 9) $\#$: **Cardinal Number**: number of elements in a set
e.g. $\#A = 5$ and $\#U = 11$

b) Venn Diagrams:

• 2 Set Diagrams:



• 3 Set Diagrams:

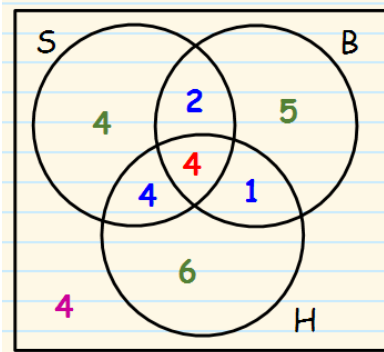


$$\begin{aligned} 1 &= B \cap P \cap C & 2 &= (B \cap P) \setminus C \\ 3 &= (P \cap C) \setminus B & 4 &= (B \cap C) \setminus P \\ 5 &= P \setminus (B \cup C) \text{ or } P \text{ only} & 6 &= C \setminus (B \cup P) \text{ or } C \text{ only} \\ 7 &= B \setminus (P \cup C) \text{ or } B \text{ only} & 8 &= (B \cup P \cup C)' \end{aligned}$$

2) Word Problems:

Tip: Try and fill the centre of the Venn Diagram first, and then spiral out from the there to the outer region step by step.

Example: A group of 30 students were asked their favourite sport in school, Hurling, Soccer or Basketball. 4 students said they liked all three. 6 said they liked soccer and basketball, 8 said they liked hurling and soccer and 5 said they liked hurling and basketball. 12 liked basketball in total, while 14 said they liked soccer and 15 said they liked hurling. How many liked none of the three sports?



Steps:

- 1) Start on the inside...4 like all three.
- 2) 6 liked soccer and basketball so we have to take off the 4 who said they liked all three to get this 2.
- 3) We find the 4 and 1 in the same way.
- 4) 15 said they liked hurling, so we have to subtract the 1, 4 and 4 that we have in the hurling circle already to get this 6.
- 5) Repeat for the 4 and 5.
- 6) Add all the numbers in the three circles and subtract from 30 to get this 4.

3) Properties of Sets:

- **Commutative**
 $A \cup B = B \cup A$ and $A \cap B = B \cap A$ but $A \setminus B \neq B \setminus A$
=> Union and Intersection are **Commutative**, whereas Set Difference is **not Commutative**
- **Associative**
 $(A \cup B) \cup C = A \cup (B \cup C)$ and $(A \cap B) \cap C = A \cap (B \cap C)$ but $(A \setminus B) \setminus C \neq A \setminus (B \setminus C)$
=> Union and Intersection are **Associative**, whereas Set Difference is **not Associative**