Now we consider the Lorenz equation. This is the prototype equation for generating chaos. Of interest here is to study how chaos arises from what appears to be a simple set of differential equations. The equations to study are

\[
\begin{align*}
\frac{dx}{dt} &= -\sigma x + \sigma y \\
\frac{dy}{dt} &= rx - y - zx \\
\frac{dz}{dt} &= -bz + xy
\end{align*}
\]

1) Find the equilibrium points of this system and show the stability of the zero fixed point.

2) Graph three solution plots, one each for \( x, y \) and \( z \) separately for the following values: \( r = 28, \sigma = 10, \) and \( b = 8/3. \) Use the initial conditions \( \bar{x} = (0,1,0). \)

3) Now plot two dimensional phase portraits for the case in problem 2. Plot \( x \) vs \( y, x \) vs \( z \) and \( y \) vs \( z. \) What do you notice about these plots.

4) Now play around with the parameters you were given in problem 1 to see what other type of behavior you can generate. Specifically, what critical value of \( r = r_c \) can you find so that the strange attractor no longer exists?