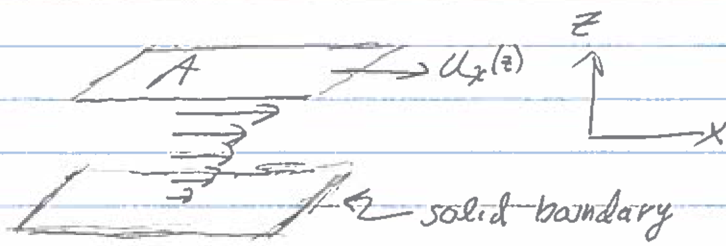
- Linear drag on sphere; Stokes Law:

$$f_{lin} = 3\pi \eta D v \qquad \eta \equiv \text{viscosity}$$

$$[v] = Lt^{-1} \; ; [D] = L \; ; [\eta] = ?$$

Viscosity η:



shear stress

$$F/A = \eta \frac{du_x(z)}{dz} \qquad \text{footnote pg 72}$$

$$\Rightarrow \eta = \frac{F}{A}\left(\frac{du_x(z)}{dz}\right)^{-1}$$

$$\therefore \; [\eta] = \frac{MLt^{-2}}{L^2}\left(\frac{Lt^{-1}}{L}\right)^{-1} = ML^{-1}t^{-1}$$

$f_d \sim v^a D^b \eta^c$? where a, b, c are integers (or integer ratios)

$$\therefore \; [v^a D^b \eta^c] = (Lt^{-1})^a L^b (ML^{-1}t^{-1})^c$$

$$= L^{a+b-c} t^{-a-c} M^c = Lt^{-2}M$$

$$\Rightarrow a+b-c=1, \; -a-c=-2, \; c=1 \qquad (\Rightarrow \text{mass} \times \text{acceleration})$$

$$\Rightarrow a = 2-c = 1 \Rightarrow b=1$$

$$\therefore \; a=1, \; b=1, \; c=1$$

& $f_d \sim \eta D v$ from dimensional analysis! (3 params).

numerical factor $= 3\pi$ for sphere (Stokes Law)