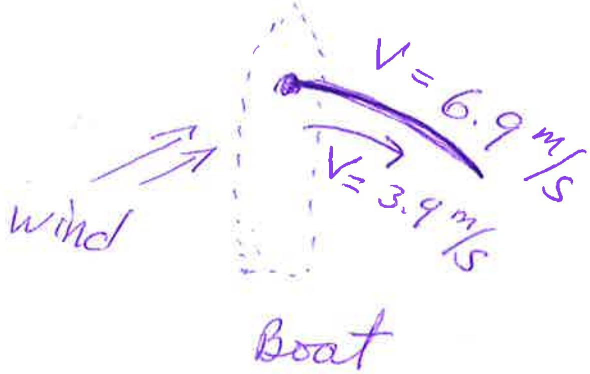
1)



$\rho = 1.29 \frac{kg}{m^2}$

Bernoulli would conserve energy:

$$\Delta E = 0 = \Delta P + \frac{1}{2}\rho(V_2^2 - V_1^2) + \cancel{\rho g \Delta h} = 0$$

same altitude.

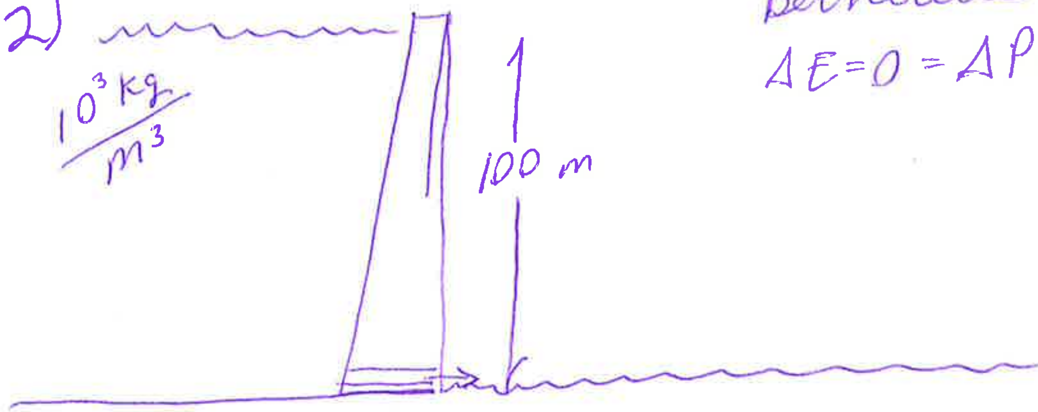
$$-\Delta P = \frac{1}{2}\left(1.29 \frac{kg}{m^3}\right)\underbrace{\left(\left(6.9 \frac{m}{s}\right)^2 - \left(3.9 \frac{m}{s}\right)^2\right)}_{32.4 \frac{m^2}{s^2}}$$

$$= 20.9 \underbrace{\frac{kg}{m^{\cancel{3}2}} \frac{m^{\cancel{2}}}{s^2}} = 20.9\ Pa$$

$$\frac{kg \frac{m}{s^2}}{m^2} = \frac{N}{m^2} = Pa$$

$$F = P \cdot A = 20.9 \frac{N}{m^2}\left[m^2\right] = 20.9\ N$$

2)



Bernoulli would say
$\Delta E = 0 = \Delta P + \frac{1}{2}\rho(V_f^2 - V_0^2) + \rho g \Delta h$

a) $V_{Top} = V_{Bottom} = 0$, so $\Delta P = \rho g \Delta h = \frac{10^3\,kg}{m^3}\,\frac{10\,m}{s^2}\,100\,m$

$$= \frac{10^6\,\frac{kg\,m}{s^2}}{m^2} = 10^6\,Pa = 10\,\underline{\underline{ATM}}$$

now, when we open the hole, $P = 0$

$P_{in} \gg P_{outside}$ $\quad \Delta P = 10^6\,Pa = \frac{1}{2}\rho(V_f^2 - V_0^2)$, with $V_0 = 0$

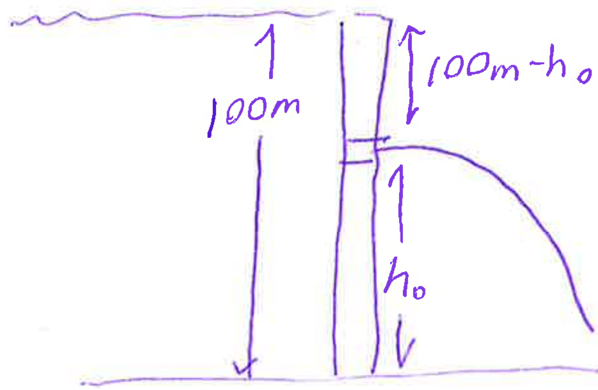
$$V_f = \left(\frac{(10^6\,Pa)\cdot 2}{\rho}\right)^{\frac{1}{2}} = \left(10^3 \cdot 2\,\tfrac{m^2}{s^2}\right)^{\frac{1}{2}} \approx 45\,m/s$$

$$\left(\frac{N\,m^3}{m^2\,kg}\right) = \frac{m^2}{s^2}, \quad N = kg\,\frac{m}{s^2}$$

~~b)~~ When it comes out, it has ~ $45\,m/s = V_H$
however, it has 0 m to fall, so $\Delta t = 0$ and
it do

b) if the hole at top has $\Delta h = 0$, $\Delta P = 0$, $V_{out} = 0$
so even though it takes a long time to fall,
it doesnt get very far.

2 c) Now, we see that if we drill a hole partially in the middle there will be some pressure



$\Delta p = \rho g (100m - h_0)$ which will yield a horizontal velocity =

$$\frac{1}{2}\cancel{\rho}(V_f^2 - \cancel{V_0^2}^{\,0}) = \cancel{\rho} g (100m - h_0)$$

$$V_f = (2g(100m - h_0))^{\frac{1}{2}}$$

<u>Then</u> we realize that vertically the water falls executing parabolic trajectory. $t_{fall} = ?$

$$h_0 = \frac{1}{2} g t^2 \qquad t = \left(\frac{2h_0}{g}\right)^{\frac{1}{2}}$$

How far does the water get ? $V_h \cdot t = X_h$!

$$X_h = (2\cancel{g}(100m - h_0))^{\frac{1}{2}}\left(\frac{2h_0}{\cancel{g}}\right)^{\frac{1}{2}}$$

notice g doesn't matter!

$$X_h = 2(100m\, h_0 - h_0^2)^{\frac{1}{2}}$$

we want to <u>maximize</u> this distance, so ~~so~~ we take the derivative wrt h_0:

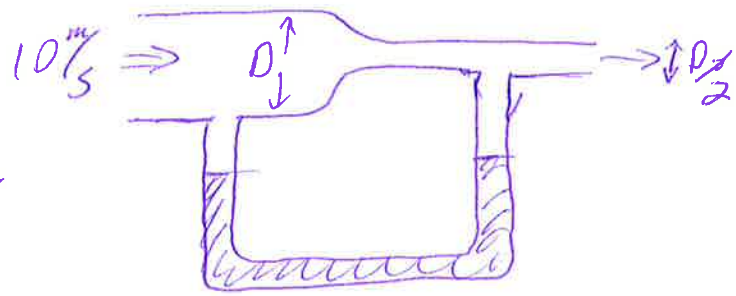
$$\frac{dX_h}{dh_0} = 2\left(\tfrac{1}{2}\right)\underbrace{(100m\, h_0 - h_0^2)}_{h_0 = 0 \text{ not interesting}}(100m - 2h_0) = 0 \longrightarrow \underline{\underline{h_0 = 50m}}$$

half way down

3) $D \Rightarrow D_0/2$

$A \Rightarrow A_0/4$

$V \Rightarrow V_0 \cdot 4 = 40\,m/s$



Because we are conserving volume or flow... ~~lets~~ let's just look at the air flow now

$$\Delta P + \frac{1}{2}\rho(V_f^2 - V_0^2) + \cancel{\rho g \Delta h} = 0$$

$$-\Delta P = \frac{1}{2}\rho(V_f^2 - V_0^2) = \frac{1}{2}\left(1.29\,\frac{kg}{m^3}\right)\left((40\,m/s)^2 - (10\,m/s)^2\right)$$

$$= \frac{1}{2}\left(1.29\,\frac{kg}{m^3}\right)\left(1600\,\frac{m^2}{s^2} - 100\,\frac{m^2}{s^2}\right)$$

$$\approx 1000\ Pa \qquad \frac{kg\,\frac{m^2}{s^2}}{m^3} = N/m^2$$

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now, look at the rise in liquid because the air pressure to the right, where the air is moving faster is 1000 P <u>less</u>

$$\Delta P = \rho g h \Rightarrow \quad h = \frac{\Delta P}{\rho g} = \frac{1000\ N/m^2}{10^3\,kg/m^3 \cdot 10\,m/s^2} = \underline{10\,cm}$$

water