1. Fill in the blank:

   Sets A and B have the same cardinality if and only if _____

   _____.

2. Which of the following sets have the same cardinality?
   $A = \{1, 2, 3\}$
   $B = \{2, 4, 6, \ldots, 400\}$
   $C = \{i, j, k\}$
   $M = \{2, 4, 6, \ldots\}$
   $S = \{1, 2, 3, \ldots, 200\}$
   $\mathbf{Z}^+$

3. Which of the sets in #2 are *countable*?

4. Prove that the set of all square numbers is countable.

5. Prove that $\mathbf{Z}$ is countable.

6. Let $\mathbf{Q}^+$ be the set of all positive rational numbers. Is $\mathbf{Q}^+$ countable? Why or why not?

7. Is $\mathbf{Z}^+ \times \mathbf{Z}^+$ countable? Why or why not?

8. Let $S = \{x \in \mathbf{R} \mid 0 < x < 1\}$. Is S countable? Why or why not?

9. Let $M = \{x \in \mathbf{R} \mid 0 < x < 0.1\}$. Show that M has the same cardinality as S from the previous problem.

10. Suppose A and B are countable sets. Is $A \cup B$ countable?

11. Is the set of irrational numbers countable? Why or why not?