

# Math 3331 Differential Equations

## 2.5 Mixing Problems

**Blerina Xhabli**

Department of Mathematics, University of Houston

`blerina@math.uh.edu`  
`math.uh.edu/~blerina/teaching.html`



## 2..5 Mixing Problems

- Balance Law
- Mixture of Water and Salt
  - Example 5.1
  - Example 5.3



# Mixing Problems

## Solution of a mixture of water and salt

$x(t)$ : amount of salt

$V(t)$ : volume of the solution

$c(t)$ : concentration of salt

$$\Rightarrow c(t) = \frac{x(t)}{V(t)}$$

## Balance Law

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

rate = flow rate  $\times$  concentration



# Example 1

See Text, Example 2.5.1

$V(t) = 100$  gal, kept constant

concentration in = 2 lb/gal

flow rate in = 3 gal/min

flow rate out = flow rate in

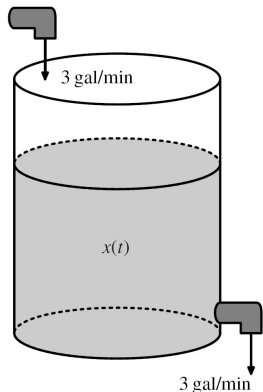
$$\Rightarrow c(t) = x(t)/100 \text{ lb/gal}$$

$$\Rightarrow \text{rate in} = 6 \text{ lb/min}$$

$$\Rightarrow \text{rate out} = 3x(t)/100 \text{ lb/min}$$

**Balance Law**

$$\frac{dx}{dt} = 6 - 3x/100$$



# Example 2

## See Text, Example 2.5.2

concentration in = 1.5 lb/gal

flow rate in = 3 gal/min

flow rate out = 1 gal/min

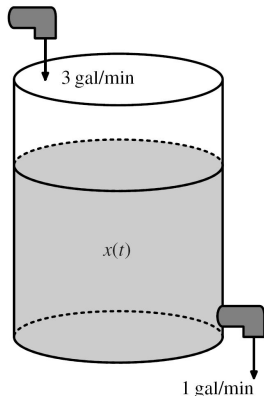
$V(0) = 300$  gal

$\Rightarrow V(t) = 300 + 2t$  lb/gal

$\Rightarrow c(t) = x(t)/(300 + 2t)$  lb/gal

$\Rightarrow$  rate in = 4.5 lb/min

$\Rightarrow$  rate out =  $x(t)/(300 + 2t)$  lb/min



## Balance Law

$$\frac{dx}{dt} = 4.5 - x/(300 + 2t)$$

