NOTES: Natural convection

NATURAL CONVECTION

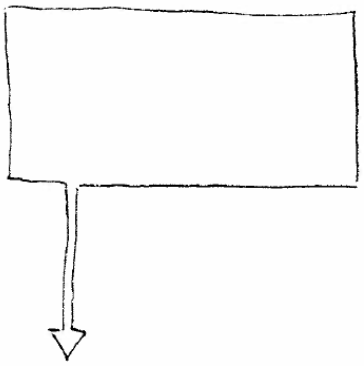
≠

BUOYANCY

- IN FORCED CONVECTION FLUID MOTION IS CAUSED BY APPLIED PRESSURE GRADIENTS. THIS IS ACCOMPLISHED BY PUMPS, FANS, BLOWERS, ETC.
- IN NATURAL OR FREE CONVECTION, FLUID MOTION IS CAUSED BY _____.

- CONSIDER A RUBBER DUCKIE FLOATING BENEATH THE SURFACE OF A BATHTUB:

TWO FORCES ACT ON THE DUCKIE:

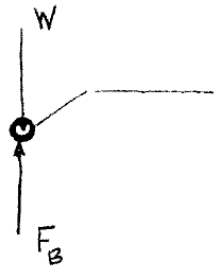


THE *NET UPWARD FORCE* IS, THEN

F_{NET} = =

NOTES: Natural convection

NOW RATHER THAN A RUBBER DUCKIE, LET'S SAY YOU'VE GOT A FLUID PARTICLE THAT'S _____ IT A MEDIUM THAT'S _____



$F_{NET,UP}$ =

WHAT DO YOU KNOW ABOUT ρ OF HOT FLUIDS COMPARED TO ρ OF COLD FLUIDS?

WE SEE, THEN THAT

_____ CAUSE

_____ CAUSE

_____ .

AND WHERE THERE'S _____ THERE'S CONVECTION.

THAT'S NATURAL CONVECTION!

A CLOSER LOOK AT $\Delta\rho$:

$\beta \equiv$

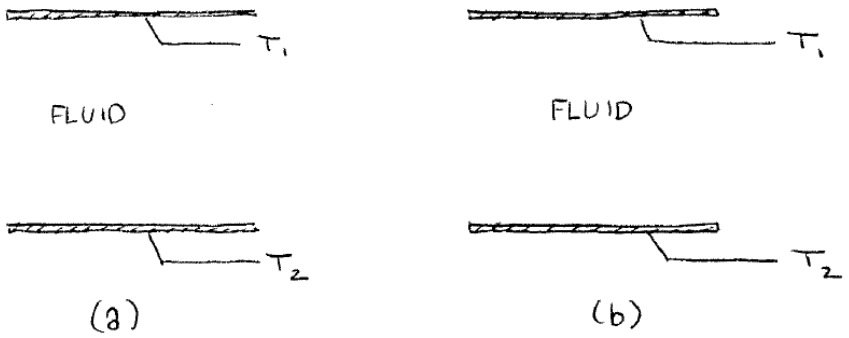
$\beta \approx$ $\therefore \Delta\rho \approx$

NOTES: Natural convection

$F_{NET,UP} \approx$

- IF $T > T_\infty$
- IF $T < T_\infty$

CONSIDER TWO PLATES SEPARATED BY AN INITIALLY STILL FLUID.



SUDDENLY WE HEAT ONE of THE PLATES. IN (a) WE HEAT THE TOP PLATE SUCH THAT $T_1 > T_2$. IN (b), $T_2 > T_1$.

What happens?

NOTES: Natural convection

IF BUOYANCY MOVES FLUID, WHAT OPPOSES THE MOTION? *

_____ .

LET'S DEFINE A DIMENSIONLESS NUMBER THAT MEASURES THE RELATIVE IMPORTANCE of THESE FORCES:

$Gr =$ _____ $=$ _____

$=$ _____

$Gr =$

HIGH Gr MEANS _____ .

LOW Gr MEANS _____ .

* (STRICTLY TRUE FOR $Pr > 1$.)