Instructions: In-class exercises are meant to introduce you to a new topic and provide some practice with the new topic. **Work in a team of up to 4 people to complete this exercise.** You can work simultaneously on the problems, or work separate and then check your answers with each other. **Turn in one copy of the exercise per group**.

Names:

Sets: Set Basics

Set notation and basics

What is a set?
A set is a structure that contains information. Often, our sets will contain numbers, but they could also contain a list of colors, students, and so on. The items that are contained in a set are known as the **elements** of the set.

Notation: Sets are usually given single, capital letters as the names. Then, to specify the elements within the set, you write it between opening and closing curly-braces { }, with each element separated by a comma.

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

Question 1
Define the following sets...

a. The set G of all students in your group.

b. The set C of all classes one member of the group is taking.

More info about sets

Order doesn't matter: Two sets with the same elements but a different order are treated as the same.

Duplicates don't matter: If an element shows up in a set more than once, it is still considered the same set as if it had just had one of that element.

Question 2

Given the sets:

$A = \{1, 2, 3\}$ $B = \{2, 2, 3\}$ $C = \{5, 6, 7\}$ $D = \{3, 2, 1\}$

For the following, fill in whether the two sets are **equal** ($=$) or **not** ($\neq$).

A ____ B A ____ C A ____ D

Common sets of numbers

Some common sets we will be working with are...

$\mathbb{Z}$, the set of integers; whole numbers - positive, negative, and 0.

$\mathbb{N}$, the set of natural numbers; counting numbers - 0 and positive integers.

$\mathbb{Q}$, the set of rational numbers; any number that can be written as a fraction/ratio.

$\mathbb{R}$, the set of real numbers; all of the above, plus numbers with unending strings of digits after the decimal point.

Question 3

For the following numbers, check ✓ which set(s) they belong to.

	$\mathbb{N}$	$\mathbb{Z}$	$\mathbb{Q}$	$\mathbb{R}$
10				
-5				
12/6				
π				
2.40				

Subsets

Subsets
We can use = to show that two sets are equivalent, but it can also be useful to show that one set is a **subset** of another - that is, all elements from one set are present in a second set.

$A \subseteq B$ specifies that all elements of set A are present in set B.

If $A \subseteq B$ and $B \subseteq A$, then $A = B$.

Element of...
You can specify that a number (or item) is **an element of** some set by using the $\in$ ("in") notation. For example, $x \in A$ means "x in A".

Question 4
For each scenario, check any items that are **true**.

a. $A = \{1, 2, 3\}$ and $B = \{2, 3\}$
☐ $A \subseteq B$ ☐ $A \nsubseteq B$ ☐ $B \subseteq A$ ☐ $B \nsubseteq A$ ☐ $A = B$

b. $C = \{red, green, blue\}$ and $D = \{red, yellow, blue\}$
☐ $C \subseteq D$ ☐ $C \nsubseteq D$ ☐ $D \subseteq C$ ☐ $D \nsubseteq C$ ☐ $C = D$

c. $E = \{1, 1, 2, 3, 4\}$ and $F = \{4, 3, 2, 2, 1\}$
☐ $E \subseteq F$ ☐ $E \nsubseteq F$ ☐ $F \subseteq E$ ☐ $F \nsubseteq E$ ☐ $E = F$

Set cardinality
Set cardinality is a way of saying the "size of the set", or the "amount of elements in the set". It can be denoted as $|X|$ or $n(X)$, depending on the book.

Question 5
Give the set cardinality for each.
a. $A = \{1, 2, 3\}$ $|A| =$

b. $B = \{\}$ $|B| =$

Set operations

Set operations
We can figure out the relationship between two sets with the following operations.

Union $\cup$: Given two sets A and B, the union $A \cup B$ will be a set that contains all elements of both sets.

Intersection $\cap$: Given two sets A and B, the intersection $A \cap B$ will be a set that contains only the elements in common between both.

Difference $-$: Given two sets A and B, the difference $A - B$ will be all the elements of A, EXCEPT for any elements that are also in B.

Question 6
Given the sets:

$$A = \{1, 2, 3\} \qquad B = \{2, 4, 6\} \qquad C = \{6, 7\}$$

Solve each of the following operations:

a. $A \cup B =$

b. $A \cap B =$

c. $A \cup C =$

d. $A \cap C =$

e. $A - B =$

f. $(A - B) \cup C =$

Complement, Universe, and Empty Set
When we're working with Set problems, usually a Universal set will be specified. The **Universal Set** U is the set of all elements of all sets in the problem (and possibly additional elements).

The **Empty Set** $\emptyset$ is a set with no elements contained within it. If you take the intersection of two sets with no common elements, the result will be $\emptyset$.

The **Complement** of a set X, written as $\bar{X}$ or X', will be $U - X$; the set of everything in the universe, EXCEPT for any elements in X.

Question 7
Given the sets:

$$A = \{1, 2, 3\} \qquad B = \{2, 4, 6\} \qquad C = \{5, 6\}$$
$$U = \{1, 2, 3, 4, 5, 6, 7\}$$

Solve each of the following operations:

a. $A' =$

b. $U - A =$

c. $C - B =$

d. $A \cap C =$

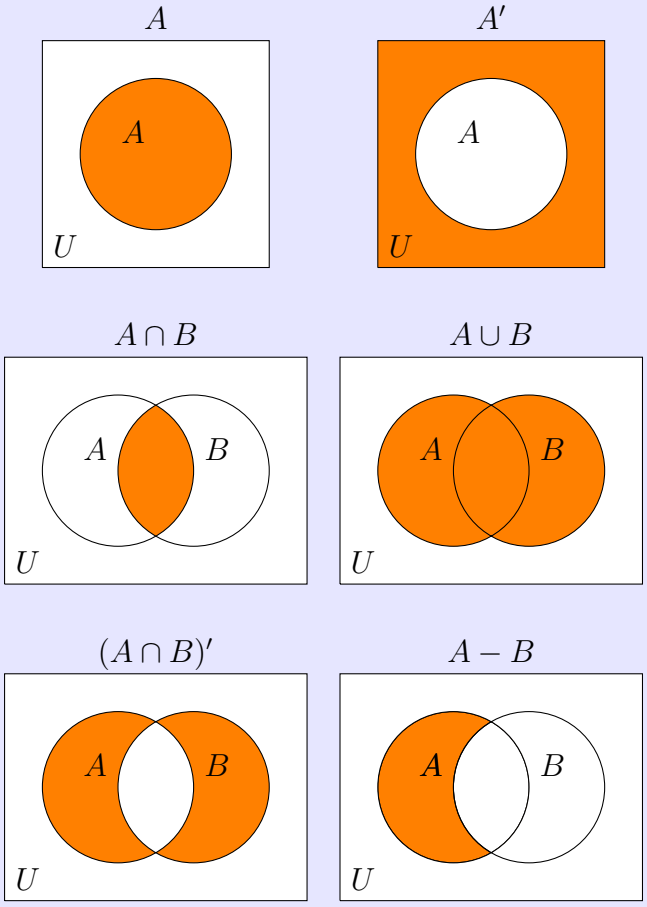
e. $(A \cup B)' =$

e. $A' \cap B' =$

Venn diagrams

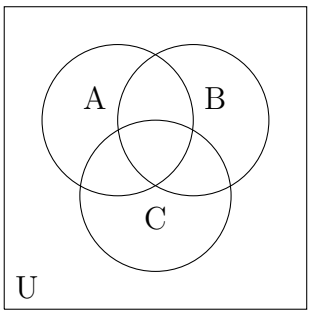
Venn diagrams

We can visualize a general set problem by using Venn diagrams. A Venn diagram will contain a rectangle, the **Universe**, and circles to represent each set. Regions are shaded in to show what parts of what sets are included.

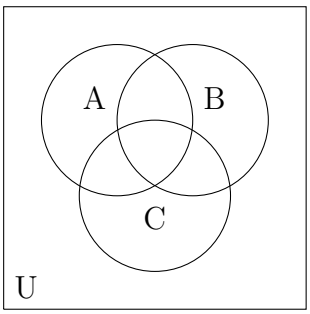


Question 8
Fill in the Venn diagrams for the following operations:

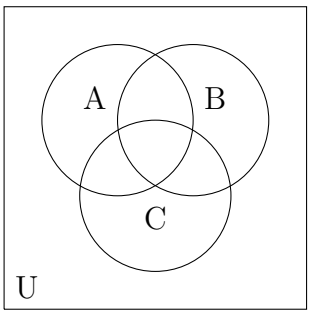
a. $A \cup B$



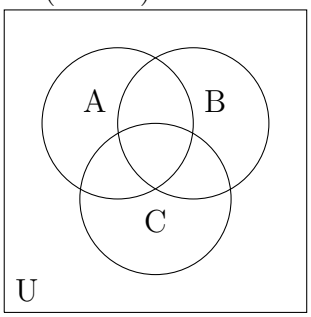
b. $A \cup C$



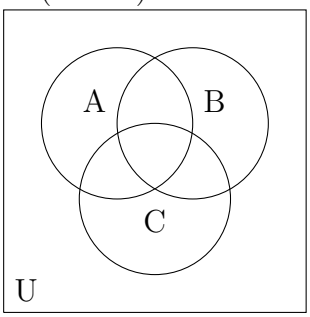
c. $A \cup B \cup C$



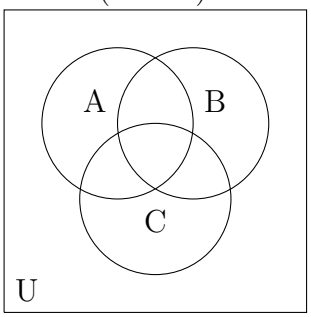
d. $(A \cup B) - C$



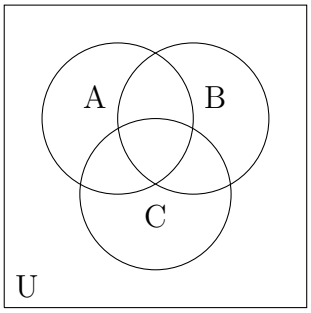
e. $(A \cap B) \cup C$



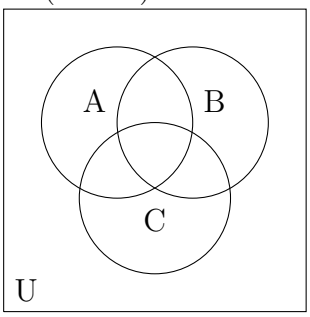
f. $A - (B \cap C)$



g. A'



h. $(A \cup B)'$



i. $(A \cap B \cap C)'$