# Announcements

1) Last Day to Drop tomorrow
   11/10

# Laplace Transforms

(Chapter 7)

## Back to the Brine!

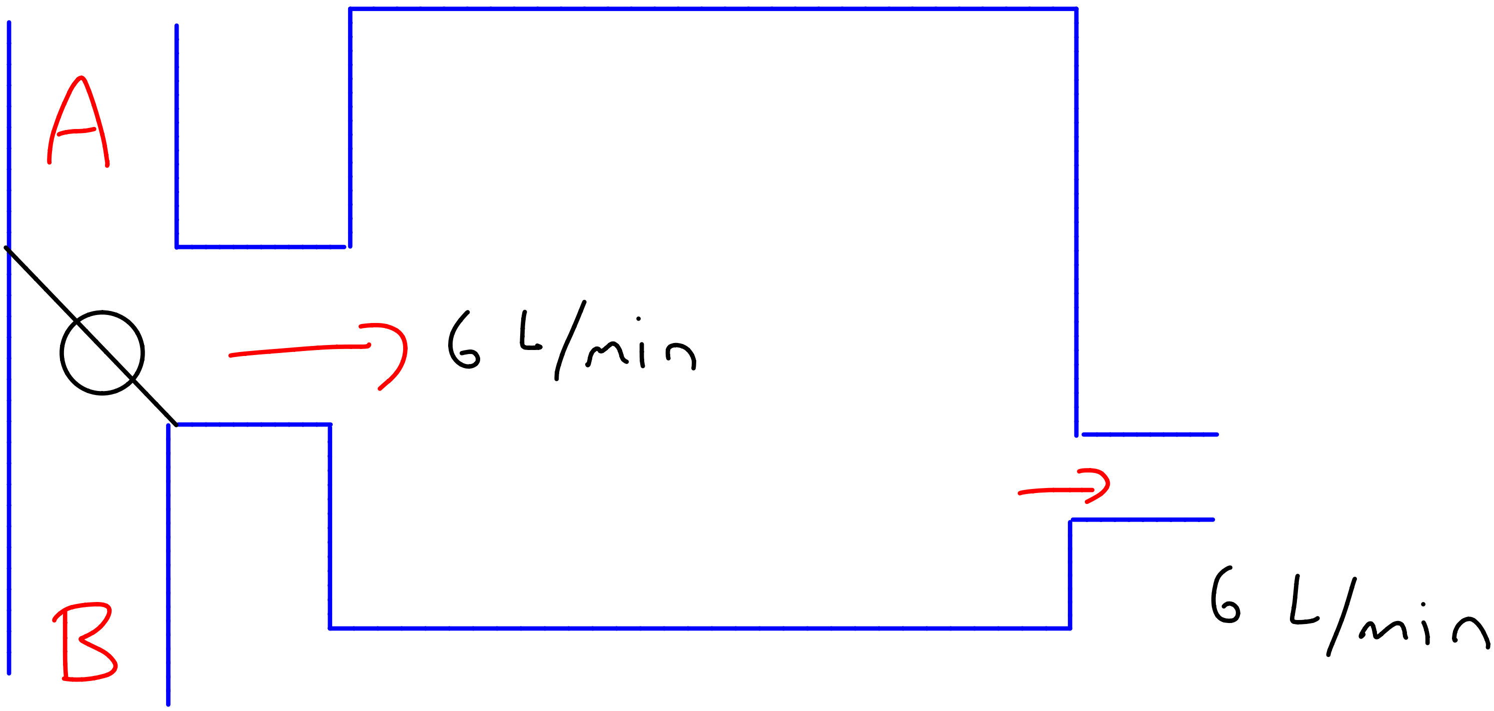
Given a tank containing 1000 L of water in which 30 kg of salt are dissolved.

The tank has two input valves, A and B, which can't both be open at the same time

Valves A and B deliver liquid at 6 L/min, but the solution from valve A contains .2 kg of salt per liter, and the solution in valve B contains .4 kg of salt per liter.

Liquid exits the tank at 6 L/min.

# Picture



At $t=0$, valve A is open. At $t=10$, valve A is closed and valve B is opened.

Find a formula for $x(t)$, the amount of salt in the tank at time $t$.

$$\boxed{\frac{dx}{dt} = (\text{rate in}) - (\text{rate out})}$$

$$= (\text{rate in}) - \frac{x(t)}{1000} \cdot 6$$

$$= (\text{rate in}) - \frac{3x(t)}{500}$$

$$= 6\,(\;?\;) - \frac{3x(t)}{500}$$

what goes here?

$$? = h(t) = \begin{cases} .2\ \text{kg}, & 0 \le t < 10 \\ .4\ \text{kg}, & t \ge 10 \end{cases}$$

Since we switch from valve A to valve B after $t = 10$.

$$\boxed{\frac{dx}{dt} = 6h(t) - \frac{3x(t)}{500}}$$

You've seen problems on the homework where you have to break functions up over the time domain - we want a better method!

Idea: convert differential equations to polynomial equations, solve the polynomial equation, somehow go back to the differential equation's solution.