Advanced Math
Motivational Problems for Combinatorics

1. Let the sets A, B, C and D be defined by A = {all people who own a GM car}, B
   = {all people who are GM employees}, C = {the president of GM}, D = {all
   people who are GM stockholders}.
   Describe in your own words, the following sets:
   a. $A \cap B$ b. $B \cap \overline{A}$ c. $(A \cup B) \cap D$ d. $C \cap A$

2. Two sets A and B are called ***disjoint*** if $A \cap B = \varnothing$. What does this mean in
   words and find an example of two sets that are disjoint.

3. A Universal Set U with nondisjoint subsets A and B has the following number of
   elements in each set:

Set	# of elements
U	$10 = n(A)$
A	$7 = n($
B	6
$A \cap B$	4

   Use a Venn Diagram to find the number of elements in $A \cup B$.

4. Use a Venn Diagram to prove the two following properties. They are called
   deMorgan's Laws of sets. State these laws in your own words as well.
   I. $\overline{(A \cup B)} = \overline{A} \cap \overline{B}$ II. $\overline{(A \cap B)} = \overline{A} \cup \overline{B}$

5. The Flabnomore Exerciser Company requires each of its employees to pass a
   yearly physical examination. The results of the most recent examination of the 50
   employees were that 30 employees were overweight, 25 had high blood pressure,
   and 20 had high cholesterol count. Moreover, 15 of the overweight employees
   also had high blood pressure, and 10 of those with a high cholesterol count were
   also overweight. Of the 25 with high blood pressure, there were 12 who also had a
   high cholesterol count. Finally, there were 5 employees who had all three of these
   undesirable conditions. When the reports reached the desk of the president, Jox
   Chinup, he asked, "Don't we have any completely healthy employees around
   here?" What's the answer to the president's question?

6. If there are 2 sophomores, 5 juniors and 4 seniors in an Advanced Math Class, it's
   pretty obvious that the class size is 11 students. (Can you explain why in the
   vocabulary of sets?) What if you were given the following information: In an
   Advanced Math Class, there are 8 students who take Spanish and 9 students who

take French. Does that mean that the class size is 17? Give examples of why or why not.

7. A survey of 100 college students gave the following data:

    8 owned a truck
    20 owned a car
    48 owned a bicycle
    38 owned neither a car nor a truck nor a bicycle
    no student who owned a car also owned a truck

How many students owned a bicycle and either a car or a truck?