**Problem 1.** Solve
$$y''' + 2y'' - y' - 2y = 0$$
by solving it directly and by reducing it to an ODE system.

Problem 2. Give the general solution of the equation system
$$y_1' = y_1 + y_2$$
$$y_2' = 3y_1 - y_2$$

Problem 3. Each of the two tanks contains 200 gal of water, in which initially 100 lb (Tank T_1) and 200 lb (Tank T_2) of fertilizer are dissolved. The inflow circulation, and outflow are shown in the figure below. The mixture is kept uniform by stirring. Find the fertilizer contents $y_1(t)$ in T_1 and $y_2(t)$ in T_2.
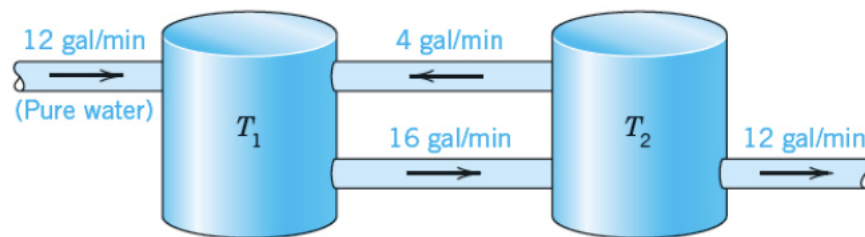
Problem 4. Determine the type and stability of the critical point of
$$y_1' = y_1 + 2y_2$$
$$y_2' = 2y_1 + y_2$$

Problem 5. What happens to the critical point of
$$y_1' = y_1$$
$$y_2' = 2y_2$$
if you introduce $\tau = -t$ as a new independent variable?

Problem 6. Find a real general solution of
$$y_1' = y_2$$
$$y_2' = -9y_1$$
Sketch some of the trajectories in the phase plane.