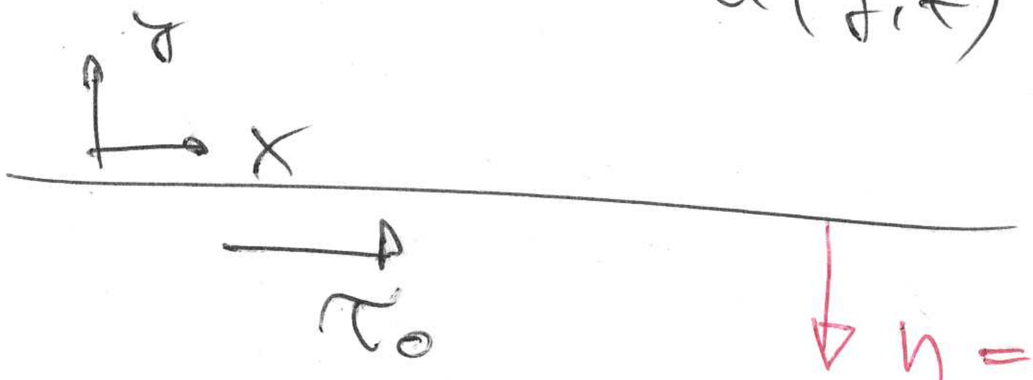
$u(y,t)$



$\underline{n} = -\underline{e_y} = -\underline{e_2}$

$$\boxed{\frac{\partial u}{\partial t} = \nu \frac{\partial^2 u}{\partial y^2}}$$

$\underline{n} = n_1 \underline{e_1} + n_2 \underline{e_2}$

$n_1 = 0$

$n_2 = -1$

$t_i = \tau_{ij} n_j$

$t_1 = \tau_0$

$t_2 = 0$

$\vdots$

BC $\boxed{\tau_0 = -\mu \frac{\partial u}{\partial y}}$ at $y = 0$

$\boxed{u \to 0 \text{ as } y \to \infty}$

IC: $\boxed{u(y, t=0) = 0}$ 2

$$\boxed{\begin{aligned} &\frac{\partial u}{\partial t} = \nu \frac{\partial^2 u}{\partial y^2} \\ &\tau_0 = -\mu \frac{\partial u}{\partial y} \quad \text{at } y = 0 \\ &u \to 0 \quad \text{as } y \to \infty \\ &u(t=0) = 0 \end{aligned}}$$

$\Longrightarrow$ u must be linear in τ_0

$$u(y, t; \nu, \tau_0, \mu)$$

$$\Longrightarrow \quad u = \tau_0 \hat{F}(y, t; \nu, \mu)$$

$[u] = \frac{m}{sec}$; $\cancel{[\mu] = \frac{kg}{m\, sec}}$; $[\rho] = \frac{kg}{m^3}$

$[\tau_0] = \frac{kg}{m\, sec^2}$; $[\nu] = \frac{m^2}{sec}$; $[y] = m$

$[t] = sec$

$$u = \tau_0 F(y, t; \nu, \rho)$$

Kill the kg in τ_0

$$u = \frac{\tau_0}{\rho} G(y, t; \nu, \rho)$$

must retain ρ here!

$$\left[\frac{\tau_0}{\rho}\right] = \frac{m^2}{sec^2}$$

[cannot take sqrt because we want soln to be linear in τ_0!]

Need to form a combin. of parameters with dim $\frac{m}{sec}$ from y, t, ν, ρ

<u>Option 1:</u> $\frac{y}{t}$ but this would ruin the sim. soln form.

Option 2: $\sqrt{\frac{\nu}{t}}$

$$u = \underbrace{\frac{\tau_0}{\rho}\sqrt{\frac{t}{\nu}}}_{\text{dim: } \frac{m}{sec}}\, f(y, t; \nu, \cancel{\rho})$$

f must be a nondim fct. of its arguments

$\Rightarrow$ f cannot depend on ρ.

$$\eta = \frac{y}{\sqrt{\nu t}}$$

$$u = \frac{\tau_0}{\rho}\sqrt{\frac{t}{\nu}}\, f\left(\frac{y}{\sqrt{\nu t}}\right)$$

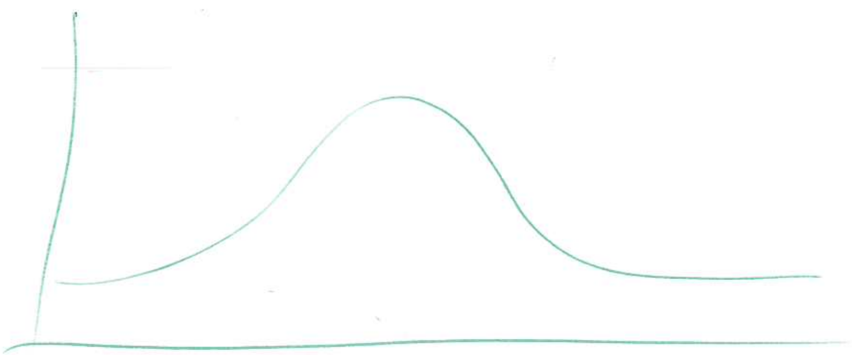
$$\frac{\partial \hat{u}}{\partial t} = \nu \frac{\partial^2 \hat{u}}{\partial y^2}$$

$$\tau_0 = -\mu \frac{\partial \hat{u}}{\partial y}$$

$\hat{u} \to 0$ as $y \to \infty$

$\hat{u} = 0$ at $t = 0$

$$u(y,t) = a(t)\, f\left(\frac{y}{b(t)}\right)$$



$$\underbrace{\frac{\tau_0}{\rho}\,\frac{t}{y}}_{a(t)}\ \hat{g}(y,t,\nu,\rho)$$

y