1. [10 pts. each] Express each set in roster form.

   (a) The set of integers between 2 and 7.

   (b) $E = \{x \mid x \in \mathbb{N} \text{ and } x \text{ is even}\}$

2. [10 pts. each] Express each set in set-builder notation.

   (a) $A = \{5, 6, 7, 8, 9, 10, 11, 12, 13, 14\}$.

   (b) B is the set of odd natural numbers.

3. [5 pts. each] State whether each statement is true or false. If false, give the reason.

   (a) $\{\#\} \in \{\$, \&, \%, @, \#, =\}$

   (b) $\psi \notin \{\alpha, \beta, \gamma, \delta, \epsilon, \zeta\}$

   (c) $\boxdot \subset \{\boxdot, \square, \boxminus, \boxslash, \boxdot, \boxast\}$

   (d) $\varnothing \subset \varnothing$

4. [10 pts.] List all the proper subsets of the set $C = \{\oslash, \sqcup, \times\}$.

5. [10 pts. each] Let $U = \{1, 2, 3, 4, 5, 6, 7, 8\}$ be the universal set, $A = \{1, 2, 4, 5, 8\}$, and $B = \{2, 3, 4, 6\}$. Determine the following.

   (a) $(A \cup B)'$

   (b) $A' \cup (A \cap B)$

   (c) $A - B'$

6. [15 pts.] Determine $(C' \cup A) \cap B$, given that
   $U = \{x \mid x \in \mathbb{N} \text{ and } x < 10\}$
   $A = \{x \mid x \in \mathbb{N}, \ x \text{ is odd, and } x < 10\}$
   $B = \{x \mid x \in \mathbb{N}, \ x \text{ is even, and } x < 10\}$
   $C = \{x \mid x \in \mathbb{N} \text{ and } x < 6\}$

7. [15 pts.] For $A = \{q, r\}$ and $B = \{4, 6, 8\}$, determine $A \times B$. Also, determine $n(A)$, $n(B)$, and $n(A \times B)$.

8. [10 pts.] Use the Venn diagram below to determine the sets $A \cap (B \cup C)$ and $(A' \cup B) \cap C$.

9. [10 pts. each] Use Venn diagrams to determine whether the following expressions are equal for all sets A, B, and C.

   (a) $(A' \cap B)'$, $\quad A \cup B'$

   (b) $A \cup (B \cap C)'$, $\quad A' \cap (B \cup C)$

10. Three major grain crops raised in the world are wheat, maize, and rice. A survey of 43 countries that raise grain yielded the following results:
    18 countries raised wheat
    16 countries raised maize
    12 countries raised rice
    9 raised wheat and maize
    3 raised maize and rice
    3 raised wheat and rice
    2 raised all three crops

   (a) [10 pts.] Draw a Venn diagram illustrating the information given above.

   (b) [5 pts.] How many countries raised none of the three crops?

   (c) [5 pts.] How many countries raised exactly one of the crops?

   (d) [5 pts.] How many raised wheat and maize, but not rice?

   (e) [5 pts.] How many raised maize or rice, but not wheat?

11. [10 pts.] Show that the set $\{3, 9, 15, 21, 27, ...\}$ is infinite by placing it in a one-to-one correspondence with a proper subset of itself. Be sure to show the pairing of the general terms in the sets!

12. [10 pts.] Show that the set $\{0, 2, 4, 6, 8, ...\}$ has cardinal number $\aleph_0$ by establishing a one-to-one correspondence between it and the set of natural numbers. Be sure to show the pairing of the general terms in the sets!

13. [10 pts. each] Write the negation of each statement.

   (a) No prions can be seen.

   (b) Some Vulcans are illogical.

   (c) All math courses are loads of fun.
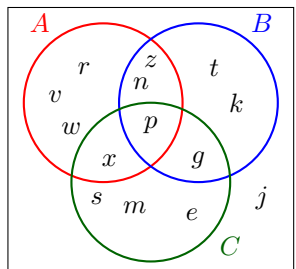
14. [10 pts. each] Let

　　p: *Mr. Freeze was foiled last week.*
　　q: *Two-Face is in town.*
　　r: *Batman is on vacation.*
　　s: *The Mad Hatter is off his meds.*

Write the following in symbolic form.

(a) If Mr. Freeze was foiled last week and Two-Face is not in town, then Batman is on vacation.

(b) Two-Face is in town if and only if Batman is on vacation or Mr. Freeze was foiled last week.

(c) It is false that Batman is not on vacation and Mr. Freeze was not foiled last week.

(d) Mr. Freeze was foiled last week and Batman is on vacation, or Two-Face is in town and the Mad Hatter is off his meds.

15. Make a truth table for each statement.

(a) [10 pts.] $\sim(p \wedge \sim q)$

(b) [10 pts.] $q \vee (p \leftrightarrow \sim q)$

(c) [15 pts.] $p \rightarrow (q \vee r)$