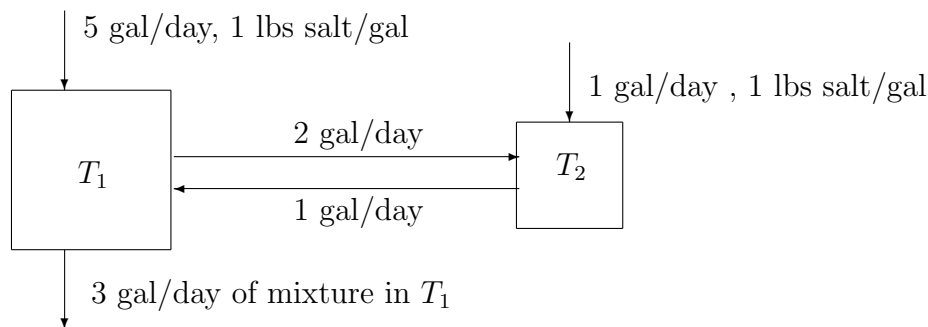


Sample Test for M309, Friday Oct 20, 2006

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



$T_1$  holds 10 gallons of salt water;  $T_2$  holds 5 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  $t$ ;

Write a system of differential equations for  $Q_1$  and  $Q_2$ .

(1b) How many lbs of salt are in  $T_1$  and  $T_2$  when the system is in equilibrium?

(2) Find the general (real) solution to  $x' = Ax$ , where  $A = \begin{bmatrix} -3 & 1 \\ -5 & 1 \end{bmatrix}$

(3) Find the general solution to  $x' = Ax + g$ , where  $A = \begin{bmatrix} 2 & 1 \\ 2 & 3 \end{bmatrix}$   $g = \begin{bmatrix} 4e^t \\ 8t \end{bmatrix}$ ,