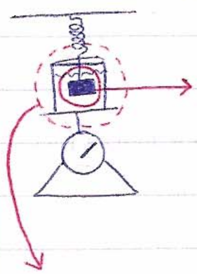
Class Notes: Lecture 28 (Biswas) 24 November 2009

CQ from end of L27:



UPPER SCALE READING

$T + B - m_{iron}g = 0$

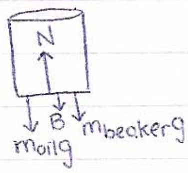
$T = m_{iron}g - B$

$= 2(9.8) - B$ (out of oil)

$= 17.3\,N$ (in oil)

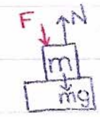
[$B = \rho_{fluid} V_{fluid} g$, $= V_{object} = \frac{2kg}{\rho_{iron}}$

$B = (916)\left(\frac{2}{7860}\right)(9.8)$]



LOWER SCALE READING

reading = N

[

$N = mg$
$N = F + mg$]

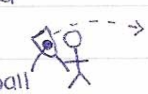
$N - B - m_{oil}g - m_{beaker}g = 0$

$N = B + (m_{oil} + m_{beaker})g$ (out of oil; in oil)

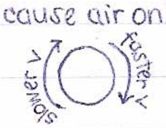
$N = B + (3)(9.8)$

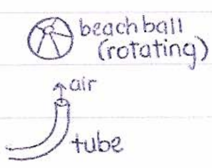
$= 31.7\,N$

Moving Fluid

DEMO: 

Ball curves because air on both sides of it is different



DEMO: 

Moving air changes the pressure of air

Equation of Continuity: V_{in} must $= V_{out}$

$$\frac{A_1(\Delta x_1)}{\Delta t} = \frac{A_2(\Delta x_2)}{\Delta t} \quad \Big\} \text{ take both as } \lim_{\Delta t \to 0}$$

$$A_1 v_1 = A_2 v_2 \quad (1)$$

$W_{nc} = \Delta KE + \Delta PE$

positive: $F_1 = P_1 A_1$; force, displacement in same direction

$W_1 = +F_1(\Delta x_1) = P_1 A_1(\Delta x_1)$

negative: $F_2 = P_2 A_2$; force, displacement in opp. directions

$W_2 = -F_2(\Delta x_2) = P_2 A_2(\Delta x_2)$

$W = P_1 A_1(\Delta x_1) - P_2 A_2(\Delta x_2)$ (2)

$W_{nc} = \Delta KE + \Delta PE$

$$\underbrace{P_1 A_1 \Delta x_1}_{P_1 V} - \underbrace{P_2 A_2 \Delta x_2}_{P_2 V} = \tfrac{1}{2} m v_2^2 - \tfrac{1}{2} m v_1^2 + mgy_2 - mgy_1$$

$$P_1 V - P_2 V = \tfrac{1}{2}\rho V v_2^2 - \tfrac{1}{2}\rho V v_1^2 + \rho V y_2 - \rho V y_1$$

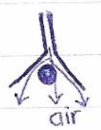
$\therefore P_1 + \frac{1}{2}\rho_1 v_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2$ ③ Bernoulli's Equation

OR $P + \frac{1}{2}\rho v^2 - \rho g y = \text{constant}$

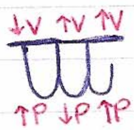
Example: 

if velocity is higher, pressure must go down

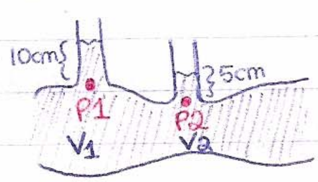
horizontal pipe:
$y_1 = y_2$

DEMO: 

although it's blowing air out, it actually sucks the ball in because A = small; V = high, creates a low P area

DEMO: 

liquid raised up more in 2nd column attached to thinner part of tube with higher V and lower P

Example: 

CQ1: $P_1 = P_{atm} + \rho g h_1$

$P_2 = P_{atm} + \rho g h_2$

CQ2: $V_1 = 0.37\ m/s$

Complete solution online