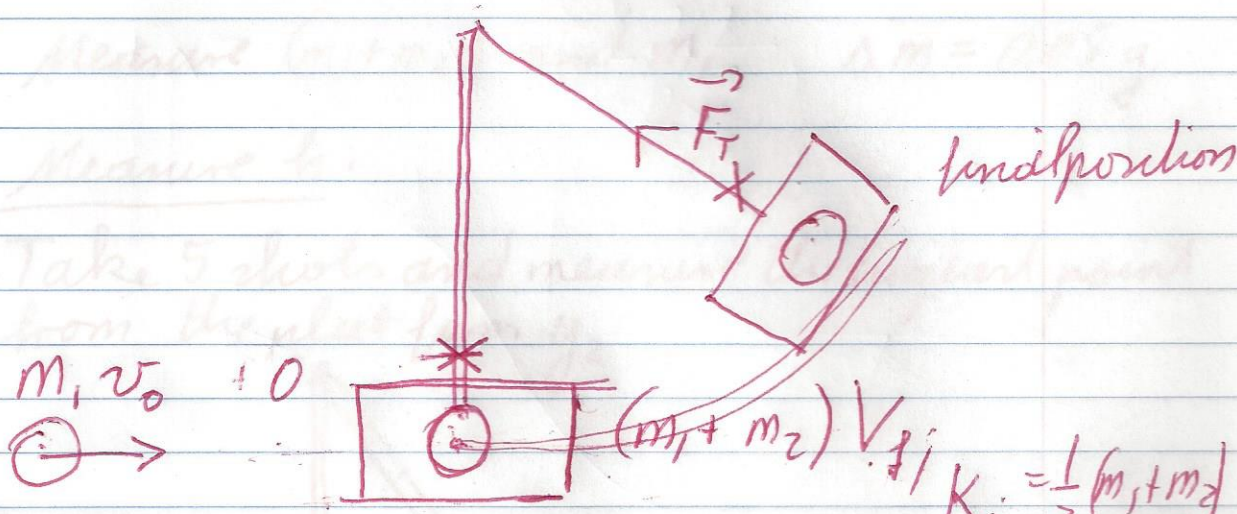
Lab # 6 Ballistic Pendulum

Makeup lab: 10/26 next Monday.

Momentum conservation review:

$$m_1 \vec{v}_{1i} + m_2 \vec{v}_{2i} = m_1 \vec{v}_{1,out} + m_2 \vec{v}_{2,out}$$



$$v_0 = \frac{(m_1 + m_2)}{m_1} \cdot V_{fi}$$

We obtain V_f by applying energy conservation.
V_f is the velocity of pendulum + ball right after collision.
We place the reference point for U at the center of mass of ball+pendulum system.

$$\frac{1}{2}(m_1+m_2)V_f^2 = (m_1+m_2)\,g\,h$$

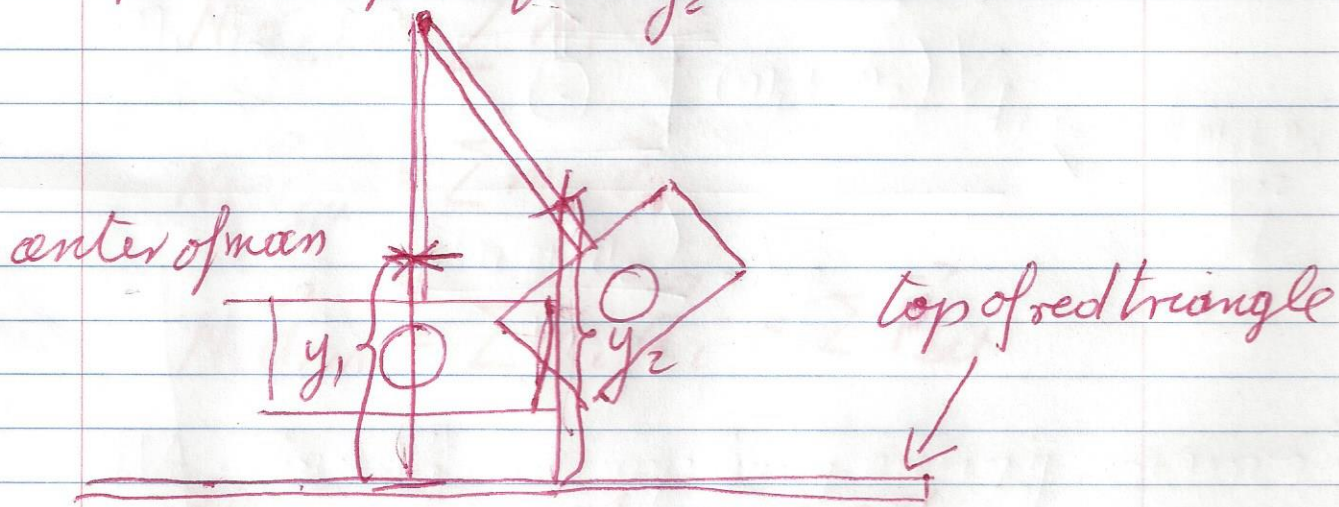
$$V_f^2 = 2gh\,; \quad V_f = \sqrt{2gh}$$

$$\boxed{v_0 = \frac{(m_1+m_2)}{m_1}\cdot\sqrt{2gh}}$$

Measure (m_1+m_2) and m_1 $\quad \Delta m = 0.05\,g$

Measure h:

Take 5 shots and measure the highest point from the platform. y_2



$h = y_2 - y_1 \quad \Delta h = 0.2\,mm = 0.02\,cm$

example $y_2 = 19.5\,cm \quad y_1 = 7.2\,cm$

$h = 12.3\,cm$

$m_1 + m_2 = 257.3\,g$

$m_1 = 58.3\,g$

$$v_0 = \frac{m_1+m_2}{m_1}\sqrt{2gh} = 6.852\,\frac{m}{s}$$ ✓

$$\frac{\Delta v_0}{v_0} = \frac{\Delta(m_1+m_2)}{(m_1+m_2)} + \frac{1}{2}\frac{\Delta h}{h} + \frac{\Delta m_1}{m_1}$$

$$M\vec{r}_{CM} = \sum m_i \vec{r}_i$$

$$M\vec{v}_{CM} = \sum m_i \vec{v}_i$$

$$M\vec{a}_{CM} = \sum m_i \vec{a}_i = \sum \vec{F}_{ext}$$

$$\frac{\Delta v_0}{v_0} = 9.2\cdot 10^{-3} \rightarrow 0.9\%$$

$$\Delta v_0 = 0.0092 \cdot 6.852 = 0.063\,\frac{m}{s} \rightarrow 0.06\,\frac{m}{s}$$

$$v_0 = (6.85 \pm 0.06)\,\frac{m}{s}$$

Calculate the energy loss:

$$\frac{\frac{1}{2}(m_1+m_2)V_f^2 - \frac{1}{2}m_1 v_0^2}{\frac{1}{2}m_1 v_0^2} \cdot 100\%$$

$$= ?$$