Modeling for Mixing Problems

$$Q'(t) = r_i c_i - r_o \frac{Q(t)}{V_0 + (r_i - r_o)t}, \qquad Q(0) = Q_0$$

as the initial value problem for mixing problems where

- $Q(t) =$ the amount of the substance dissolved in the liquid in the tank at time t.
- $r_i =$ flow rate of liquid entering (flow rate in).
- $c_i =$ concentration of substance in liquid entering (conc. in).
- $r_o =$ flow rate of liquid exiting (flow rate out).
- $V_0 =$ the initial volume of liquid in the tank.
- $Q(0) =$ the initial amount of the substance dissolved in the liquid in the tank.

Modeling for Falling Object

$$mv' = mg - \gamma v, \quad v(0) = v_0, \quad \text{where}$$

- $v(t) =$ the velocity of the falling object at time t. (m/s)
- $m =$ the mass of the object. (kg)
- $g =$ the acceleration due to gravity. (9.8 m/s^2 or 10 m/s^2)
- $\gamma =$ drag coefficent. (kg/s)
- $v_0 =$ the initial velocity of the object.

Modeling for Motion of an Object in a Resistive Fluid Medium

$$mv' = p - \gamma v^2, \quad v(0) = v_0, \quad \text{where}$$

- $v(t) =$ the velocity of the falling object at time t. (m/s)
- $m =$ the mass of the object. (kg)
- $p =$ the propulsive force. (N)
- $\gamma =$ drag coefficent. (kg/s)
- $v_0 =$ the initial velocity of the object.

The limiting velocity is

$$v_L = \sqrt{\frac{p}{\gamma}}.$$