Problem 1. Show that if \( L \) is a line in the plane, and \( S \) is a conic section, then one of the following possibilities must occur:

1. \( L \) and \( S \) do not intersect at all (that is, \( S \cap L = \emptyset \)),
2. \( L \) and \( S \) intersect at one point (that is, \( S \cap L = \{P\} \) for some point \( P \)),
3. \( L \) and \( S \) intersect at two points (that is, \( S \cap L = \{P, Q\} \) for some point \( P, Q \)),
4. \( L \) is entirely contained in \( S \) (that is, \( L \subseteq S \)).

In other words, you must show that if the intersection of \( L \) and \( S \) has three distinct points, then \( L \) is entirely contained in \( S \). (HINT: There are lots of ways to do this problem, but one possibility would be to make a change of coordinates that will simplify the situation.)

Problem 2. Problem 1 of the notes on conic sections.

Problem 3. Problem 2 of the notes on conic sections.

Problem 4. Problem 3 of the notes on conic sections.