0. Write your name, section number, and student ID clearly on your homework. Staple it together. If you do not own a stapler, buy one. If you do not do all of this question then you receive no points for this problem.

READ 411-422 in EPP

1. Prove that the set of integers divisible by 12 is countable.

2. (a) Prove that the union of 2 countable sets is countable.
   (b) Prove that the union of any finite number of countable sets is countable. (hint: use the previous question).
   (c) Prove that the union of countably many countable sets is countable.

3. Prove that the cartesian product of countably many countable sets is countable.

4. For each of the following, first say if the set is countable or un-countable, then prove your conjecture.
   (a) \( \{f | f : \mathbb{Z} \rightarrow \{1, 2, 3\}\} \)
   (b) \( \{f | f : \mathbb{R} \rightarrow \{1, 2, 3\}\} \)
   (c) \( \{f | f : \{1, 2, 3\} \rightarrow \mathbb{Z}\} \)
   (d) \( \{f | f : \{1, 2, 3\} \rightarrow \mathbb{R}\} \)