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Lec. No. 16 & 17
Date: 2/2/11

$f = mx^*$

$$u^* = (f^2 - y^2)F$$

$$\frac{\partial u^*}{\partial x^*} = \left(2f\frac{\partial f}{\partial x^*}\right)F + (f^2-y^2)\cdot\frac{dF}{dx^*}$$

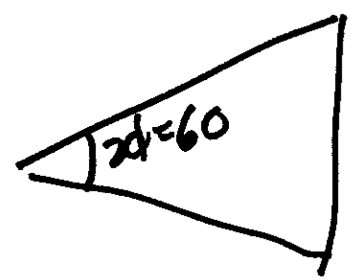
$$= (2m^2x^*)F + (f^2-y^2)\frac{dF}{dx^*}$$

$$\frac{\partial^2 u^*}{\partial x^{*2}} = 2m^2F + 2m^2x^*\frac{dF}{dx^*} + (f^2-y^2)\frac{d^2F}{dx^{*2}} + \frac{dF}{dx^*}\cdot 2f\frac{df}{dx^*}$$

$$\frac{2m^2x^*}{2mf}$$

$$= (f^2-y^2)F'' + 4mf\,F' + 2m^2F$$

$$\frac{\partial^2 u^*}{\partial y^{*2}} = -2\cdot F$$



$$g_n = (z+iy)^n$$

$$g_1 = 1 \qquad (n=0)$$

$$\left.\begin{array}{l} g_2 = z \\ g_3 = y \end{array}\right\} \quad (n=1)$$

$$g_4 = z^2 - y^2 \text{ (real)} \qquad (n=2)$$

$$g_5 = 2zy \text{ (im)}$$

$$(z+iy)^2$$

$$= \underline{\underline{z^2 - y^2}} + i\,(\underline{\underline{2zy}})$$

$$\frac{z^2}{a^2} + \frac{y^2}{b^2} = 1$$

q_w

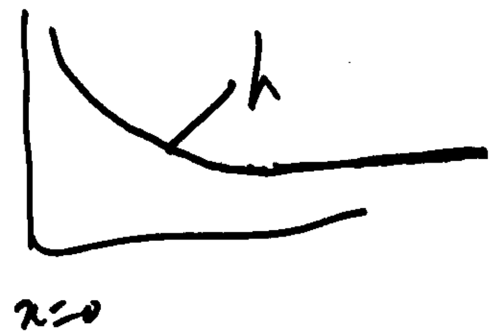
$\rightarrow \dot{m} c_p\, dT_b = q_w \cdot P \cdot dx$

$$\frac{dT_b}{dx} = \frac{q_w P}{\dot{m} c_p} = \text{Const.}$$

$q_w \rightarrow$ Const

$$h = \frac{q_w}{T_w - T_b}$$

$$h = \frac{+k \left.\frac{\partial T}{\partial y}\right|_R}{T_w - T_b}$$

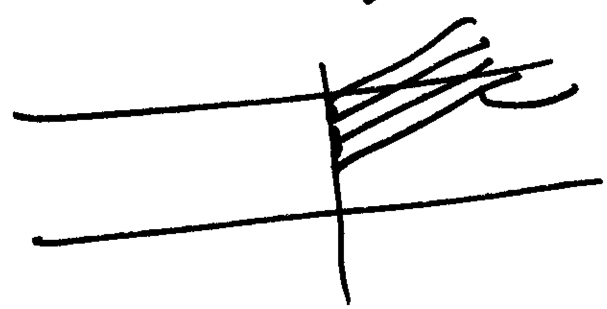


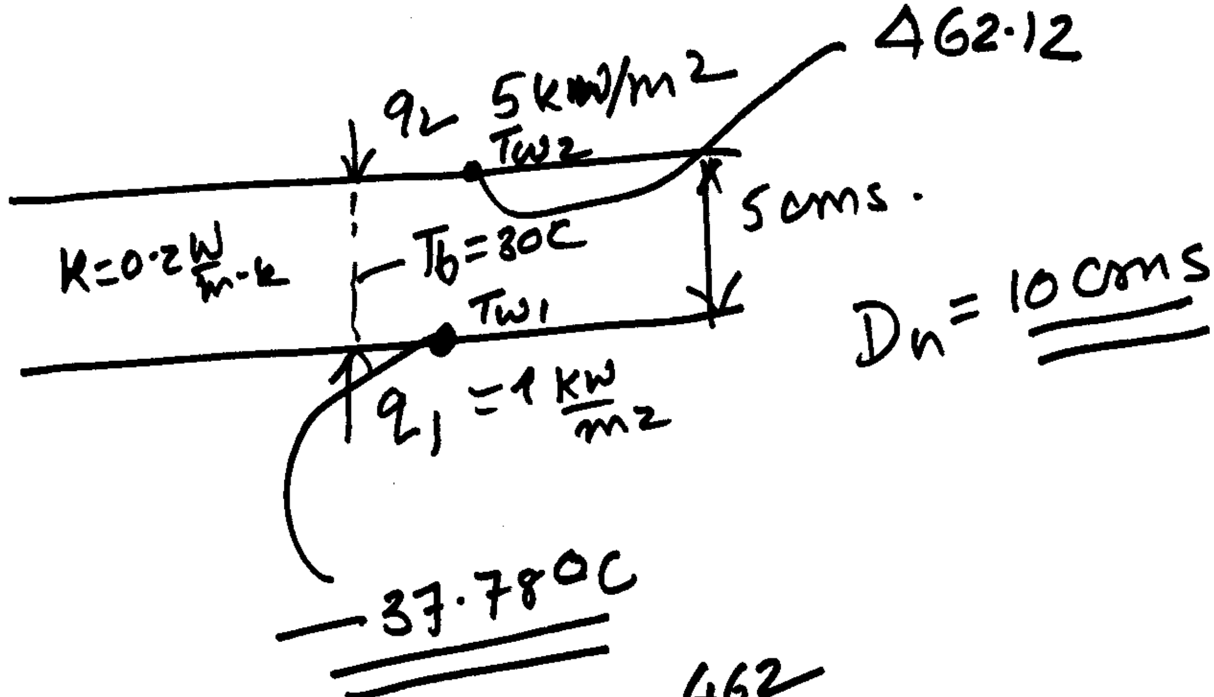
$$\phi = \frac{T_w - T}{T_w - T_b}.$$

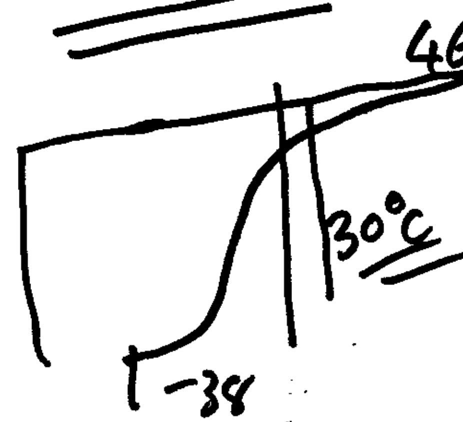
$$\frac{\partial \phi}{\partial x} = 0 = \frac{1}{(T_w - T_b)} \frac{d(T_w - T)}{dx} - \frac{(T_w - T)}{(T_w - T_b)^2} \frac{d}{dx}(T_w - T_b) = 0$$

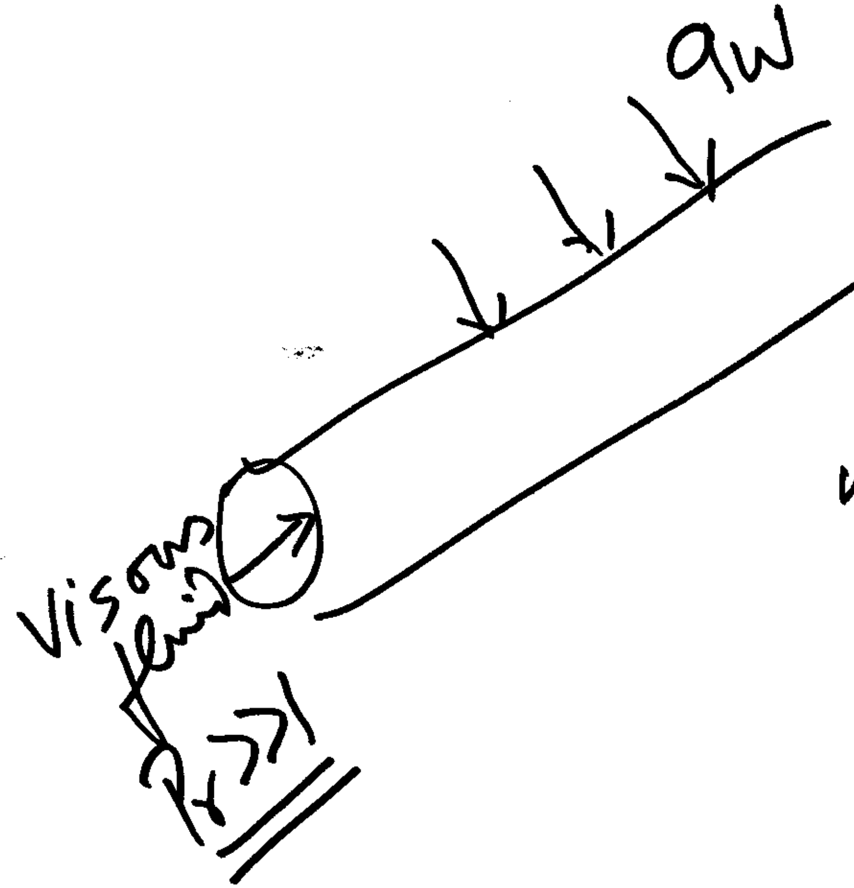
$$\frac{d(T_w - T)}{dx} = \frac{T_w - T}{T_w - T_b} \frac{d}{dx}(T_w - T_b)$$

$$\frac{dT_w}{dx} = \underline{\underline{\frac{dT}{dx}}} = \underline{\underline{\frac{dT_b}{dx}}}$$




462.12
q_2 5 kW/m²
T_{w2}
5 cms.
$K = 0.2 \frac{W}{m\text{-}k}$
$T_b = 30C$
T_{w1}
$q_1 = 1 \frac{kW}{m^2}$
$D_h = 10$ cms
37.78°C


462
30°C
-38



$$\frac{d u_{fd}}{dx} = 0$$

$$u_{fd}\frac{dT}{dx} = \frac{d}{dx} u_{fd}\cdot T$$

$$= \frac{d}{dx} \frac{\int_0^R u_{fd}\, T r\, dr}{\int_0^R u_{fd}\, r\, dr} \quad T_b$$

$$\frac{dT_b}{dx}$$

liquid metals

$Pr < 0.01$

$T_w = \text{const}$

$x^* = \frac{x}{R}$

$r^* = r/R$

$$\frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial T}{\partial r}\right) + \frac{\partial^2 T}{\partial x^2} = \frac{u_{fd}}{\alpha}\frac{dT}{dx}$$

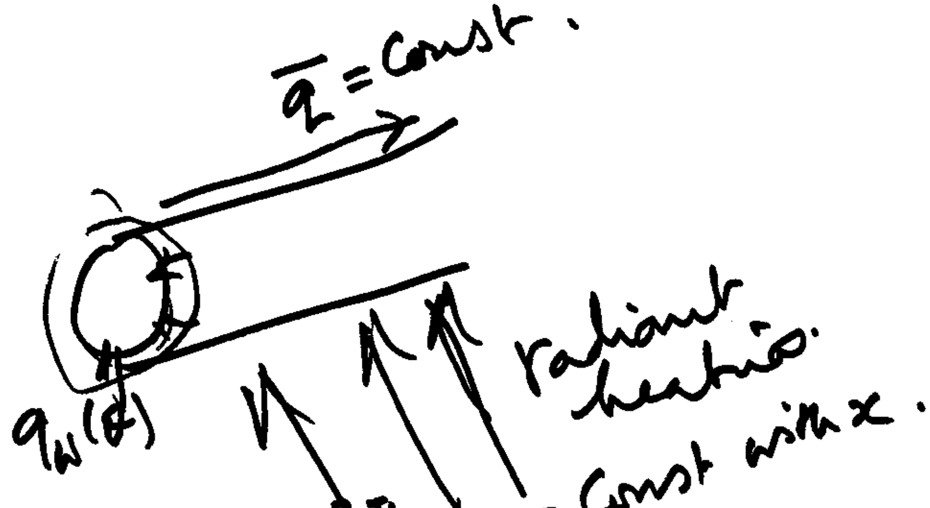
$$\frac{1}{R^2}\frac{1}{r^*}\frac{\partial}{\partial r^*}\left(r^*\frac{\partial T}{\partial r^*}\right) + \frac{\partial^2 T}{\partial x^{*2} \cdot R^2} = \frac{u_{fd}}{\alpha}\frac{dT}{dx^* \cdot R}$$

$$\frac{1}{r^*}\frac{\partial}{\partial r^*}\left(r^*\frac{\partial T}{\partial r^*}\right) + \frac{\partial^2 T}{\partial x^{*2}} = \frac{u_{fd} R}{\alpha}\frac{dT}{dx^*} = \frac{Pe}{2}\frac{dT}{dx^*}$$

$$\frac{u_{fd} \cdot R}{\nu}\cdot\frac{\nu}{\alpha}$$

$$\frac{Re \cdot Pr}{2} \rightarrow Pe$$

$Pe\left[\frac{1}{r^*}\frac{\partial}{\partial r^*}\left(r^*\frac{\partial T}{\partial r^*}\right.\right.$



$\bar{q} = \frac{1}{2\pi}\int_0^{2\pi} q_w\, d\theta$ = const with x.