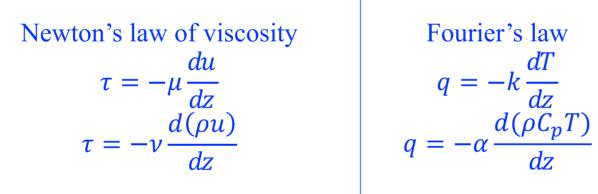
B. Fick's law of diffusion

$$J_A = -D_{AB} \frac{dC_A}{dz} \& J_B = -D_{BA} \frac{dC_B}{dz}$$



- $\nu$ : momentum diffusivity
- $\alpha$  : thermal diffusivity
- D : mass diffusivity



1) Relation between  $D_{AB}$  and  $D_{BA}$ (1) for gases

• 
$$C_A + C_B = C\left(=\frac{P}{RT}\right)$$
  
 $\frac{dC_A}{dz} + \frac{dC_B}{dz} = 0 \Rightarrow \frac{dC_A}{dz} = -\frac{dC_B}{dz}$ 

• 
$$J_A + J_B = C_A(u_A - u_0) + C_B(u_B - u_0)$$
  
=  $C_A u_A - C_A u_0 + C_B u_B - C_B u_0$   
=  $C_A u_A + C_B u_B - (C_A u_0 + C_B u_0)$   
=  $N_A + N_B - (C_A + C_B)u_0 = 0$ 

• Thus

$$J_A + J_B = 0$$
  

$$J_A + J_B = \left(-D_{AB}\frac{dC_A}{dz}\right) + \left(-D_{BA}\frac{dC_B}{dz}\right)$$
  

$$= -(D_{AB} - D_{BA})\frac{dC_A}{dz} = 0$$

$$\therefore D_{AB} = D_{BA} = D_{v}$$



(2) for liquids ( $\rho$  is constant)

• 
$$\rho_A + \rho_B = \text{constant}$$
  
 $\frac{d\rho_A}{dz} + \frac{d\rho_B}{dz} = 0 \Rightarrow \frac{d\rho_A}{dz} = -\frac{d\rho_B}{dz}$ 

• 
$$j_A + j_B = \rho_A (u_A - u) + \rho_B (u_B - u)$$
  
=  $\rho_A u_A - \rho_A u + \rho_B u_B - \rho_B u$   
=  $\rho_A u_A + \rho_B u_B - (\rho_A + \rho_B) u$   
=  $n_A + n_B - \rho u = n - n = 0$ 

$$j_A + j_B = \left(-D_{AB}\frac{d\rho_A}{dz}\right) + \left(-D_{BA}\frac{d\rho_B}{dz}\right)$$
$$= -(D_{AB} - D_{BA})\frac{d\rho_A}{dz} = 0$$

$$\therefore D_{AB} = D_{BA} = D_{v}$$

$$j_{A} = -D_{AB} \frac{d\rho_{A}}{dz}$$
$$j_{B} = -D_{BA} \frac{d\rho_{B}}{dz}$$

