1. For each of the following systems carry out the following steps.

(i) Identify the critical points.
(ii) For each critical point \( c \), identify the corresponding linear system. Write down the general solution of these linear systems and discuss the stability of the solutions near the critical solution \( x(t) = c \).
(iii) Plot the direction field of the original system and discuss the evolution of the system for various initial conditions.

(a)
\[
\frac{dx}{dt} = x(1 - x - y) \\
\frac{dy}{dt} = y(1.5 - y - x)
\]

(b)
\[
\frac{dx}{dt} = x(1 - 0.5y) \\
\frac{dy}{dt} = y(-0.25 + 0.5x)
\]

2. For each of the following systems construct a suitable Liapunov function of the form \( ax^2 + cy^2 \) where \( a \) and \( c \) are to be determined. Then show that the critical point at the origin is of the indicated type.

(a)
\[
\frac{dx}{dt} = -x^3 + xy^2 \\
\frac{dy}{dt} = -2x^2y - y^3 , \quad \text{asymptotically stable}
\]

(b)
\[
\frac{dx}{dt} = x^3 - y^3 \\
\frac{dy}{dt} = 2xy^2 + 4x^2y + 2y^3 , \quad \text{unstable}
\]