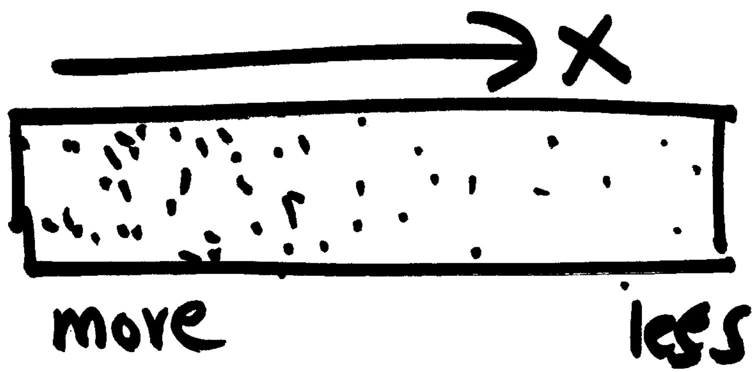
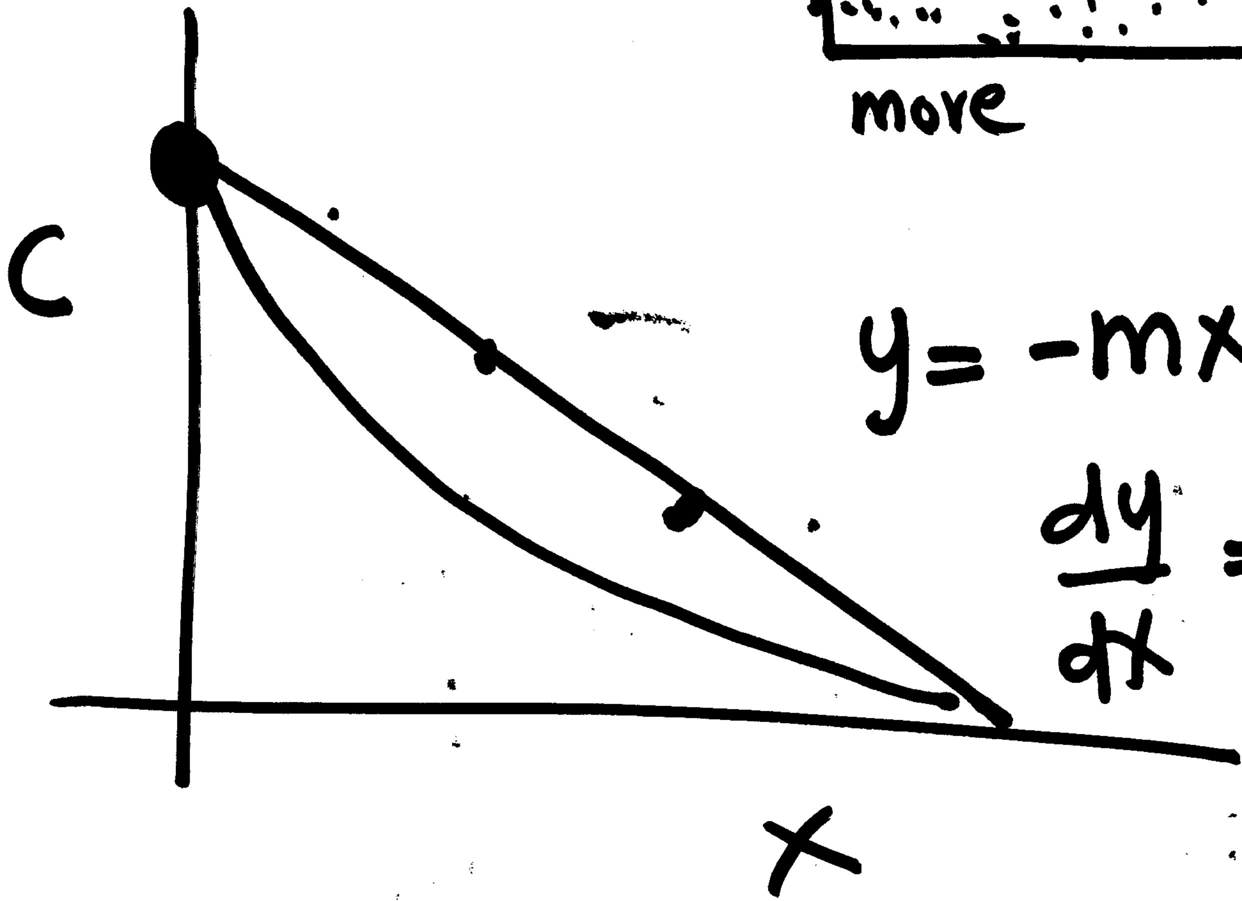
Prof. Ranjith. P
Lec. 17 (1/10/11)

① $C(x,t)$





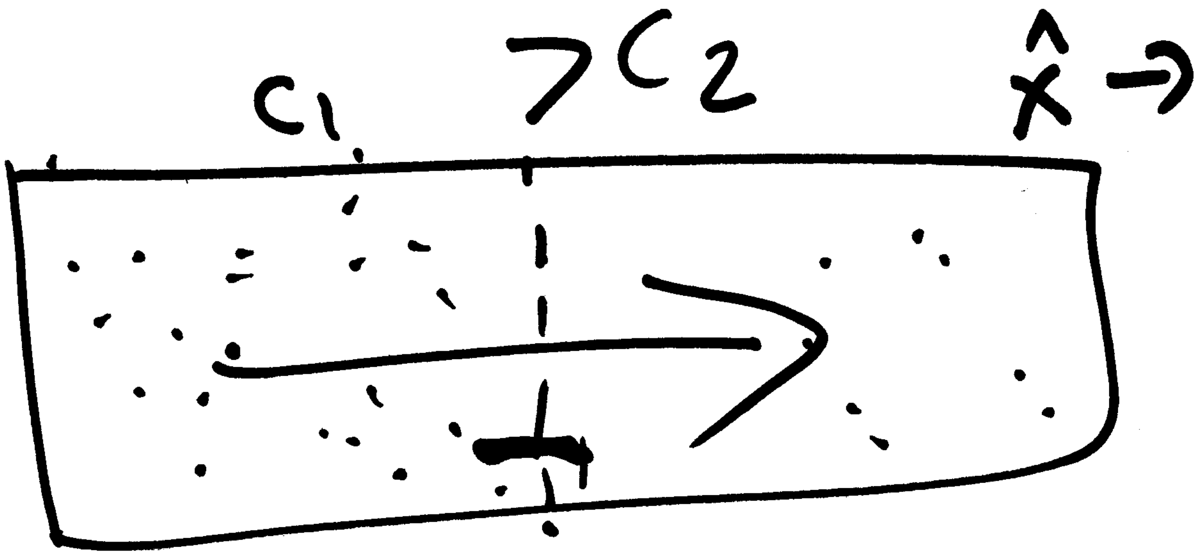
$$y = -mx + c$$

$$\frac{dy}{dx} = -m$$

$$\frac{\partial c}{\partial x}:$$

$$\boxed{\frac{dc}{dx} = -m < 0}$$

(2)



$$\vec{J}_D = (\quad)\,\hat{x}$$

$\Delta c \rightarrow 0$

$$J_D \propto \frac{\partial c}{\partial x}$$

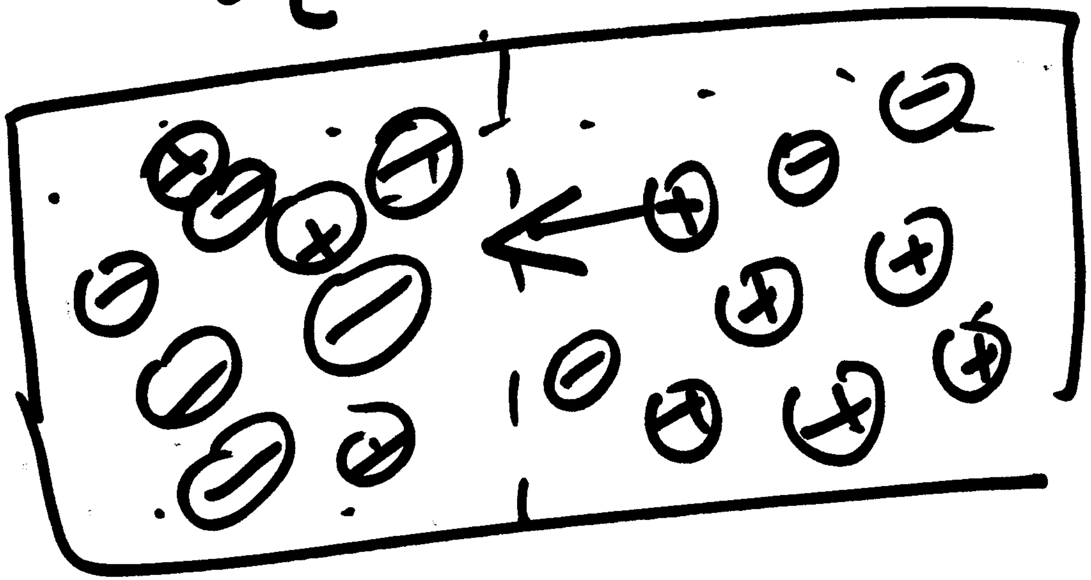
$$\vec{J}_D = -(\,)\,\frac{\partial c}{\partial x}\,\hat{x}$$

1D: $$\vec{\nabla} = \frac{\partial}{\partial x}\hat{x}$$: in 1D

2D: $$\vec{\nabla} = \frac{\partial}{\partial x}\hat{x} + \frac{\partial}{\partial y}\hat{y}$$: 2D

3D: $$\vec{\nabla} = \frac{\partial}{\partial x}\hat{x} + \frac{\partial}{\partial y}\hat{y} + \frac{\partial}{\partial z}\hat{z}$$

$$\vec{f}_E = q\vec{E}$$

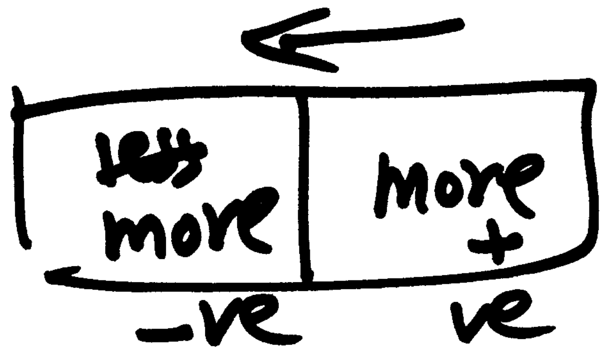


$$\rightarrow \vec{f}_E$$

$$\vec{f}_E = 6\pi\eta a \underline{\vec{v}}$$

$$\vec{f}_E = 6\pi\eta a \vec{v}$$

$$\vec{v} = \frac{\vec{f}_E}{6\pi\eta a}$$

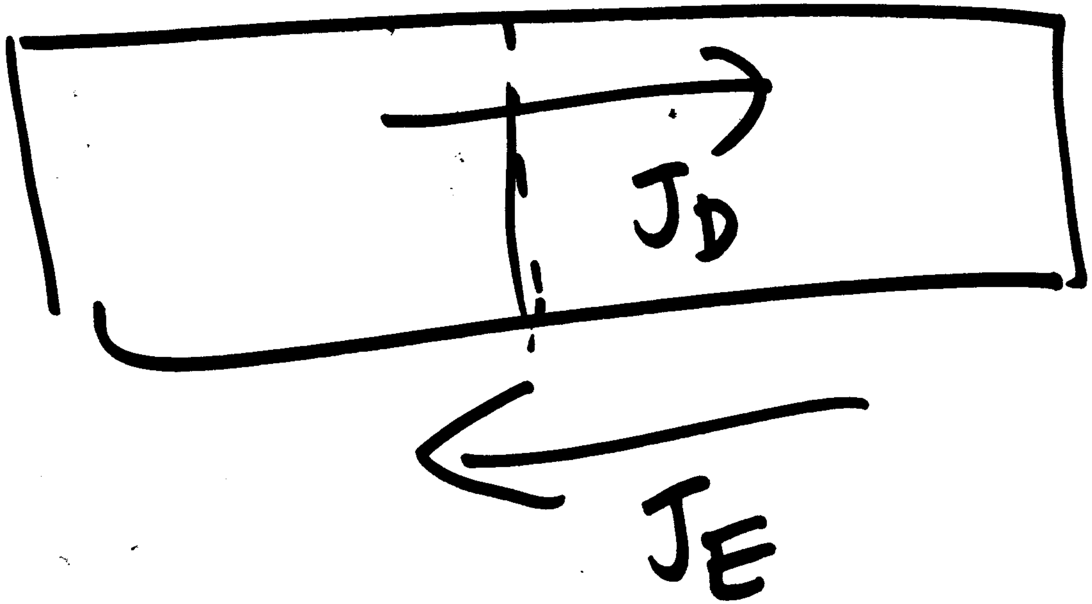


$\vec{J}_D$

$$\vec{J}_E \propto \vec{v}$$

$$\vec{J} = c\vec{v}$$

At Equilibrium



$$\vec{J}_D + \vec{J}_E = 0$$

$$\vec{J}_D = -\vec{J}_E$$

$$\vec{f}_E = \frac{-q^2}{K r^2} \qquad 0 \quad 0$$

$$q\vec{E} = \vec{f}$$

$$\vec{E} = \frac{\vec{f}}{q} = \frac{-q}{K r^2}$$

$$\cancel{\vec{f} = \ldots}$$

$$\vec{E} = -\frac{d\phi}{dx}\hat{x}$$

$$\boxed{\vec{E} = -\vec{\nabla}\phi}$$

$$= -\frac{\partial \phi}{\partial x}\hat{x}$$

$$\left(-D\frac{dc}{dx}\right)\hat{x} = \left(\frac{c\,q}{6\pi\eta a}\frac{d\phi}{dx}\right)\hat{x}$$

$$-D\int_{c_1}^{c_2}\frac{dc}{c} = \frac{q}{6\pi\eta a}\int_{\phi_1}^{\phi_2}\frac{d\phi}{dx}\,dx$$

$$\int_{c_1}^{c_2} \frac{dc}{c} = \frac{-q}{6\pi\eta a D} \int_{\phi_1}^{\phi_2} \frac{d\phi}{dx}\, dx$$

$$\ln c \Big|_{c_1}^{c_2} = \frac{-q}{6\pi\eta a D}\, \phi \Big|_{\phi_1}^{\phi_2}$$

Final

$$\ln c_2 - \ln c_1 = \frac{-q}{6\pi\eta a D}(\phi_2 - \phi_1)$$

$$\ln\left(\frac{c_2}{c_1}\right) = -\frac{q}{6\pi\eta a D}(\phi_2 - \phi_1)$$

$$\boxed{\ln\frac{c_2}{c_1} = -\frac{q}{6\pi\eta a D}\,\underbrace{\Delta\phi}_{(\phi_2-\phi_1)}}$$