1. Consider the ODE $x'' - x' + 2x = 0$. Which of the following best describes the phase portrait of the system

$$\frac{d\vec{x}}{dt} = A\vec{x}, \text{ where } \vec{x} = \begin{bmatrix} x \\ x' \end{bmatrix}?$$

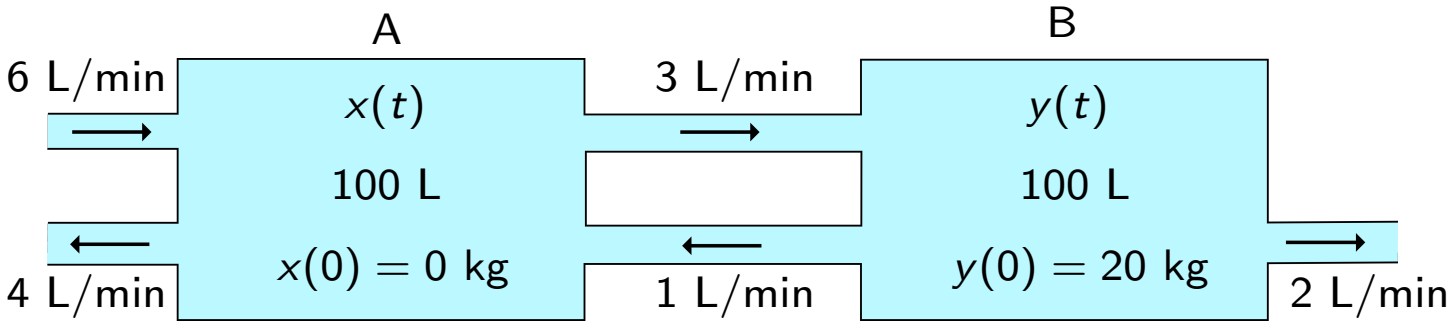
(A) Source

(B) Sink

(C) Saddle

(D) None of the above

Remember these interconnected salt-water tanks...?



2. Which of the following best describes the phase portrait of the first order system that describes dx/dt and dy/dt in terms of x and y?

(A) Source

(B) Sink

(C) Saddle

(D) None of the above

3. True or False?

Consider the system

$$\frac{d\vec{x}}{dt} = A\vec{x}, \text{ where } A = \begin{bmatrix} -1 & 1 & 3 \\ 0 & -2 & 0 \\ 0 & 0 & -2 \end{bmatrix}.$$

Then $\lim_{t\to\infty} \vec{x}(t) = 0$, regardless of the initial conditions.

4. Which of the following functions are solutions to the ODE $x''' - 3x'' + 2x' = 0$?

(A) $x(t) = 2e^t$

(B) $x(t) = -3e^{2t}$

(C) $x(t) = 5$

(D) All of the above

4. Which of the following functions are solutions to the ODE $x''' - 3x'' + 2x' = 0$?

(A) $x(t) = 2e^t$

(B) $x(t) = -3e^{2t}$

(C) $x(t) = 5$

(D) All of the above

Follow-up. What is the general solution of this ODE?

5. Consider the same ODE $x''' - 3x'' + 2x' = 0$. Which of the following is a basis for the solution space?

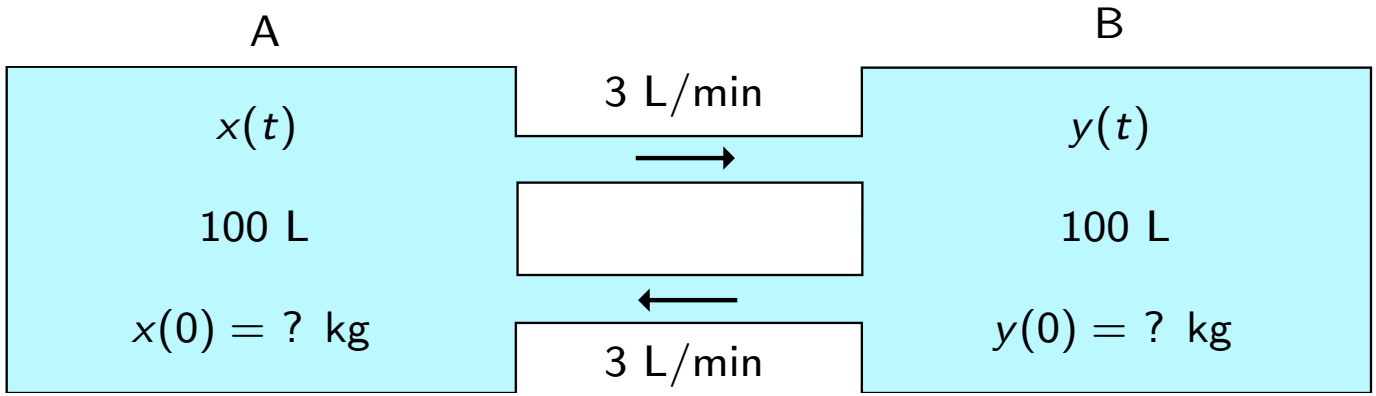
(A) $1, e^t, e^{2t}$

(B) $1, 1 + e^t, 1 + e^t + e^{2t}$

(C) $1 + e^t + e^{2t}, e^t + e^{2t}, e^{2t}$

(D) All of the above

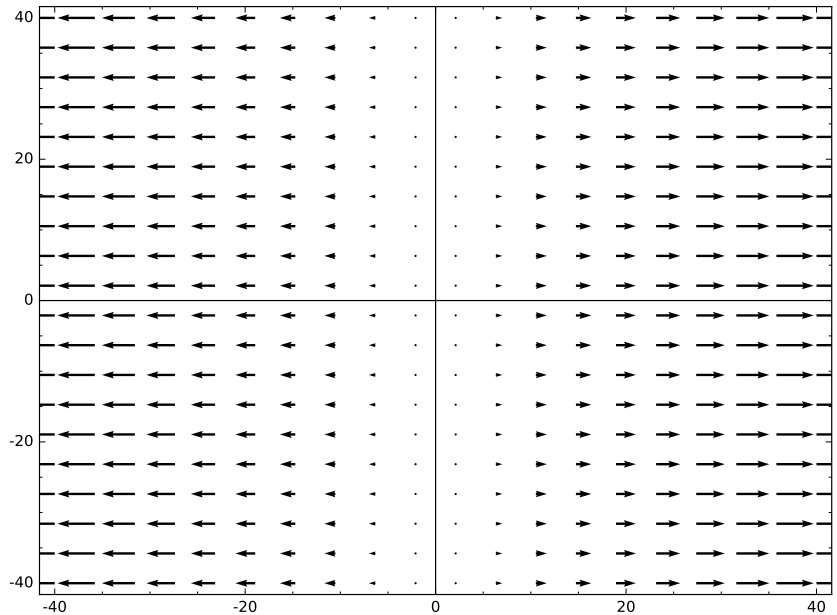
More interconnected salt-water tanks!



6. True or False?

$$\lim_{t\to\infty} \begin{bmatrix} x(t) \\ y(t) \end{bmatrix} = \frac{x(0)+y(0)}{2} \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

7. For which matrix A does $\vec{x}' = A\vec{x}$ have the depicted phase portrait?



(A) $\begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}$

(B) $\begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix}$

(C) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

(D) None of the above