Provide both a clear and organized presentation. Completely answer each question, give exact values only, and show all of your work. Only a scientific calculator can be used on this exam.

1. (19 pts) There are 32 students surveyed in Math 17, and it is found that 23 are female and 8 work at least part time. It is also known that 28 of these students surveyed are either female or work at least part time.

   i) Create a *Venn diagram* representing the information given.

   ii) How many of these students surveyed are both female and working at least part time?

   iii) How many of these students surveyed are neither female nor working at least part time?

   iv) How many of these students surveyed are female but do not work at all?

2. (12 pts) Consider the universe $U = \{1,2,3,4,5,6,7,8,9\}$ and let $P = \{2,3,5,7\}$ and $Q = \{1,3,5,7,9\}$. Determine each of the following:

i) $\overline{P}$

ii) $\overline{P} \cap \overline{Q}$

iii) $P \cup Q$

iv) $\overline{P \cup Q}$

3. (10 pts) Define a new set operator, denoted by $\oplus$, as follows:

Given two sets A and B, let $A \oplus B = \{x | x \in A \text{ or } x \in B, \text{and } x \notin A \cap B\}$.
If $A = \{?, \#, \%, @\}$ and $B = \{\#, \%, @, \$\}$, then determine $A \oplus B$.

4. (10 pts) I have two empty buckets, one having a 4-gallon capacity and the other having an 11-gallon capacity. I wish to use these two buckets to gather an amount of sand that will occupy exactly one gallon. Clearly explain how I can accomplish this.

5. (19 pts) There are 30 cats surveyed and the following results were obtained:

11 are tailless,
14 have French names,
16 have a nasty cough,
8 are tailless and have French names,
7 have French names and have a nasty cough,
6 are tailless and have a nasty cough,
5 are tailless and have French names and have a nasty cough

i) Create a *Venn diagram* representing the information given.

ii) How many of these cats surveyed have tails?

iii) How many of these cats surveyed are tailless or have French names, but do not have a nasty cough?

iv) How many of these cats surveyed have French names and a nasty cough, but are not tailless?

6. (10 pts) Rewrite 101110_{two} in base ten.

7. (10 pts) Rewrite 50 in base three.

8. (10 pts) Recall the symbols used in the Roman Numeral System:

I	One
V	Five
X	Ten
L	Fifty
C	One Hundred
D	Five Hundred
M	One Thousand

Rewrite CMXXXIV in standard form in our Hindu-Arabic numeral system.