Consider three systems of differential equations and initial conditions:

a. 
\begin{align*}
x' &= 2y \\
y' &= -x
\end{align*}

with \( x(0) = 0, \ y(0) = 1, \)

b. 
\begin{align*}
x' &= -y \\
y' &= x - y
\end{align*}

with \( x(0) = 1.8, \ y(0) = 0, \)

c. 
\begin{align*}
x' &= y^2 \\
y' &= x
\end{align*}

with \( x(0) = -1, y(0) = 0. \)

For each system:
1. Find the critical points.
2. Formulate the phase plane equation. Solve it for a and c. Use IDE software to plot the solutions, \( y(x), \) and print out or sketch the results.
3. Use IDE to find more solutions (no need to attach any plots here) with several different initial condition. Based on these solutions, determine if the critical points found in (1) are stable/asympotically stable.
4. For a and b solve the systems explicitely to find \( x(t) \) and \( y(t) \) with the given initial condition. (Note that we cannot do the same for c since it is a nonlinear system. This is the kind of system for which phase plane analyses are most useful). Observe what happens to the solution when \( t \to \infty \) and explain why this is consistent with your conclusions about stability in (3).