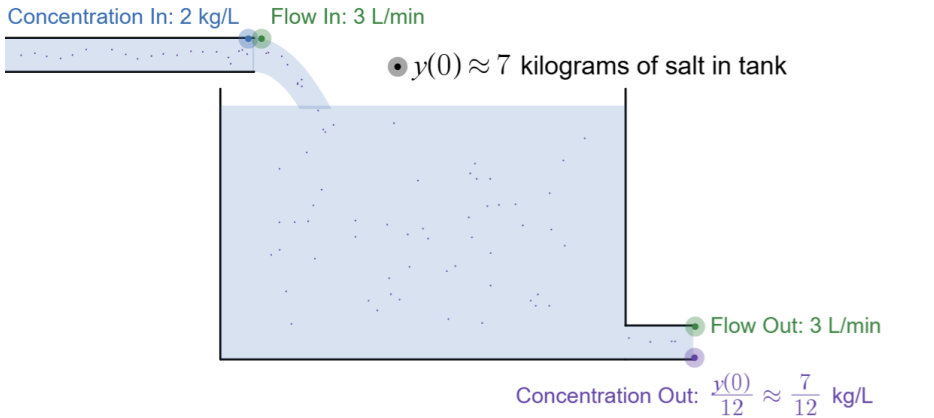
Finish 9.4 *(Mixing, Air Resistance and Summary)*



https://www.desmos.com/calculator/o7vcgrzq4t

Mixing Problems:

"R*ate of change equals rate IN minus rate OUT.*"

***Example 1**:*

A 12 Liter vat contains 7 kg of salt initially.
A pipe pumps in salt water (brine) at 3 L/min with a concentration of 2 kg/L of salt.
The mixture drains at 3 L/min.
The vat is well mixed.

Let $y(t)$ = "kg of salt in vat at time t".

(a) Find $y(t)$.

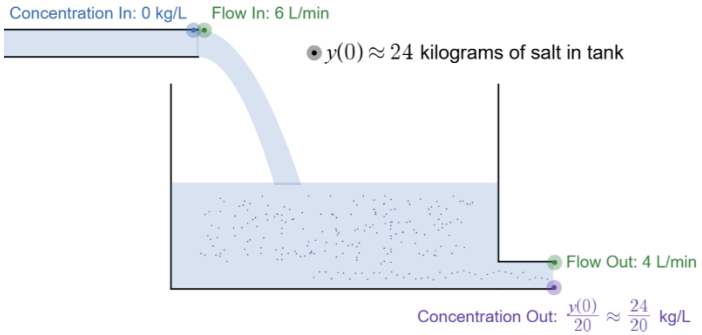
(b) Find the limit of $y(t)$ as $n \to \infty$.

Mixing Problem Summary

$$\frac{dy}{dt} = \text{Rate In} - \text{Rate out}$$

$$= \left(? \ \frac{kg}{L}\right)\left(? \ \frac{L}{min}\right) - \left(\frac{y}{V} \ \frac{kg}{L}\right)\left(? \ \frac{L}{min}\right)$$

$$y(0) = ? \text{ kg}$$



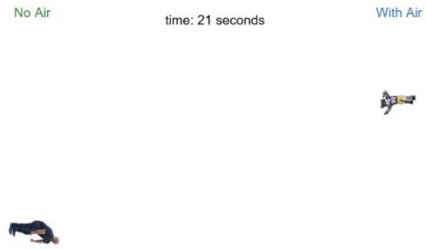
https://www.desmos.com/calculator/v5itrp8xt1

***Example 2**: How is this different?*

A 50 Liter tank currently has 20 Liters of water with 24 kg of dissolved salt. A pipe pumps in *pure water* at 6 L/min. The mixture drains at 4 L/min. Let $y(t)$ = "kg of salt in vat at time t".

4. Air Resistance:

A skydiver steps out of a plane 4,000 meters high with and initial velocity of 0 m/s.
The skydiver has a mass of 60 kg.
(Treat downward as positive).



Newton's 2nd Law says:

$$m\frac{d^2y}{dt^2} = \text{sum of forces on the object}$$

https://www.desmos.com/calculator/etfy3nebtb

Forces

Gravity:

$$F_g = mg = 60 \cdot 9.8 = 588 \text{ N}$$

Air resistance: (*linear drag model*)

$$F_d = -k\,v \quad \text{N}$$

Assume k = 12 is the drag constant

Final Layout:

Pages 1, 2: Integrals
Page 8, 9: Diff. equations
Pages 3-7: Other concepts…

- Foundations
  - Riemann sums (idea/notation)
  - What an integral represents
  - FTOC (part 1)
- Acceleration/Velocity
  - "Tomato" problems
  - Net Change / Total Change
- Volumes of Revolution
- Simpson's/Trapezoid Rules
- Improper Integrals
- Other Applications
  - Average Value
  - Arc Length
  - ~~Center of Mass~~
  - Work