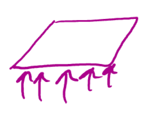
# Concept of Upthrust

23 November 2020 13:20

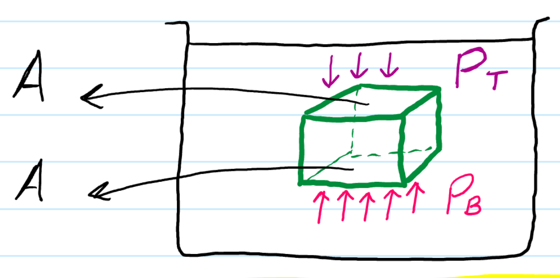


direction → force

define :- Upthrust is defined as the upward force which is experienced by any object if it is immersed in a fluid.

Why Upthrust acts :-

"Pressure Increases with the depth"




$P_B$ = Pressure exerted on the bottom face

$P_T$ = Pressure exerted on the top face

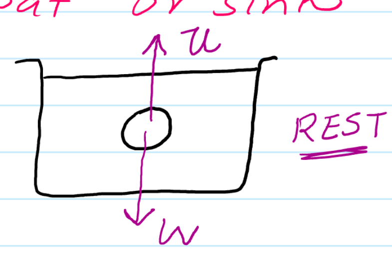
Since $P_B > P_T$

∴ This difference in Pressure b/w the top & the bottom surface exerts an upward force on the object which is known as "upthrust"

State why Upthrust :- b/c of difference in Pressure b/w the Top and the Bottom Surfaces.

Side note

Q How do we determine whether an object will float or sink




if $W > U$ Sink

if $U > W$ float

formulas for calculating Upthrust

derivation "NOT" Required

$$U = (P_B - P_T)A \rightarrow (1)$$

A = Area of Top / Bottom face (provided that the areas are identical).

Q:: What if the areas are non-identical ?

Then the 1st formula is not applicable hence we use eq (2)

$$U = \rho_f \cdot g \cdot V_o \rightarrow (2)$$

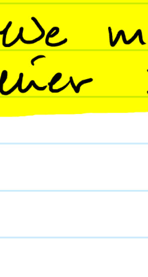
$\rho_f$ = density of fluid

$g$ = acc. of free fall

$V_o$ = Volume of the object.

- How to represent Upthrust in a diagram

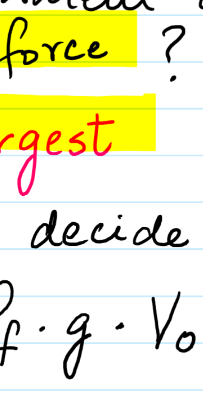
Ex. (1) An object is falling in AIR at constant Speed.




O levels (i) Mark the forces on the diagram?

Equation $W = AR$ (wrong)

- Since we have now done Upthrust. ∴ we must mark not 2 but rather 3 forces on the diagram




Equation $W = U + AR$.

Briefly comment on the magnitude of each force ?

W = Largest

How to decide b/w AR & U

$U = \rho_f \cdot g \cdot V_o$ ∴ $U \propto \rho_f$

In this case object was falling in Air ∴ $\rho_f$ (air) = v. Low ∴ U = smallest.

Increasing Order = U, AR, W.

Ex. A gas molecule is stationary inside a Liquid column.

(i) Mark the forces on the diagram

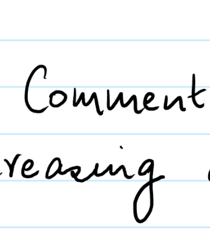

Q:: What about Air Resistance?

fluid alternate terms ::

1. fluid Resistance
2. drag force
3. Viscous drag.

Since stationary ∴ Viscous drag is not marked / mentioned.

(ii) Mark forces if the gas molecule is moving upwards at constant speed ? → V.D (down)




Since moving upwards ∴ Viscous drag downwards

(ii) Form an Equation $W + V.D = U$

(iii) Comment on magnitude

Increasing order

U = Largest.

Compare b/w V.D and W

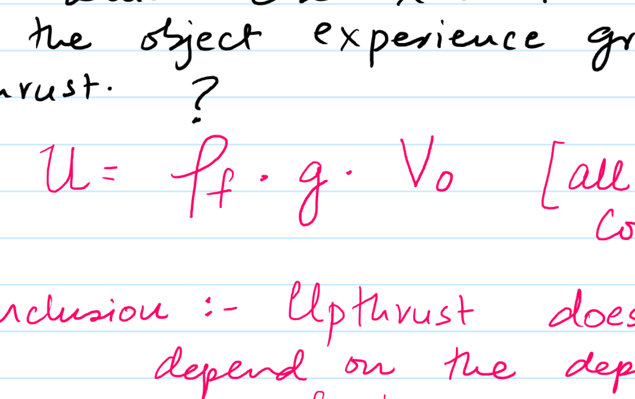
gas molecule ∴ W (negligable)

W = smallest

W, V.D, U.

$T_1 + U = W$

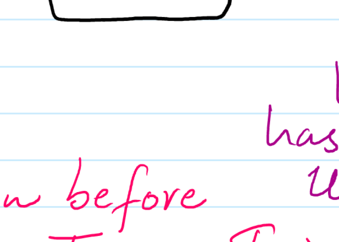
$T_2 + U = W$




Q In which case X or Y will the object experience greater upthrust. ?

$U = \rho_f \cdot g \cdot V_o$ [all are Constant].

Conclusion :- Upthrust does not depend on the depth of immersion



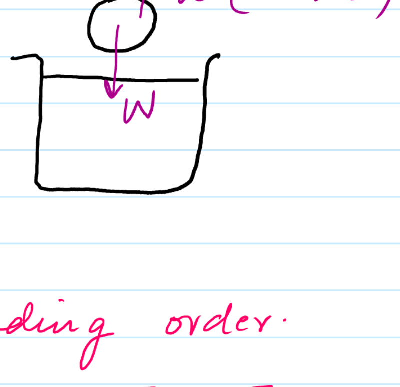

$U = \rho_f \cdot g \cdot V_o$.

$V_o$ immersed has reduced ∴ U also decreases.

$T_3 + U = W$

U reduces; $T_3$ higher than before

$T_3 > T_1$ or $T_3 > T_2$.




$T_4 + U = W$

U smallest; $T_4$ Larger than $T_1, T_2, T_3$.

Ascending order.

$T_1 = T_2, T_3, T_4$.