Set notation and relationships:
Definitions:

$\in$ “is an element of”. $x \in A$ means that x is an element of A. Every set is defined by its elements, and two sets are equal if they have all of the same elements.

ϕ “the empty set”. The set that contains no elements.

$\subseteq$ ”is a subset of”. $A \subseteq B$ if every element of A is also an element of B. Note that Every element of A is an element of A so $A \subseteq A$. Note also that ϕ has no elements, so it is a subset of every set.

U “the universe” or “the universal set”. The set of all elements that are relevant for the current problem (often the set of all numbers or all points in the plane).

$|\ |$ “the number of elements of”. $|A|$ is the number of elements in A. Note that $|\phi| = 0$ because the empty set does not have any elements.

$\cap$ “intersection”. The intersection of two sets is the set of all of the elements that are in both sets: $x \in A \cap B$ if $x \in A$ and $x \in B$ both

$\cup$ “union”. The union of two sets is the set of all of the elements that are in either set: $x \in A \cup B$ if $x \in A$ or $x \in B$ (or both—“or” when used about sets is always inclusive: one or the other or both).

$\overline{}$ “complement”. The complement of a set is all of the elements in the Universe that are not in the set: $x \in \overline{A}$ if $x \notin A$

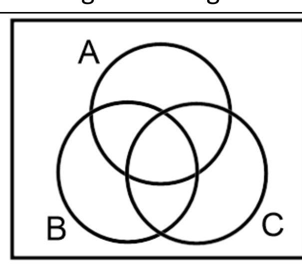
$-$ “minus”. $A - B$ is all of the elements that are in A that are not in B: $x \in A - B$ if $x \in A$ but $x \notin B$

Theorems/relationships:
Given sets A, B, C in universal set U

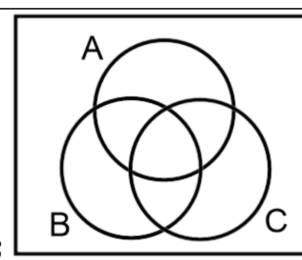
Thm 2.0	Thm. 2.1	Thm 2.2 (DeMorgan’s laws)
a. $A \cup U = U$ b. $A \cap U = A$ c. $A \cup \phi = A$ d. $A \cap \phi = \phi$ e. $A \cup A = A$ f. $A \cap A = A$	a. $A \cup B = B \cup A$ and $A \cap B = B \cap A$ b. $A \cup (B \cup C) = (A \cup B) \cup C$ and $A \cap (B \cap C) = (A \cap B) \cap C$ c. $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$ and $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$ d. $\overline{\overline{A}} = A$ (that’s a double complement, not an =) e. $A \cup \overline{A} = U$ f. $A \cap \overline{A} = \phi$ g. $A \subseteq A \cup B$ and $B \subseteq A \cup B$ h. $A \cap B \subseteq A$ and $A \cap B \subseteq B$ i. $A - B = A \cap \overline{B}$	a. $\overline{A \cup B} = \overline{A} \cap \overline{B}$ b. $\overline{A \cap B} = \overline{A} \cup \overline{B}$

18. Show $(A - B) \cup (A \cap B) = A$ using theorems and by making Venn diagrams.

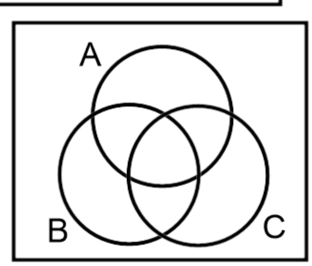
Steps	Theorem
$(A - B) \cup (A \cap B)$	
$= (A \cap \overline{B}) \cup (A \cap B)$	
$= A \cap (\overline{B} \cup B)$	
$= A \cap U$	
$= A$	



$A - B$

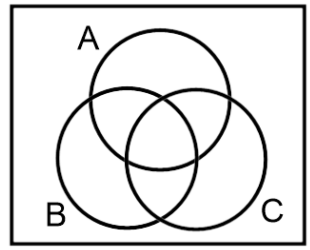


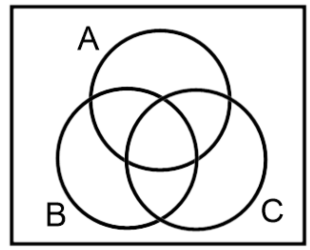
$A \cap B$

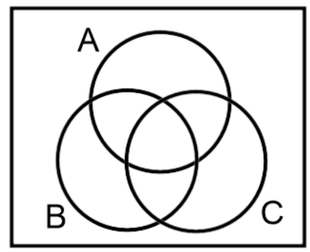


19. Show $(A-B)\cap(A\cup B)=A-B$ using theorems and by making Venn diagrams.

Steps	Theorem
$(A-B)\cap(A\cup B)$	
=	2.1.i
=	2.1.b (intersection)
=	2.1.c (second version)
=	2.1.f
=	2.0.c
=	2.1.a
=	2.1.b
=	2.0.f
=	2.1.i







Homework: Prove each of the following by using theorems and making Venn diagrams

17. $A\cap(B-A)=A\cap B$

21. $\overline{A}\cap(A\cup B)=B-A$

22. $\overline{(A-B)}\cap A=B\cap A$

(hint: step 1 uses thm 2.1.i and step 2 uses thm 2.2.b)