Problem 2.1

The logarithmic potential is defined as

\[ \Phi_L(x, y) = \frac{1}{2} v_0^2 \ln \left( R_c^2 + x^2 + \frac{y^2}{q^2} \right). \]

For this problem we set \( q = 0.9, R_c = 0.14, \) and \( v_0 = 1. \) Through numerical experimentation, find initial conditions that lead to

(a) Box orbits. These orbits have no particular sense of circulation about the centre and the time averaged angular momentum is zero.

(b) Loop orbits. These kind of orbits have a fixed sense of circulation about the centre.

For each of the two cases, plot the \((x, y)\) trajectory of the orbit.

Problem 2.2

Plot the \((y, \dot{y}), (x = 0, \dot{x} > 0)\) surface of section for the two orbits of Problem 2.1.