

Chapter 1: Set Theory (10 hours)
Section 1.1: Types of Sets and Set Notation

Important Terminology!

set: mathematical way to represent a collection or a group of objects

ex: set of school books

element: an object in a set

ex: math textbook from a set of books

universal set: a set of elements under consideration for a particular context

subset: a set whose elements all belong to another set

ex: the set of even digits $E = \{2, 4, 6, 8\}$ is a subset of the set $D = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$.

$$E \subset D$$

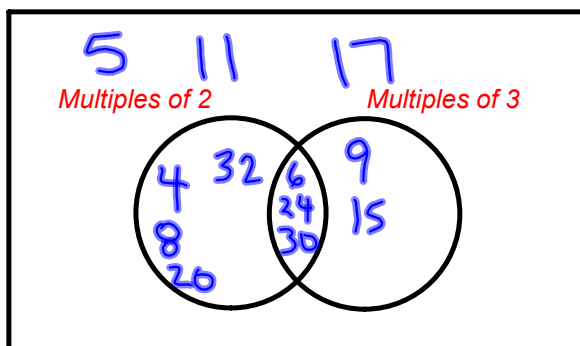
complement: Any elements of a universal set that do not belong to a subset of it
ex: Given the set $D:\{1, 2, 3, 4, 5, 6, 7, 8, 9\}$, if $E = \{2,4,6,8\}$ then $E' = \{1,3,5,7,9\}$ is the complement of E

Empty set: a set with no elements
ex: the set of odd numbers divisible by 2

disjoint: two or more sets having no elements in common
ex: the set of even numbers and odd numbers are disjoint

Venn Diagram: a way to illustrate set intersections, unions, complements and subsets.

Example 1: S: {4, 5, 6, 8, 9, 11, 15, 17, 20, 24, 30, 32}



a) What is the universal set? How many elements are in the set?

set S 12

b) What are the subsets and list the elements of each.

M2: {4, 6, 8, 20, 24, 30, 32}

M3: {6, 9, 15, 24, 30}

M2 ⊂ S

M3 ⊂ S

c) Why do the circles overlap?

common numbers in subsets. (6, 24, 30)

d) Why are some numbers not placed in either circle?

Some numbers fall into neither subset
(5, 11, 17)

Example 2:

Consider the following sets:

U = universal set of playing cards in a standard 52-card deck,

S = the set of all 13 spades,

B = the set of all 26 black cards (spades and clubs),

D = the set of all 13 diamonds.

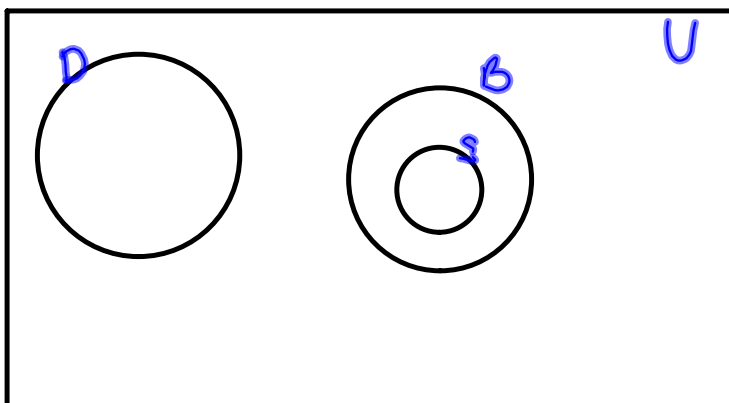
a) Which of these sets are subsets of other sets? Use proper notation.

$B \subset U$ $S \subset B$ $D \subset U$ $S \subset U$

b) List the disjoint sets, if there are any.

$B \dot{\cap} D$ $S \dot{\cap} D$

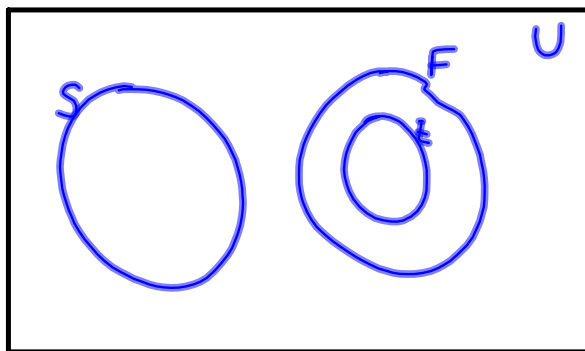
c) Represent the sets using a Venn diagram.



Textbook pg 15 #2, 9, 11, 14, 17

#2. a) Draw a Venn diagram to represent these sets

- universal set $U = \{\text{natural numbers from 1-40}\}$
- $E = \{\text{Multiples of 8}\}$
8, 16, 24, 32, 40
- $F = \{\text{Multiples of 4}\}$
4, 8, 12, 16, 20, 24, 28, 32, 36, 40
- $S = \{\text{Multiples of 17}\}$
17, 34



b) List the disjoint sets.

$S \cap F$
 $S \cap E$

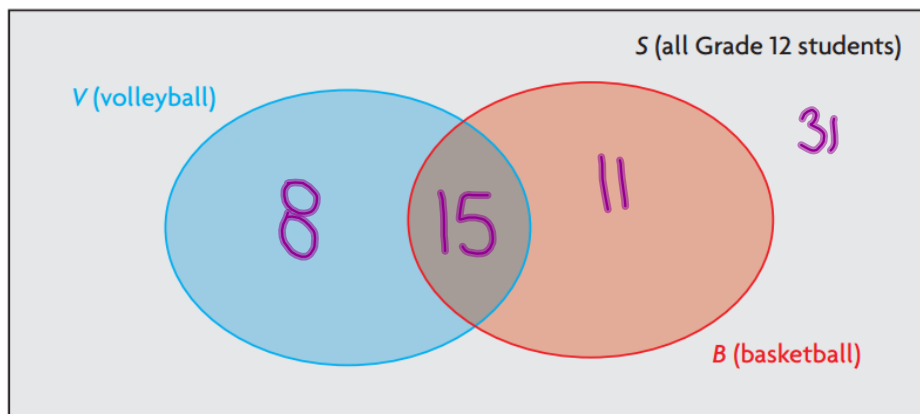
c) Is each statement true or false.

- i) $E \subset F$ True
- ii) $F \subset E$ False
- iii) $E \subset E$ True
- iv) $F' = \{\text{odd numbers from 1 to 40}\}$ False
- v) The set of natural numbers from 41-50 is $\{\}$ True

Section 1.2: Exploring Relationships between Sets

Example 1:

In an Alberta school, there are 65 Grade 12 students. Of these students, 23 play volleyball and 26 play basketball. There are 31 students who do not play either sport. The following Venn diagram represents the sets of students.



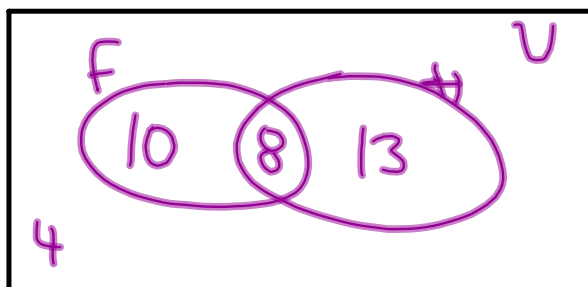
How can you use this Venn diagram to determine the number of students who play volleyball only, basketball only, and both volleyball and basketball?

Example 2: In a class there are:

- 8 students who play both football and hockey
- 21 students who play hockey
- 18 students who play football
- There are a total of 35 students in the class

Draw a Venn diagram to represent this situation.

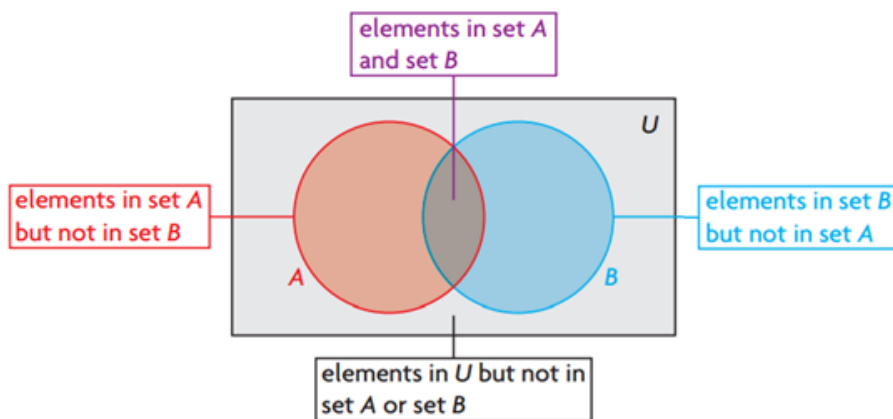
$$\begin{aligned}\text{Football only} &= 18 - 8 = 10 \\ \text{hockey only} &= 21 - 8 = 13 \\ \text{Neither sport} &= 35 - 10 - 13 - 8 \\ &= 4\end{aligned}$$



pg 20 #1,2,3,4

Summary:

- Each element in a set appears only once in a Venn diagram
- if an element occurs in more than one set it goes in the overlap region



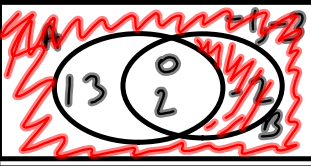
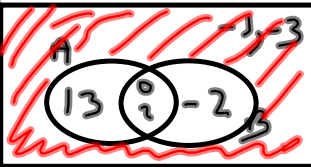

Textbook pg 20 #1,2,3,4

Section 1.3: Intersection and Union of Two Sets

Example 1: The universal set of all integers from -3 to 3. Set A is the set of non-negative integers and set B is the set of all integers divisible by 2.

Universal Set: $\{-3, -2, -1, 0, 1, 2, 3\}$
 Set A: $\{0, 1, 2, 3\}$
 Set B: $\{-2, 0, 2\}$

Set Notation	Meaning	Venn Diagram	Answer
$A \cup B$ (A union B)	any element that is in either set		$-2, 0, 1, 2, 3$
$A \cap B$ (A intersect B)	only elements that are in both set A and B		$0, 2$
$A \setminus B$ (set A minus set B)	elements found in set A but excluding the ones that are also in set B		$1, 3$

Set Notation	Meaning	Venn Diagram	Answer
A' (A complement or not A)	All elements in the universal set outside of A		$-1, -2, -3$
$(A \cup B)'$ elements outside A and B	elements outside of A and B		$-1, -3$
$(A \cap B)'$	elements outside the overlap of A and B		$1, 3, -2$ $-1, -3$

Shading Worksheet
pg 32 #1, 3, 4, 6, 7,8,9,11,12,13

Section 1.3 cont'd:

Principle of Inclusion and Exclusion

$$n(A \cup B) = n(A) + n(B) - n(A \cap B)$$

Note: When the sets are disjoint

$$n(A \cup B) = n(A) + n(B)$$

Example 2:

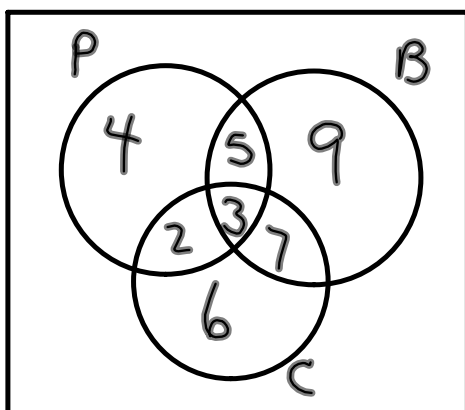
There are 36 students who study science.

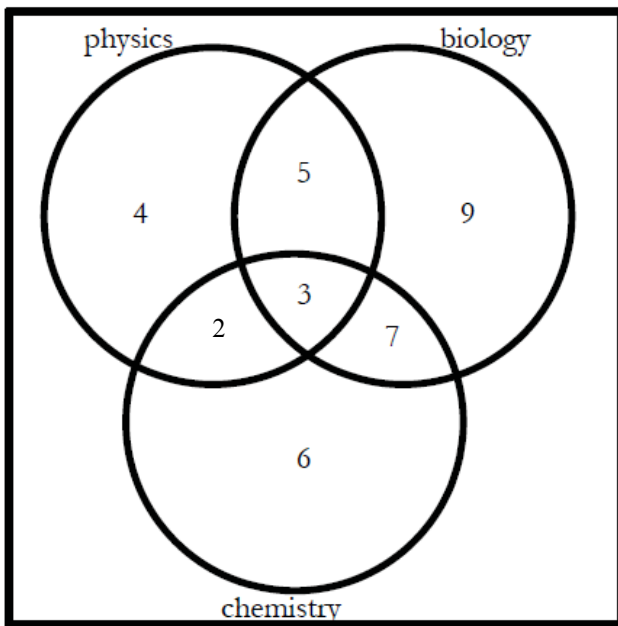
14 study Physics, 18 study Chemistry, 24 study Biology,

5 study Physics and Chemistry, 8 study Physics and Biology,

10 study biology and Chemistry, 3 study all three subjects.

- a) Determine the number of students who study Physics and Biology only. **5**
- b) Determine the number of students who study at least two subjects. **17**
- c) Determine the number of students who study Biology only. **9**





a) $n(P \text{ and } B \text{ only}) = 13$

b) $n(\text{at least } 2) = 17$

c) $n(B \text{ only}) = 9$