# Fluids #6

p414 MC 1, 2, 7
Concept 16
p415 Problems 18, 20, ~~22~~, 46
Online - Understand Bernoulli

## p414 - Multiple Choice

(12)

1)  Two empty soda cans, blow horizontally

(3)

- higher speed air, lower pressure
- move closer (high P outside pushes in)

2) Roof blown off during tornado

- higher speed wind, causes lower pressure
- higher P air inside house, pushes out

7) Cut end envelope + blow air past, it bulge open

- blown air blowing past outside exerts less pressure than air inside

- Concept

16) Partly close end hose, water squirts further
Why?

- Blocking opening reduces cross-sectional area $A_1 V_1 = A_2 V_2$ $\downarrow A \uparrow V$

(1) Fill in blanks: Blocking the opening of the hose w/ your thumb reduces the cross-sectional area. Thus by continuity eqn a smaller area means a greater horizontal speed & hence a longer travel distance

– Problems

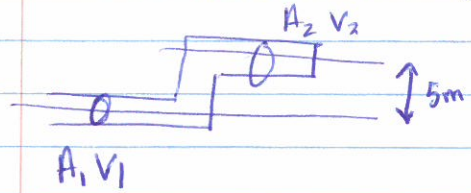
18) $r_1 = .06\,m$
$V_1 = 1.8\,m/s$
$P_1 = 2.2 \times 10^5\,N/m^2$

a) $Q_1 = ?$ $\quad Q = Av = \pi r^2 v$

$= \pi (.060m)^2 (1.8\,m/s)$
$= .0204\,m^3/s$

b) $P_2$ after go up 5m hill
flow into $r_2 = .050m$

(3)




① $A_1 V_1 = A_2 V_2$

$V_2 = \frac{A_1 V_1}{A_2} = \frac{\pi r_1^2 V_1}{\pi r_2^2}$

$= \frac{(.06m)^2 (1.8\,m/s)}{(.050m)^2}$

$V_2 = 2.6\,m/s$

② $P_2 + \frac{1}{2}\rho V_2^2 + \rho g y_2 = P_1 + \frac{1}{2}\rho V_1^2 + \rho g y_1$

$P_2 = P_1 + \frac{1}{2}\rho (V_1^2 - V_2^2) - \rho g y_2$

$= (2.2 \times 10^5\,N/m^2) + \frac{1}{2}(1000\,kg/m^3)((1.8\,m/s)^2 - (2.6\,m/s)^2)$
$- (1000\,kg)(9.81\,m/s^2)(5.0m)$

$= 1.7 \times 10^5\,N/m^2$

20) wash skylights, 8m above ground
connect two hoses .8 cm to 1.0 cm
small hose on roof, large hose faucet on ground
P at small was 1 atm, want v = 6 m/s
What P ground level? what speed

① $V_1 = ?$ $\quad A_1V_1 = A_2V_2 \quad V_1 = \frac{A_1V_1}{A_2} = \frac{\pi r_2^2 V_2}{\pi r_1^2}$

$$V_{@1} = \frac{(.8\,cm)^2(6.0\,m/s)}{(1.0\,cm)^2} = 3.8\,m/s$$

(2)

② $P_2 + \frac{1}{2}\rho V_2^2 + \rho g y_2 = P_1 + \frac{1}{2}\rho V_1^2 + \rho g y_1$ ← ground level

$$P_1 = P_2 + \frac{1}{2}\rho(V_2^2 - V_1^2) + \rho g y_2$$

$$= 1.0\times10^5\,N/m^2 + \frac{1}{2}(1000\,kg/m^3)((6.0\,m/s)^2 - (3.8\,m/s)^2) + (1000\,kg/m^3)(9.81\,m/s^3)(8.0\,m)$$

$$P_1 = 1.9\times10^5\,N/m^2$$

46) cooler filled w/ water has hole

$r = .40\,cm$
$h = 1.0\,m$
$A = .4m \times .6m$


a) initial flow rate

$P_1 = P_2 = P_{atm}$

① $\cancel{P_1} + \frac{1}{2}\cancel{\rho} V_1^2 + \cancel{\rho g y_1} = \cancel{P_2} + \frac{1}{2}\cancel{\rho} V_2^2 + \cancel{\rho} g y_2$

$V_1 = \sqrt{2 g y_2} = \sqrt{2(9.81 m/s^2)(1.0m)} = 4.4 m/s$

② $Q = A v_1 = \pi r_1^2 v_1 = \pi (.004\,m)^2 (4.4 m/s)$

$Q_1 = 2.2 \times 10^{-4}\ m^3/s$

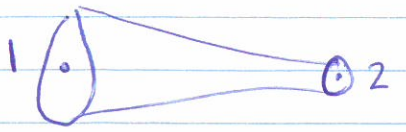
b) $t_{empty} = ?$ $\quad Q = \frac{\Delta V}{\Delta t} \quad t = \frac{\Delta V}{Q}$

$t = \frac{(.40m)(.60m)(1.0m)}{2.2 \times 10^{-4}\ m^3/s} = 1090\,s$

c) flow rate slows w/ time so $v_1 \downarrow$, $Q \downarrow$

in reality takes more time

- Online - Understand Bernoulli




• 1+2 same height

a) $A_1 > A_2$ $\quad A_1V_1 = A_2V_2$ $\quad \downarrow A \uparrow v \downarrow P$

$P_1 > P_2$ $\quad$ lower P

b) Net force causes fluid to

(1) Increase v

c) If point 2 was higher point, how $\Delta P$ compare?

- P based on v change & h change
- larger P drop occuring than purely horizontal

d) physical point of view - pressure drop larger

Greater amount of work is needed to balance ...

- Increase in PE from elevation change