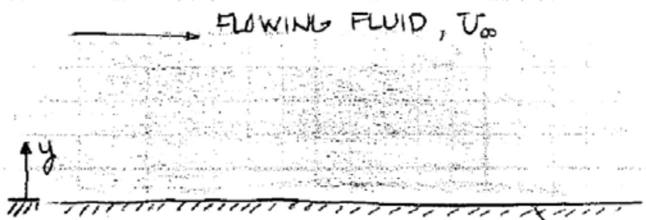
CONVECTION

CONVECTION INVOLVES $\dot{Q}$ BETWEEN A SOLID SURFACE AND

A ____________ ____________

IT ∴ BEHOOVES US TO REVIEW FLUIDS (A LITTLE)



FLUID VELOCITY HERE IS ____

TWO KINDS of STRESS $\not\equiv$ IN A FLUID

$$\frac{F}{A_{NORMAL}} \Rightarrow$$

(USUALLY THIS IS ____________)

$$\frac{F}{A_{TANGENT}} \Rightarrow \qquad = \boxed{\tau}$$

IN A *Newtonian Fluid*

$$\tau = \text{——}$$

LOOK FAMILIAR? IT SHOULD!! WHAT DOES THIS REMIND YOU OF?

ANYWAY, THE FLOWING FLUID EXERTS A *DRAG FORCE* ON THE SURFACE. WE'D LIKE TO KNOW WHAT THAT IS

IN TERMS of τ, ______ JUST LIKE

$F_D =$ ______

IN HEAT TRANSFER

IN *DIMENSIONLESS FORM*,

$$C_f \equiv \frac{\tau}{\frac{1}{2}\rho U_\infty^2}$$

SKIN FRICTION COEFF.

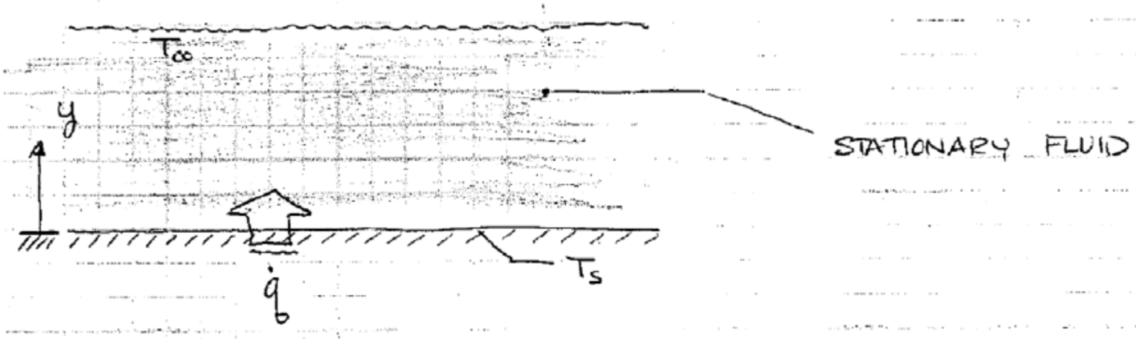
IF WE KNOW C_F:

→ WE KNOW τ

→ WE KNOW $F_D = \tau A$

NOW LET'S FOCUS ON THE HEAT TRANSFER.

FIRST LET'S IMAGINE OUR FLUID IS *STATIONARY*

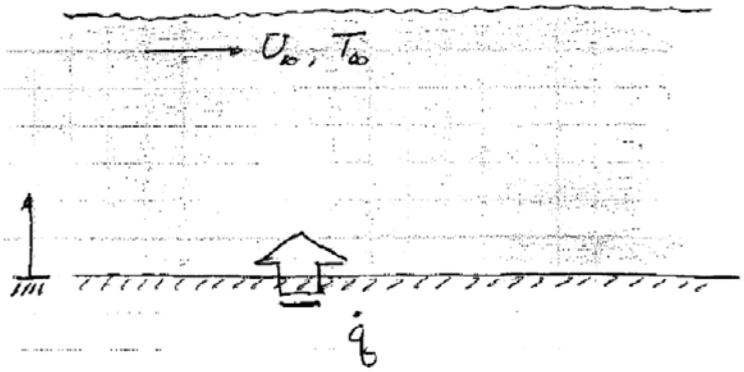


• WHAT IS *MODE* of $\dot{q}$? ______

∴ $\dot{q} =$ ______

NOTES: Intro to convection

NOW LET'S MOVE OUR FLUID.



$\dot{q} =$ ______

WHY?

• WHAT IS *MODE* of $\dot{q}$? ____________

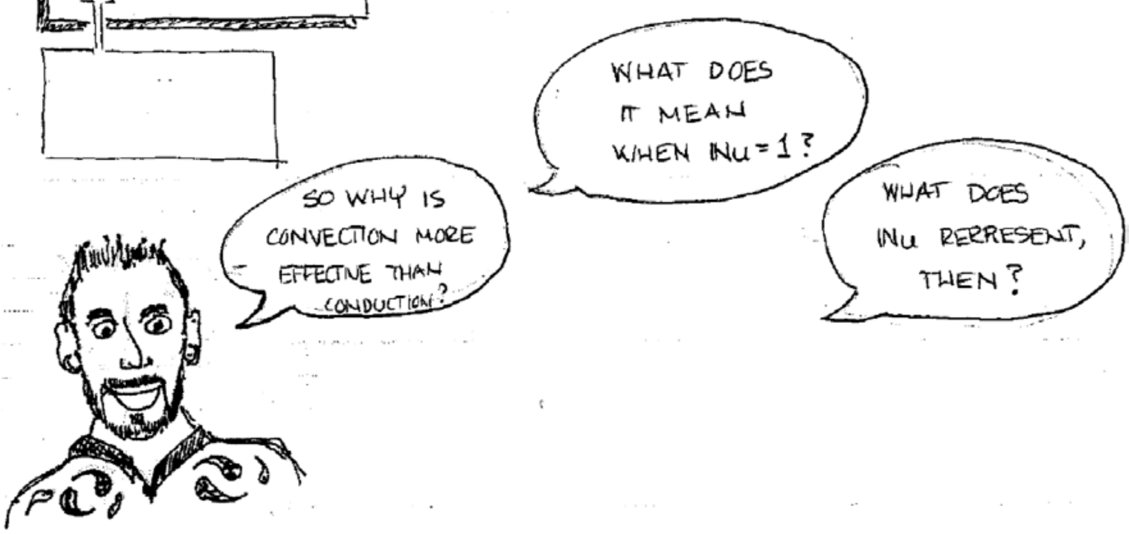
GIVES US A WAY TO FIND h ANALYTICALLY.

SET

$h =$ ______________

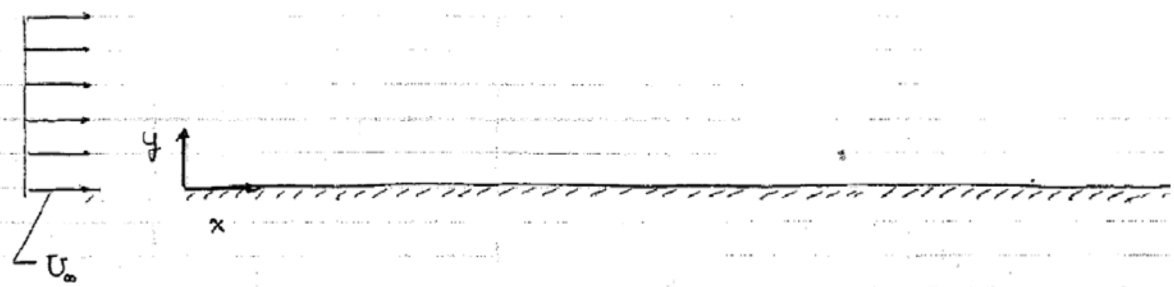
IN DIMENSIONLESS FORM:

$Nu =$ ______



BOUNDARY LAYERS

VELOCITY (MOMENTUM) B.L. ⟶



- INSIDE THE B.L. ______________________
- OUTSIDE THE B.L. ______________________

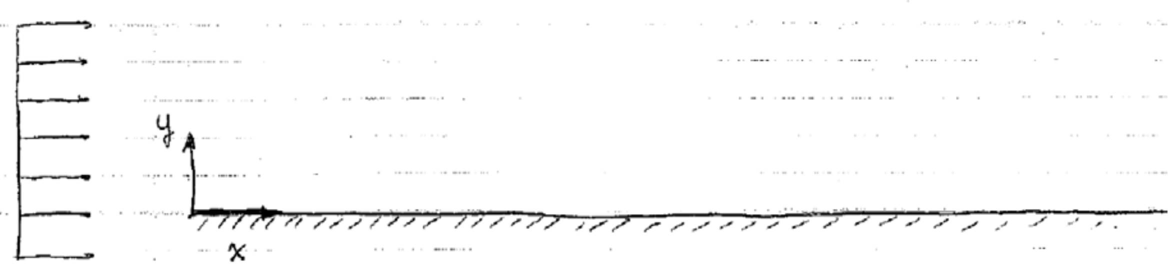
WHERE DOES TRANSITION TAKE PLACE?

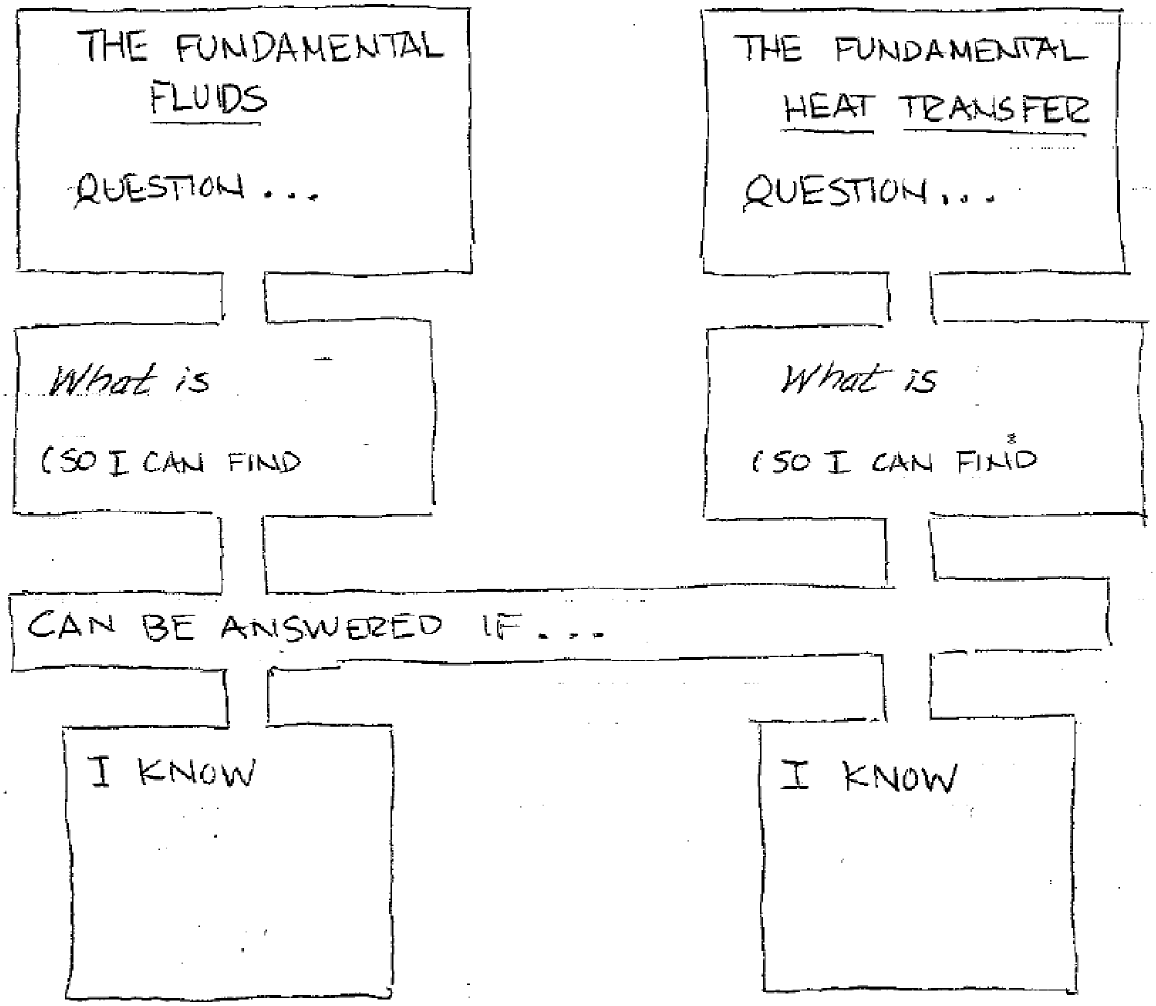
Re_x = ______ = ______ ~ ⇧ FOR TRANSITION

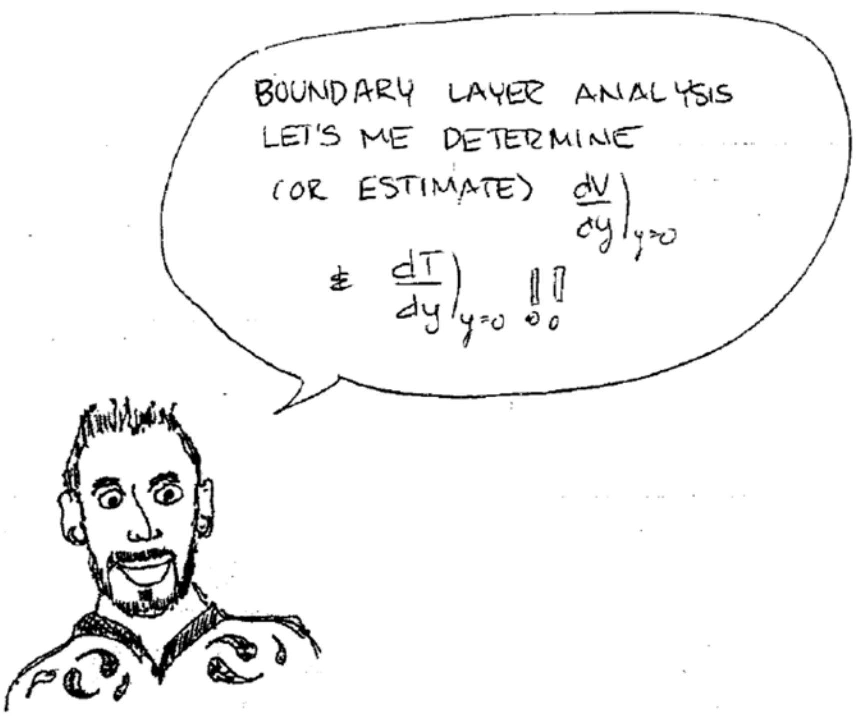
= ____________

REYNOLDS NUMBER

THERMAL BOUNDARY LAYER ⟶




THE FUNDAMENTAL FLUIDS QUESTION . . .
THE FUNDAMENTAL HEAT TRANSFER QUESTION . . .
What is
(SO I CAN FIND
What is
(SO I CAN FIND
CAN BE ANSWERED IF . . .
I KNOW
I KNOW


BOUNDARY LAYER ANALYSIS LET'S ME DETERMINE (OR ESTIMATE) $\left.\frac{dV}{dy}\right|_{y=0}$ & $\left.\frac{dT}{dy}\right|_{y=0}$!!