Solutions to HW from 1/27

1. No. The volume is changing, but the mass is not. Temperature increases decrease density (density = mass/volume), and so the volume gets bigger even as the mass is fixed (volume = mass/density)

2. $m_{NaCl} = 1.00000\,kg$ & $m_{Na} = 0.39337\,kg$

$\Rightarrow m_{Cl} = m_{NaCl} - m_{Na} = 0.60663\,kg$

Assuming the numbers of Na atoms & of Cl atoms are equal, and that each atom has the same mass, the atomic mass ratio equals the macroscopic mass ratio

$$\frac{m_{Cl}}{m_{Na}} = \frac{0.60663\,kg}{0.39337\,kg} = 1.5421 \quad (5 \text{ sig figs})$$

4. ρ = density of H_2O. ρ is constant by assumption, and m = mass is conserved, so volume $V = m/\rho$ is conserved:

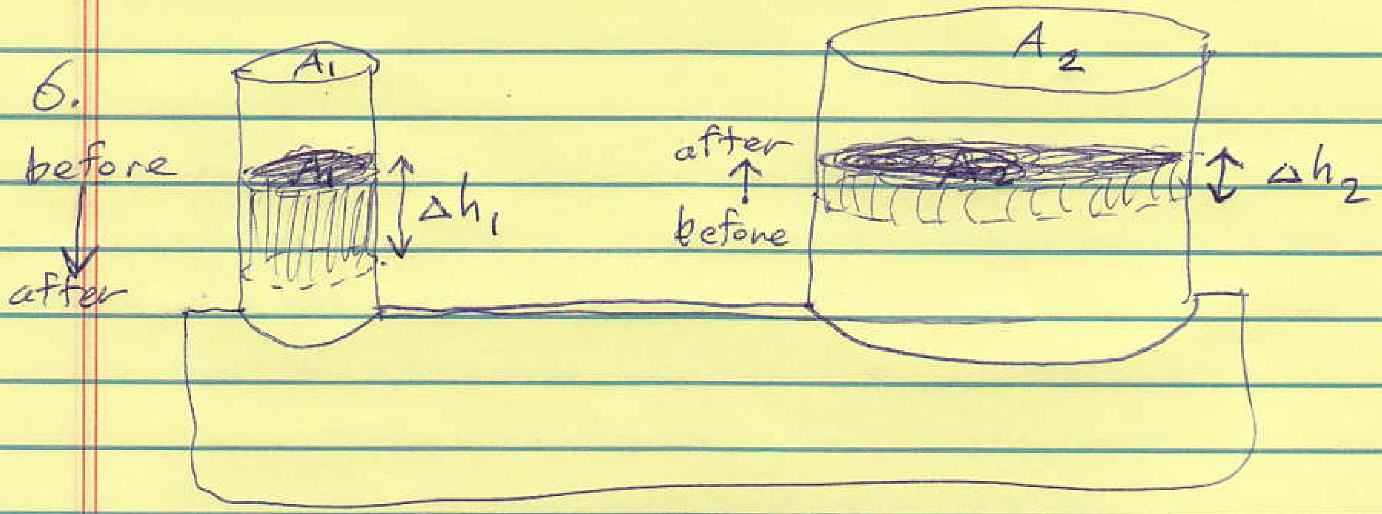
$V_{before} = 2 \cdot (4/3)\pi b^3$ (2 spherical balls)

$V_{after} = (4/3)\pi r^3$ & $V_{before} = V_{after}$,

so $2b^3 = r^3$, so $\boxed{r = b\sqrt[3]{2}}$.

Solutions to 1/27 HW

6.



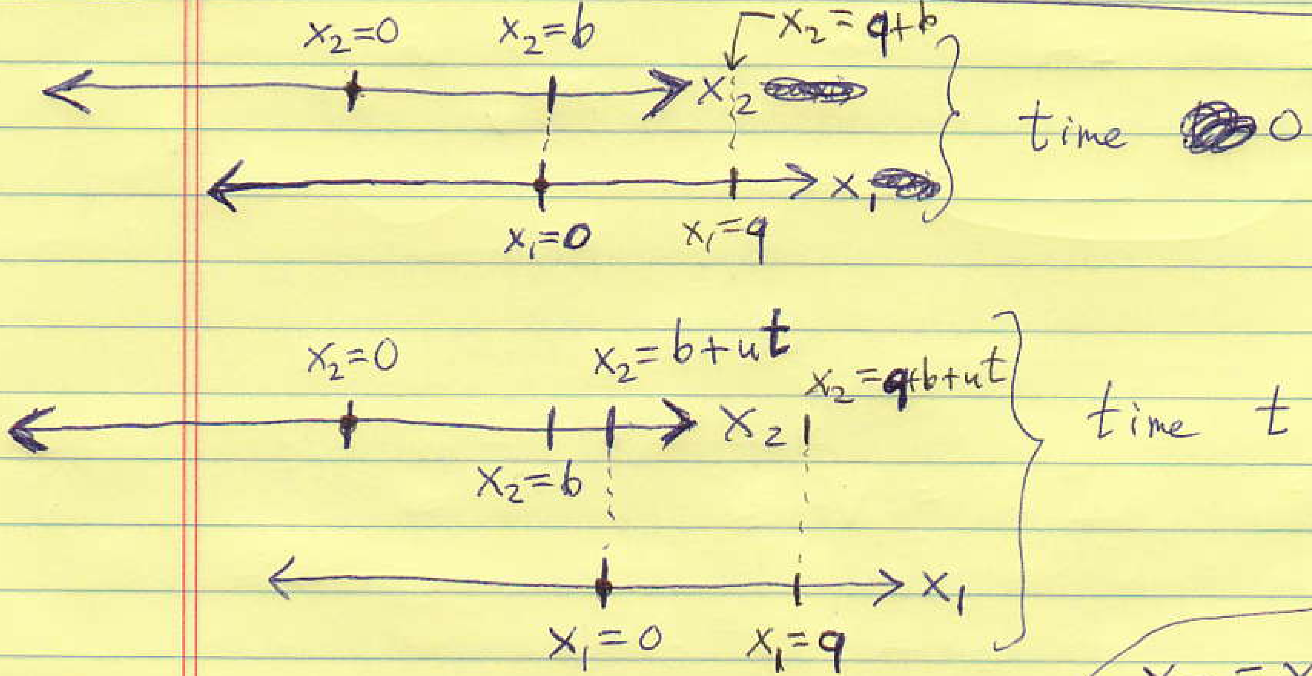
The volume $V_1 = A_1 \Delta h_1$ of fluid leaving the left tube must equal the volume $V_2 = A_2 \Delta h_2$ entering the right tube, assuming the fluid has constant density. So, $\boxed{A_1 \Delta h_1 = A_2 \Delta h_2}$

Equivalently, $\boxed{\frac{\Delta h_2}{\Delta h_1} = \frac{A_1}{A_2}}$ or $\boxed{\frac{\Delta h_1}{\Delta h_2} = \frac{A_2}{A_1}}$

(Any is correct.)

7. The ~~velocity~~ Falling water doesn't speed up as it descends a constant diameter pipe. (Why? Because it's not freely falling; every "slice" of water is lying on a slice just below it that pushes back some to prevent free fall.)

HW due 2/3: Ch. 1 #3, 8, 9, 10



$$x_2 = x_1 + b + ut$$

x_1-frame moving at constant velocity u, according to the x_2-frame

Good when $u \ll c$

$3\times10^8\,m/s$

No quiz on 2/3

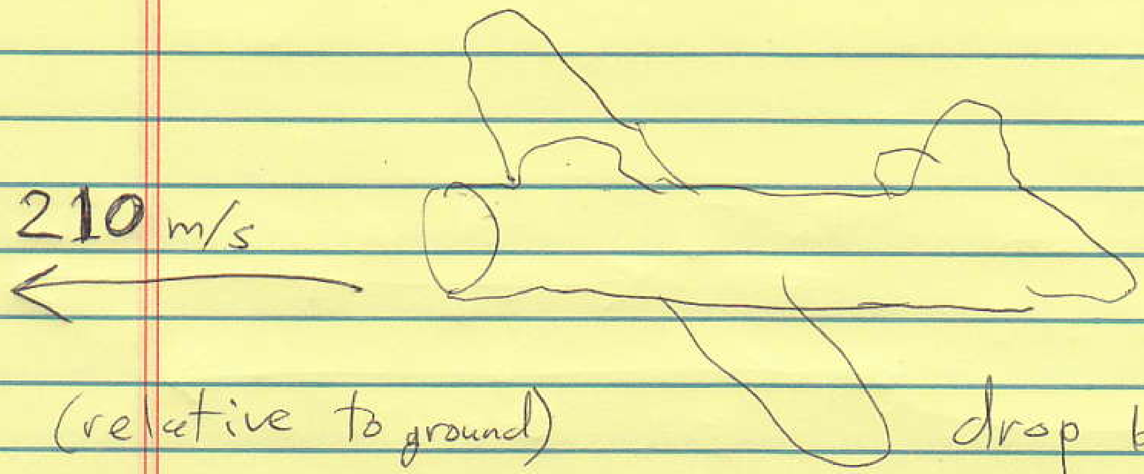
We'll do some review.

Test on 2/8

(paper) Notes + calculators OK.

210 m/s

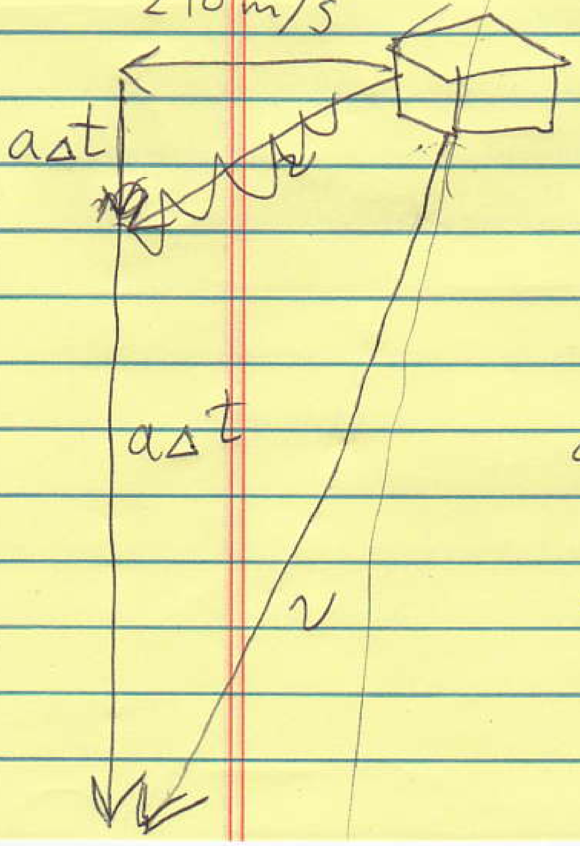
(relative to ground)

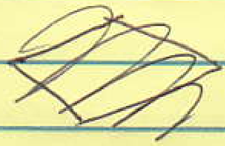


drop box:

$t = 0$

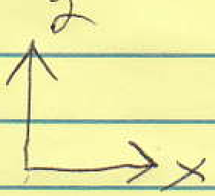
Ignore air resistance for simplicity.





later time

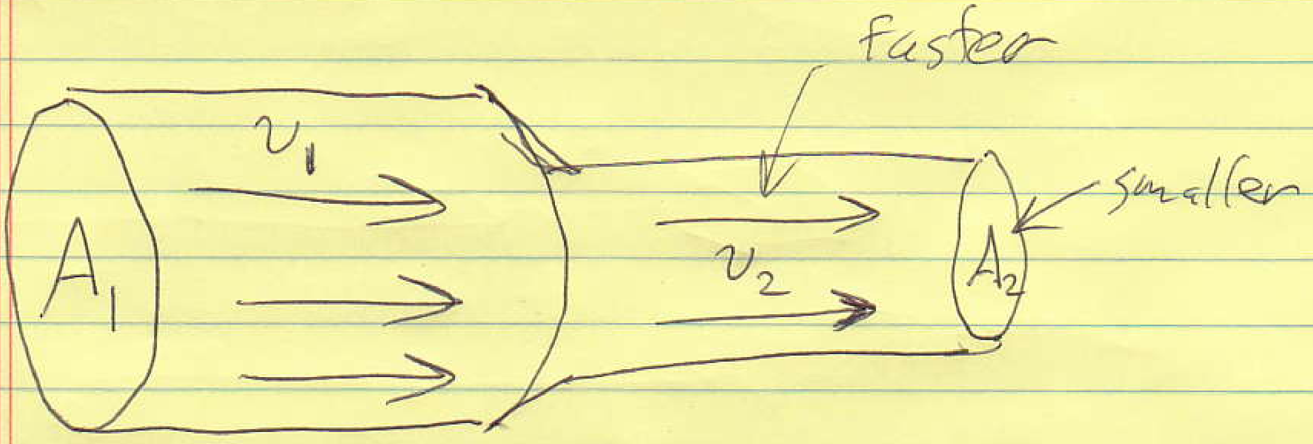
$a\Delta t = \Delta v_y$



$a = 9.8\,m/s^2$ constant

$\Rightarrow$ parabola

Box drops straight down from plane's reference frame (if air resistance is negligible).

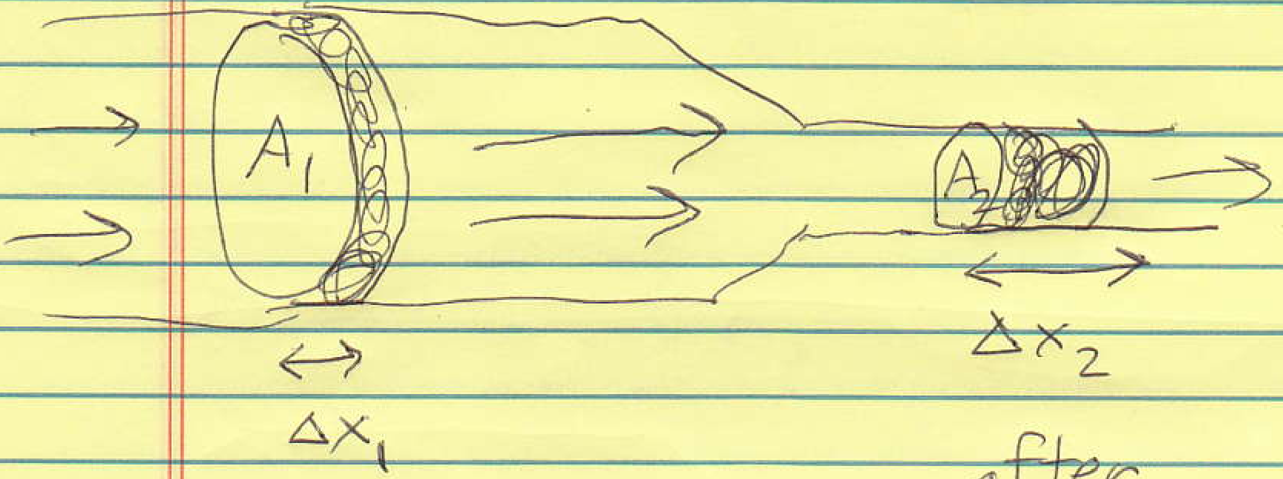


$$A_1 v_1 = \frac{\text{volume in}}{\text{time elapsed}} = \frac{\text{volume out}}{\text{time elapsed}} = A_2 v_2$$

assuming density constant

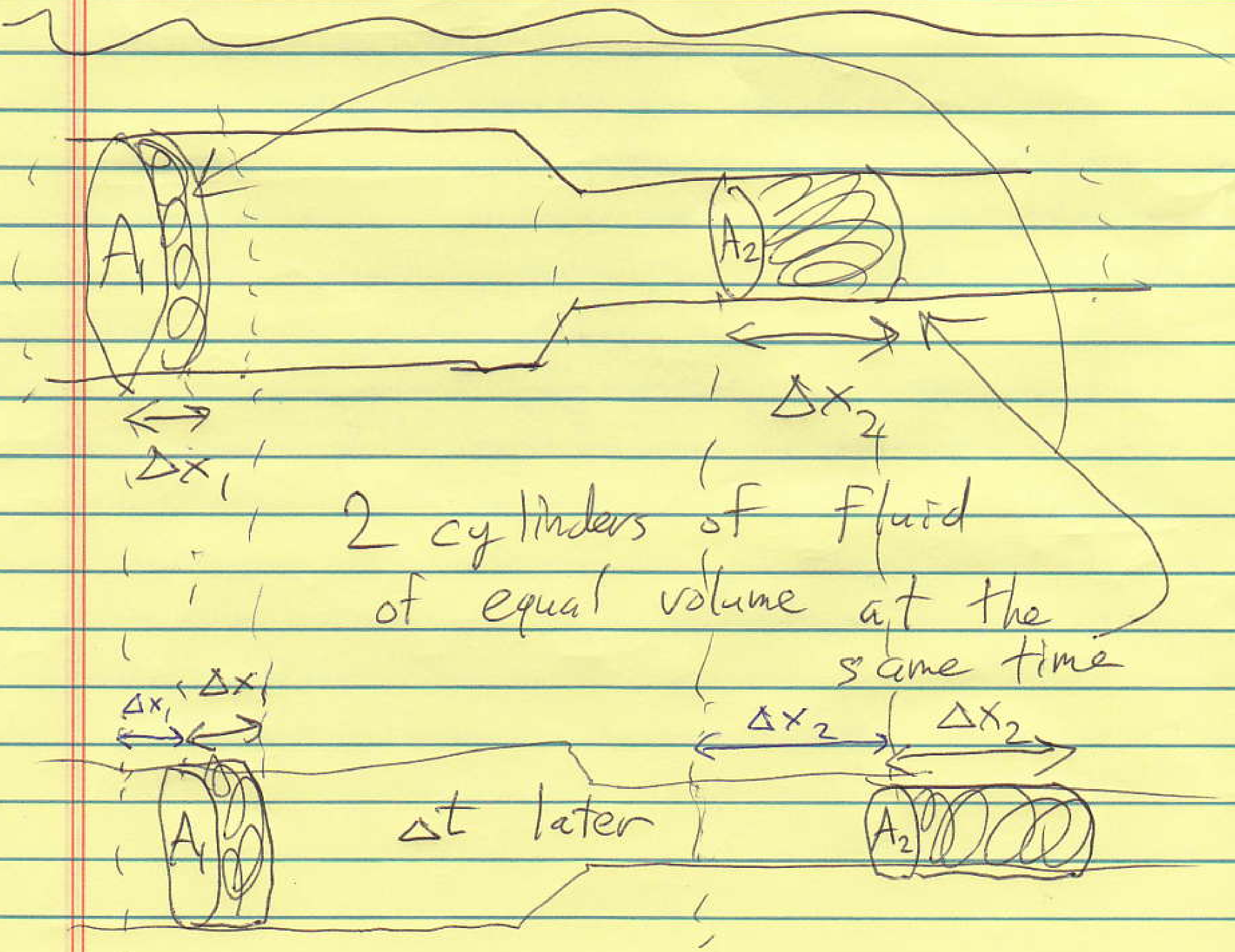
If $\left.\begin{matrix}\text{mass} & \text{or} \\ \text{density} & \rho\end{matrix}\right\}$ conserved, then $V = \frac{m}{\rho}$

conserved too



before   after

$V = A_1 \Delta x_1$ $V = A_2 \Delta x_2$



$$v_1 = \frac{\Delta x_1}{\Delta t} \qquad v_2 = \frac{\Delta x_2}{\Delta t}$$

$$\frac{\text{volume}}{\Delta t} = \frac{A_1 \Delta x_1}{\Delta t} = \frac{A_2 \Delta x_2}{\Delta t}$$

$$A_1 v_1 = A_2 v_2$$