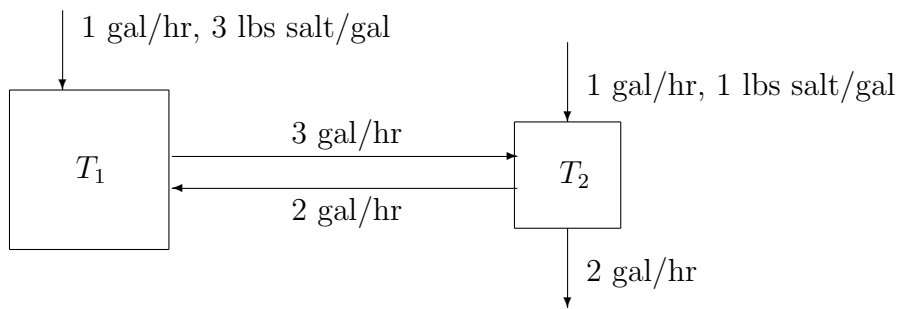


(1) There are two tanks, with pipes carrying salt water as shown:



\$T\_1\$ holds 30 gallons of salt water; \$T\_2\$ holds 10 gallons of salt water.

Let \$Q\_1\$ be pounds of salt in \$T\_1\$ at time \$t\$;

Let \$Q\_2\$ be pounds of salt in \$T\_2\$ at time \$t\$;

(1a) Write a system of differential equations for \$Q\_1\$ and \$Q\_2\$.

$$Q_1' = -.1Q_1 + .2Q_2 + 3$$

$$Q_2' = .1Q_1 - .4Q_2 + 1$$

$$Q_1 = 70; \quad Q_2 = 20$$

Let \$R\_1 = Q\_1 - 70\$, \$R\_2 = Q\_2 - 20\$. The system is

$$R_1' = -.1R_1 + .2R_2$$

$$R_2' = .1R_1 - .4R_2$$

The char poly is \$r^2 + 0.5r + 0.02\$ The roots are \$r = \frac{-0.5 \pm \sqrt{0.25 - 0.2}}{2}\$

Both roots are negative (because \$\sqrt{0.25 - 0.2} < 0.5\$), so the point \$(70, 20)\$ is a stable node.

At \$(70, 20)\$, the system is in equilibrium