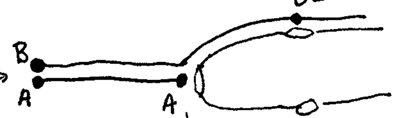
57P.



these two "molecules" have the ~same total energy.

speed is very large (this is an airplane)

speed is essentially zero at stagnation point

"Total Energy of A" $\simeq$ "Total Energy of B" at any point along their path

$$P_A + \tfrac{1}{2}\rho \underbrace{v_A^2}_{0} + \rho g y_A = P_B + \tfrac{1}{2}\rho \underbrace{v_B^2}_{\text{very large}} + \rho g y_B$$

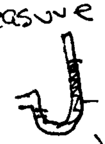
the difference between these two terms is very small compared to what happens when we square v_B

$$P_A = P_B + \tfrac{1}{2}\rho v_B^2$$

$$P_A - P_B = \tfrac{1}{2}\rho v_B^2$$

$$\Delta P = \tfrac{1}{2}\rho_{air} v_B^2$$

A manometer is used to measure this pressure difference



$\Delta P = \rho_{fl} g h$

$$\rho_{fluid}\, g h = \tfrac{1}{2}\rho_{air} v_B^2$$

$$v_B^2 = \frac{2\rho_{fluid}\, g h}{\rho_{air}}$$

48E.

these two "molecules" have the ~same total energy

moving fast

moving fast

"Total Energy of A" = "Tot Energy of B" at any point along their path

$$P_{bot} + \tfrac{1}{2}\rho v_{bot}^2 + \rho g y_{bot} = P_{top} + \tfrac{1}{2}\rho v_{top}^2 + \rho g y_{top}$$

the differences btw these will be small compared to the differences btw the kinetic terms

$$P_{bot} + \tfrac{1}{2}\rho v_{bot}^2 = P_{top} + \tfrac{1}{2}\rho v_{top}^2$$

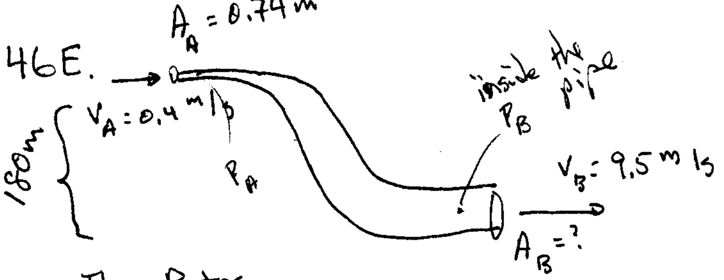
$$P_{bot} - P_{top} = \tfrac{1}{2}\rho(v_{top}^2 - v_{bot}^2)$$

$$\Delta P =$$

Since pressure = force/area

$$\text{Lift force} = \Delta P \cdot A = \tfrac{1}{2}\rho A(v_{top}^2 - v_{bot}^2)$$

46E.



Flow Rates

$$A_A v_A = A_B v_B$$

$$(0.74)(0.4) = A_B (9.5)$$

$$A_B = 0.031\ m^2$$

Bernoulli:

inside the pipe at B

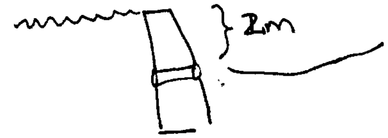
$$P_A + \tfrac{1}{2}\rho v_A^2 + \rho g y_A = P_B + \tfrac{1}{2}\rho v_B^2 + \rho g \cancel{y_B}^{\,0}$$

$$\tfrac{1}{2}\rho (v_A^2 - v_B^2) + \rho g h_A = P_B - P_A$$

$$\tfrac{1}{2}\left[10^3 \tfrac{kg}{m^3}\right]\left[0.4^2 - 9.5^2\right] + 10^3 (9.8)(180) = \Delta P$$

$$\Delta P = 1.72 \times 10^6 \text{ Pascal}$$

22.



dia = 1.20 cm radius = 0.60 cm

$A = \pi r^2 = 1.13 \times 10^{-4}\ m^2$

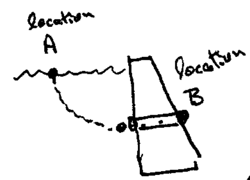
a) $\Delta P = \rho g \Delta h = (1030 \tfrac{kg}{m^3})\ 9.8\ (2)$

$= 2.019 \times 10^4\ Pa$

Force $= \Delta P \cdot A = (2.019 \times 10^4)(1.13 \times 10^{-4})$

$= 2.28$ Newtons $\sim \tfrac{1}{2}$ lb.

b)



$$P_A + \tfrac{1}{2}\rho v_A^2 + \rho g \overset{2m}{y_A} = P_B + \tfrac{1}{2}\rho v_B^2 + \rho g y_B^{=0}$$

P_A: atm $\tfrac{1}{2}\rho v_A^2$: the water level drops very slowly so $v_A \sim 0$ P_B: atm

$$\cancel{\rho} g y_A = \tfrac{1}{2}\cancel{\rho} v_B^2$$

$$9.8(2) = \tfrac{1}{2} v_B^2$$

$$v_B = 6.26\ m/s$$

c) Flow Rate

$$A v = (1.13 \times 10^{-4}\ m^2)(6.26) = 7.07 \times 10^{-4}\ m^3/s$$

12" ≅ 30 cm

1 acre = 4047 m^2

$$\text{time} \sim \frac{\text{volume}}{\text{flowrate}} = \frac{(4047)(0.30)}{7.07 \times 10^{-4}}$$

$= 1.72 \times 10^6$ sec

~ 20 days.