1. A 50 gallon tank initially holds 20 gallons of pure water. Salt-water solution containing .5 pounds of salt per gallon of water begins entering the tank at a rate of 4 gallons per minute. Simultaneously, a drain is opened at the bottom of the tank, allowing salt-water solution to leave the tank at a rate of 2 gallons per minute.

Set-up (but DO NOT solve) the differential equation governing the salt content in the tank as a function of time. You should have a sketch of the system as well as a description of the rate in and rate out terms.

The rate of salt coming in is given by the flow rate times the concentration,

\[ \text{rate, in} = 4 \text{gal/min} \times .5 \text{lbs/gal} \]

The rate out is given by the rate of flow out times the concentration

\[ \text{rate, out} = 2 \text{gal/min} \times x(t)/\text{volume} \]

The volume is changing \( v(t) = 20 + 4t \) (you could use a conservation law to derive this) so the differential equation is

\[ \frac{dx}{dt} = 2 - 2x/(20 + 4t) \]