REVIEW 2-19-2018

HOMEWOR3

Question Problem 1 why did I divide the flow per Area if I am given the value of the flux [1 W/m²]

Answer - There is a mistake, I should use the value of the flux.

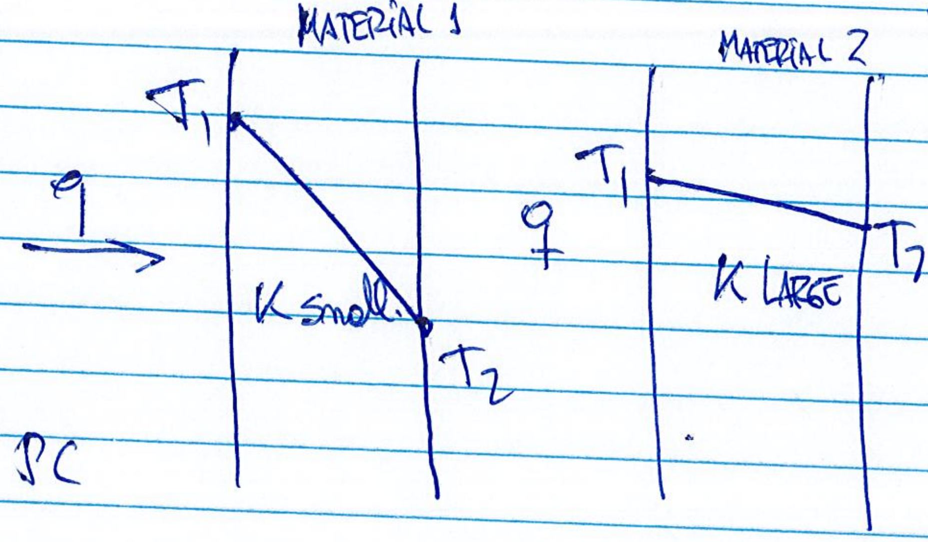
SOLUTION OF PROBLEM

$hA[T_{fluid} - T_s$

CONDUCTION IN A SLAB in ONLY ONE DIRECTION (x)

$$\underbrace{\frac{\partial T}{\partial t}}_{\text{Unsteady state part.}} = \frac{K}{\rho C}\frac{\partial^2 T}{\partial x^2} + \frac{\dot q}{\rho C}$$

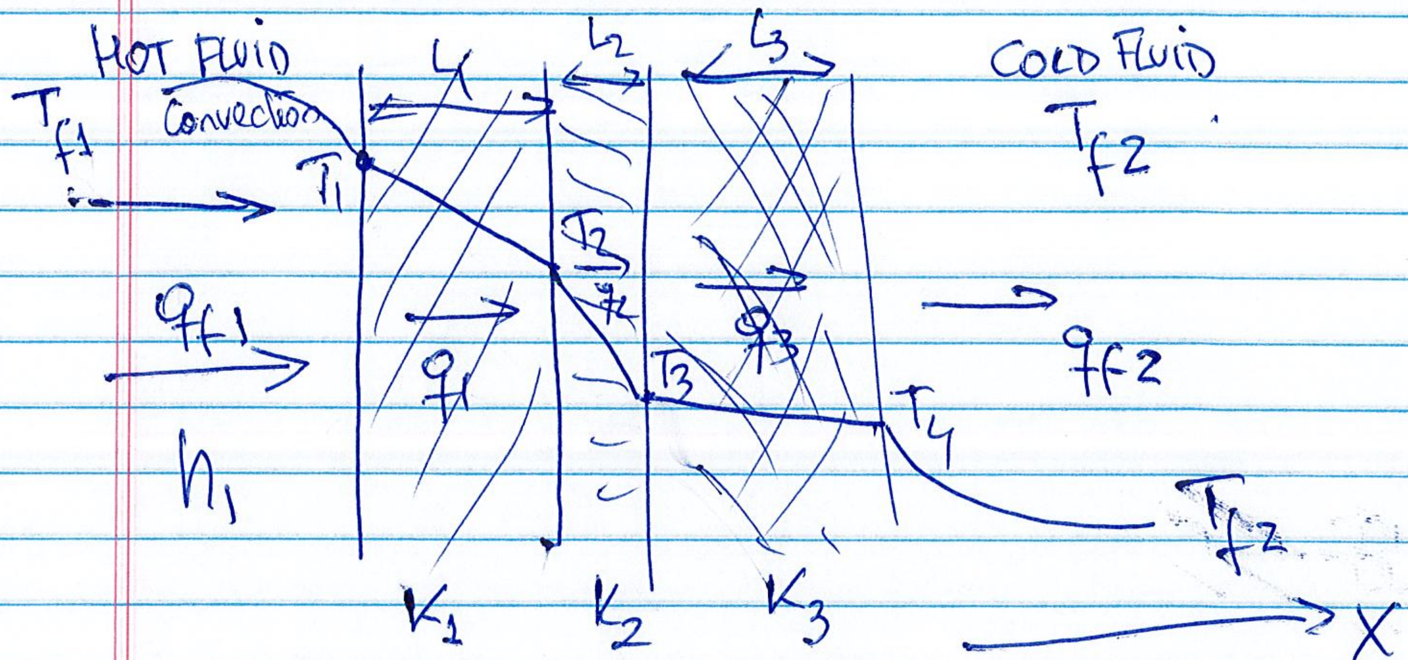
$$\alpha = \frac{K}{\rho C} = \frac{[\text{ABILITY OF A MATERIAL TO CONDUCT HEAT}]}{\text{THERMAL INERTIA OF THE MATERIAL}}$$



NO HEAT GENERATION.

$$\rho C\frac{\partial T}{\partial t} = K\frac{\partial^2 T}{\partial x^2} + \cancel{\dot q}$$

Interpelation of Resistances.



Because steady state

$$q_{f1} = q_1 = q_2 = q_3 = q_{f2} \quad \underline{\text{Assumption}}$$

$$q_x = \frac{T_{f1} - T_{f2}}{\underbrace{R_{conv\,fluid1}}_{\frac{1}{h_1 A}} + \underbrace{R_{cond\,1}}_{\frac{L_1}{K_1 A}} + \underbrace{R_{cond\,2}}_{\frac{L_2}{K_2 A}} + \underbrace{R_{cond\,3}}_{\frac{L_3}{K_3 A}} + \underbrace{R_{conv\,fluid_2}}_{\frac{1}{h_2 A}}} \qquad (1)$$

Area perpendicular to the heat flow

Question what is U ?

Answer: Eq.(1) can be written as

$$q_x = UA\,[T_{f1} - T_{f2}] \qquad (2)$$

overall heat transfer coefficien.

By comparing Eq.(1) and Eq.(2)

$$q_x = \frac{A(T_{f1} - T_{f2})}{\left\{\frac{1}{h_1} + \frac{L_1}{K_1} + \frac{L_2}{K_2} + \frac{L_3}{K_3} + \frac{1}{h_2}\right\}} = UA(T_{f1} - T_{f2})$$

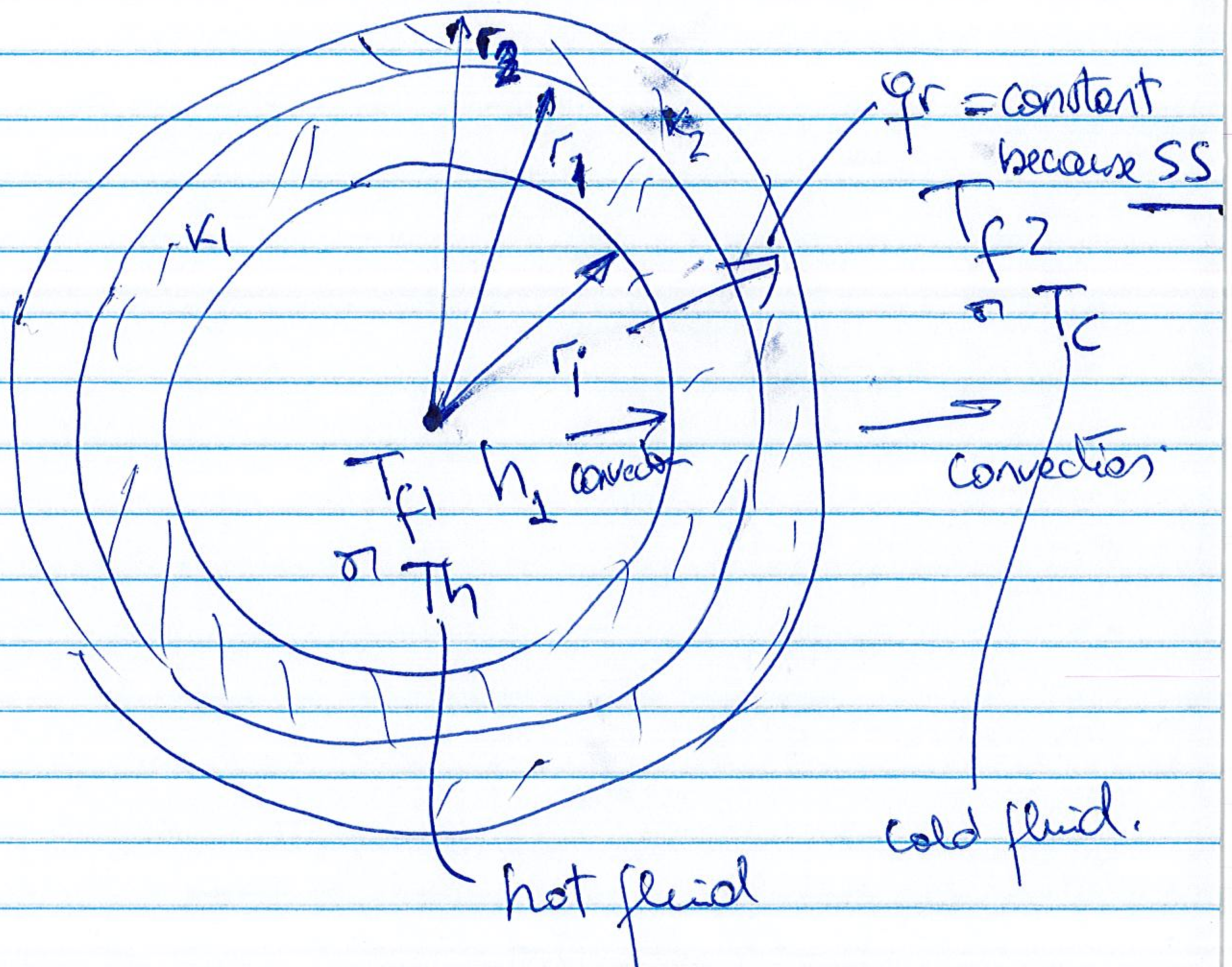
$$\boxed{\frac{1}{U} = \frac{1}{h_1} + \frac{L_1}{K_1} + \frac{L_2}{K_2} + \frac{L_3}{K_3} + \frac{1}{h_2}}$$

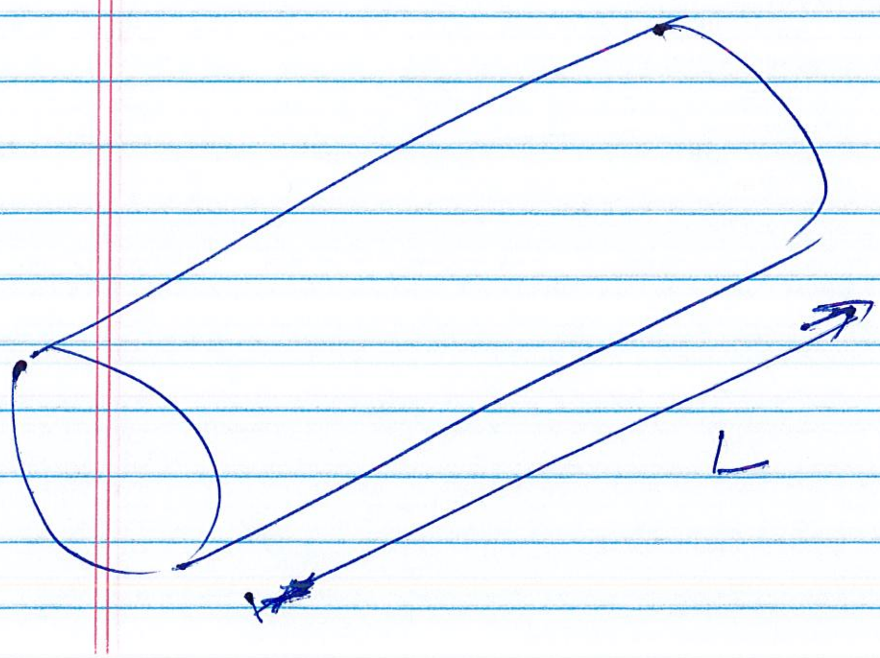
if we do not know A

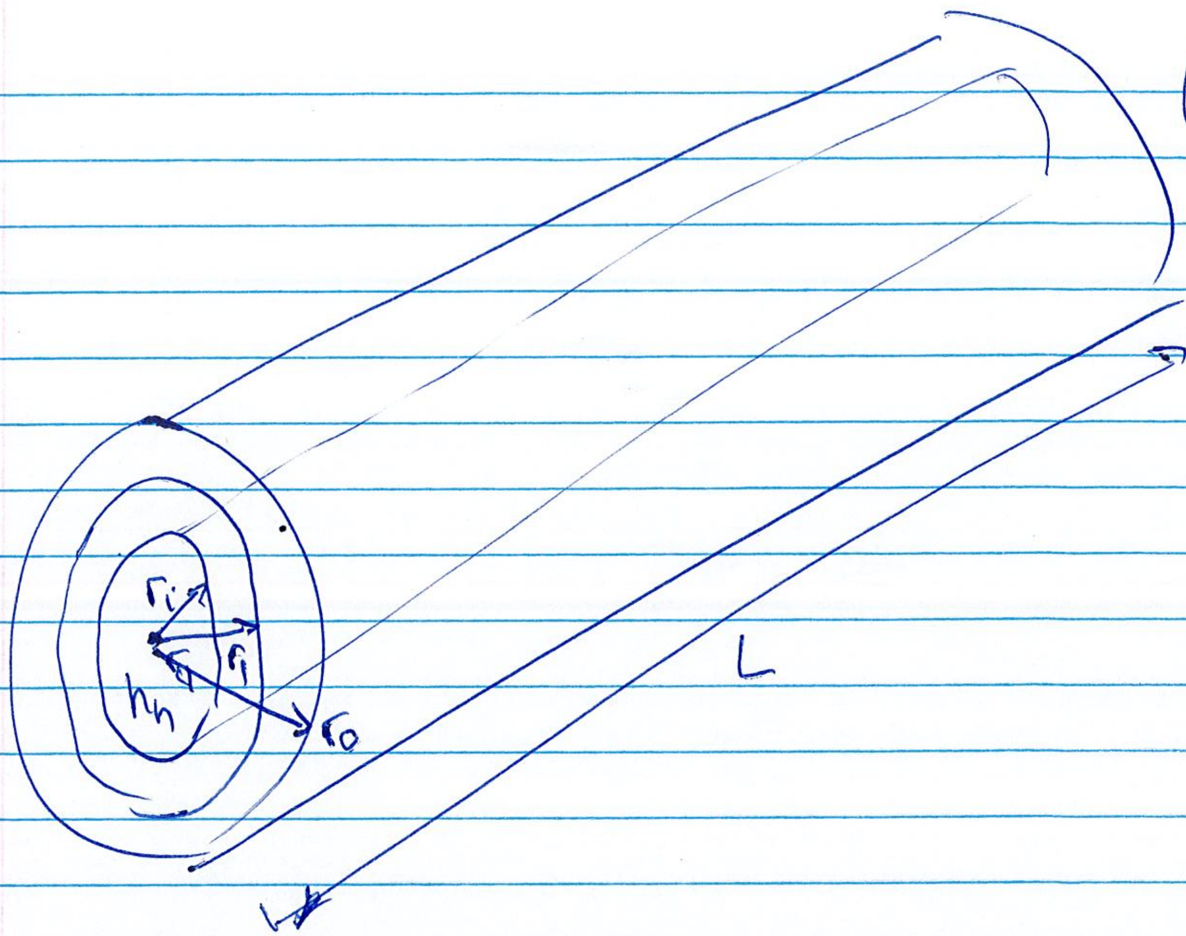
$$q''_x = \frac{q_x}{A} = U\,[T_{f1} - T_{f2}]$$

Flux

Equation to calculate Heat Flow in a cylinder. with ~~three~~ TWO different layers







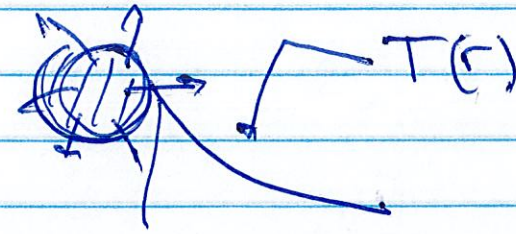
$A_i = 2\pi r_i L$ ✓

$A_o = 2\pi r_o L$ ✓

$A_1 = 2\pi r_1 L$ [Not done in general]

$$\frac{1}{\underbrace{2\pi L r_i}_{A_i} h_h} + \frac{r_i \ln r_1/r}{\underbrace{r_i 2\pi L}_{A_i} K_1} + \frac{r_i}{r_o \underbrace{2\pi L r_i}_{A_i} h_c}$$

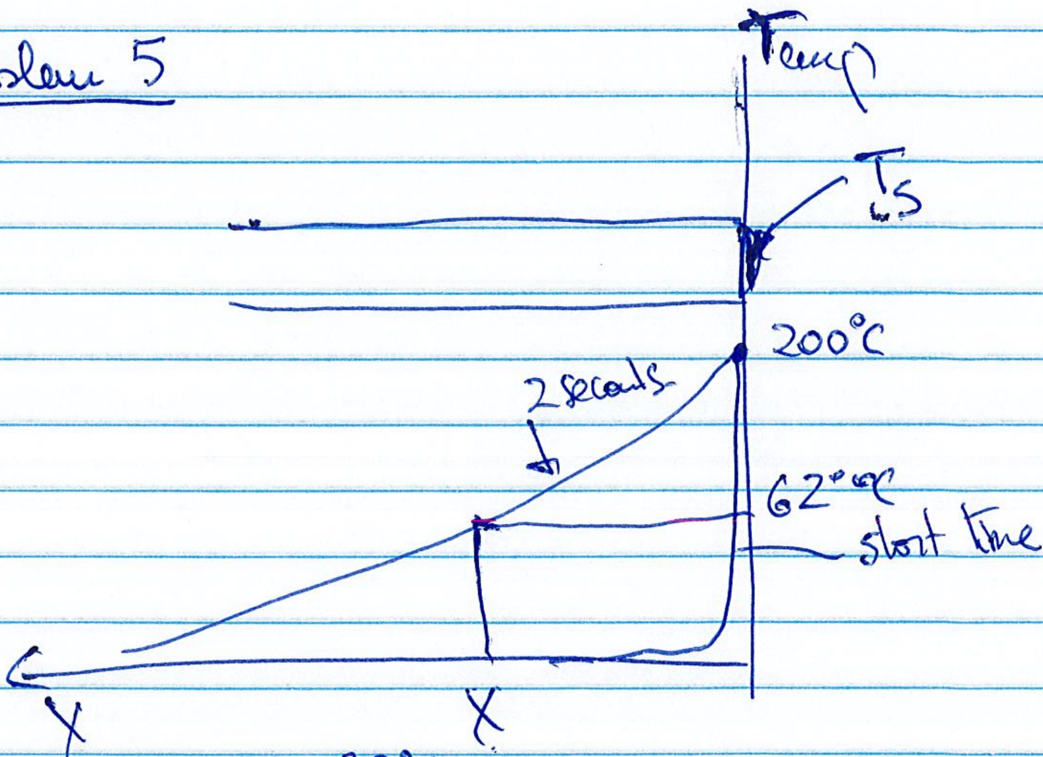
Problem 3 in the tutorial problems



you get T(r) from the problem

$$q_r = -K_{tissue} A \left.\frac{dT(r)}{dr}\right|_{r = R_{\text{Heat source}}}$$

Problem 5



$$\frac{\overset{62}{T(x,t)} - \overset{33°C}{T_i}}{\underset{200°C}{T_s} - T_i} = 1 - \operatorname{erf}\left(\frac{X}{2\sqrt{\alpha t}}\right)$$

$$\frac{62-33}{200-33} = 0.174 = 1 - \mathrm{erf}\left[\frac{x}{2\sqrt{\alpha t}}\right] \qquad (8)$$

$$\mathrm{erf}\left[\frac{x}{2\sqrt{\alpha t}}\right] = 1 - 0.174 = 0.9$$

ϕ	$\mathrm{Erf}[\phi]$
–	–
	–
–	
–	
$\phi \leftarrow$	$0.9\sim$

$$1.175 = \frac{x}{2\sqrt{\alpha t}} \implies x = 1.175 \times 2 \times \sqrt{\alpha \times 2\,se}$$

$\uparrow$ m.

$$\frac{x}{2\sqrt{\alpha t}} > 2 \qquad \mathrm{erf}\left[\frac{x}{2\sqrt{\alpha t}}\right] \to 1$$

$$T(x,t) \cong T_i \qquad x \geq 4\sqrt{\alpha t}$$