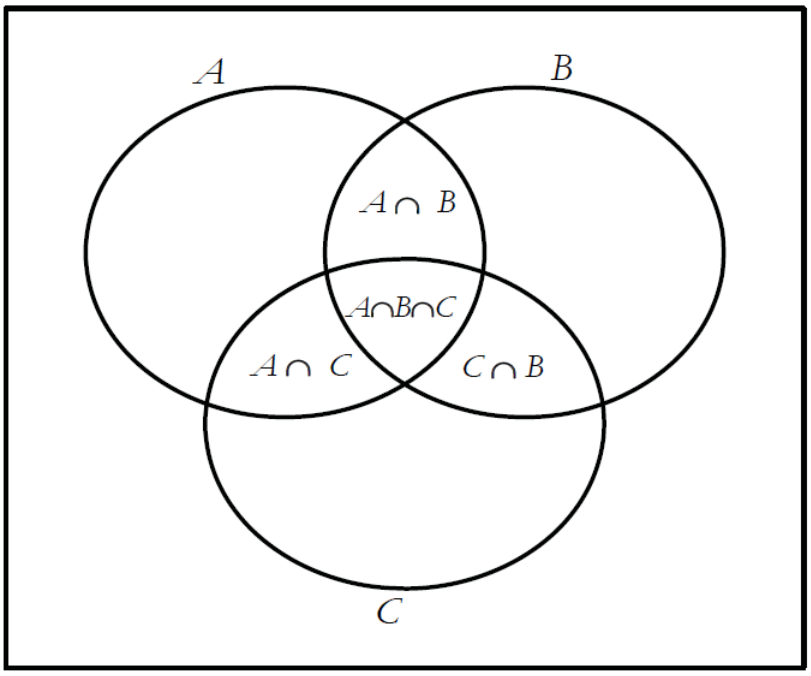
Math 3201 **Date:**_____

1.4A Venn Diagrams of Three Intersecting Sets

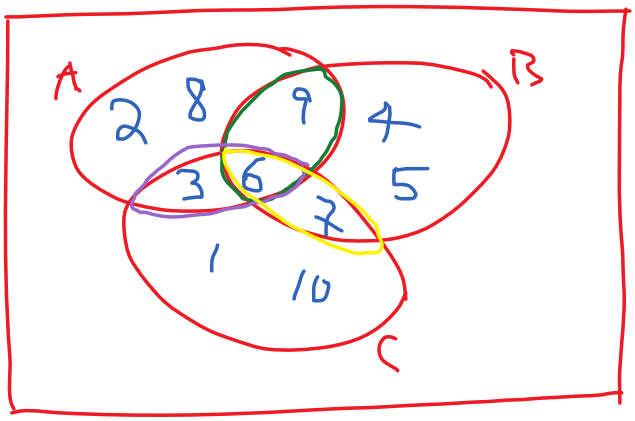
Since situations involving three intersection sets are more complicated than those involving two intersecting sets, we will **not** look at the formula for determining the number of elements in the union of the three sets. Instead, we will only solve these problems using Venn Diagrams.

Example of a Venn Diagram showing three intersecting sets:



Example 1
Set A has elements {2, 3, 6, 8, 9}
Set B has elements {4, 5, 6, 7, 9}
Set C has elements {1, 3, 6, 7, 10}

(A) Draw a Venn Diagram representing the situation.



$n(A \cap B) = 2$
$n(A \cap C) = 2$
$n(B \cap C) = 2$
$n(A \cup B \cup C) = 10$

(B) Determine the value of $n(A \cap B)$.

$n(A \cap B) = 2$

(C) Determine the value of $n(A \cap C)$.

$n(A \cap C) = 2$

(D) Determine the value of $n(B \cap C)$.

$n(B \cap C) = 2$

(E) Determine the value of $n(A \cup B \cup C)$.

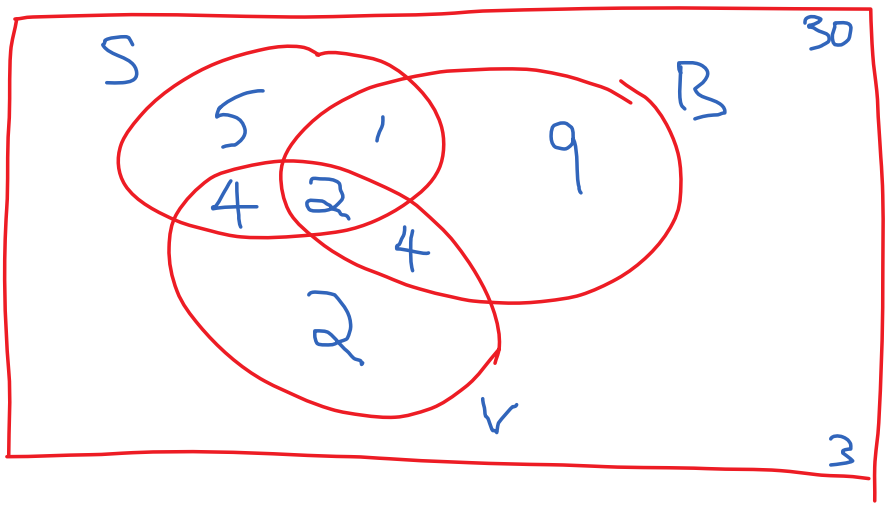
$n(A \cup B \cup C) = 10$

Example 2

A group of 30 students are surveyed to find out which of the three sports, soccer (S), basketball (B) or volleyball (V), they play. The results are as follows:

- 3 children do not play any of these sports
- 2 children play all three sports
- 6 play volleyball and basketball
- 3 play soccer and basketball
- 6 play soccer and volleyball
- 16 play basketball
- 12 play volleyball

(A) Draw a Venn Diagram representing this situation.



(B) How many students play soccer only?

$n(S \setminus B \setminus V) = 30 - (3+1+2+4+4+7+9) = 5$

(C) How many students play soccer but not basketball

$5 + 4 = 9$

(D) How many students play volleyball but not basketball?

$2 + 4 = 6$

Summary of Steps - Venn Diagrams with Three Sets

Drawing Venn Diagrams with three sets can be tricky. Follow these steps for creating the diagrams:

1. First, put in the number of elements OUTSIDE all the sets.

2. Put in the number of elements in the intersection of ALL THREE sets.

3. Put in the number of elements in the intersection of two sets. There will often be three of these numbers to put in, for example A∪B, A∪C, B∪C. You will have to subtract the number of elements in the intersection of **all** sets from each of these numbers.

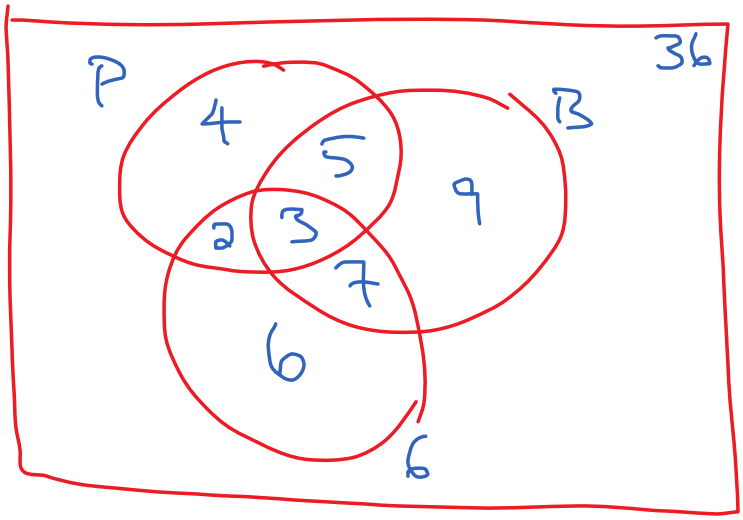
4. Put in the total numbers for each set. Subtract the numbers in the appropriate intersections.

5. Check your diagram by adding up all the numbers. This should equal the total that was given in the problem.

Your Turn

1. 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) Create a Venn Diagram of the situation.



(B) Determine the number of students who study Physics and Biology only.

$n(P \cap B \setminus C) = 5$

(C) Determine the number of students who study at least two subjects.

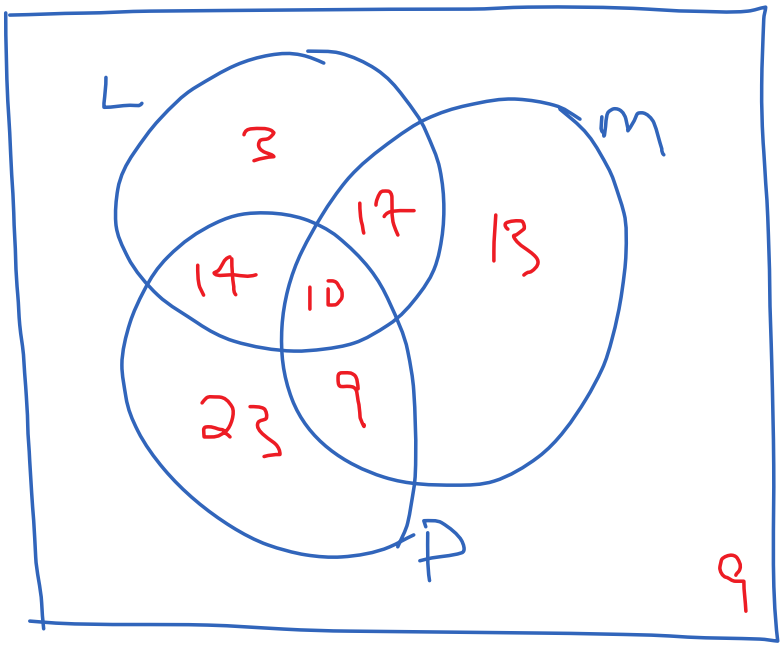
$n((P \cap B \setminus C) \cup (P \cap C \setminus B) \cup (C \cap B \setminus P) \cup (P \cap B \cap C))$

$= 5 + 2 + 7 + 3 = 17$

(D) Determine the number of students who study biology only.

$n(B \setminus P \setminus C) = 9$

2. A survey of a machine shop reveals the following information about its employees: 44 employees can run a lathe, 49 employees can run the milling machine, 56 employees can operate a punch press, 27 employees can run a lathe and a milling machine, 19 employees can run a milling machine and operate a punch press, 24 employees can run a lathe and operate a press punch, 10 employees can operate all three machines, 9 employees cannot operate any of the three machines. Draw a Venn Diagram and use it to determine the number of people employed at the machine shop.



$n(U) = 3+17+13+14+10+9+23+9 = 98$

Textbook Questions: page 51 - 52 #2, 4, 9