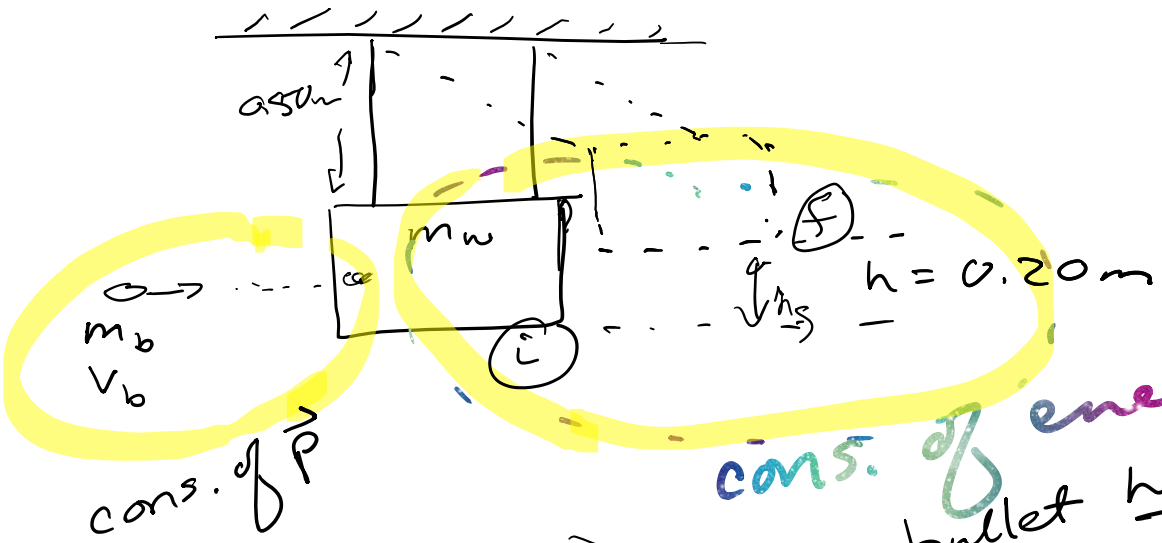
Lesson video #3 - Multi-concept problems (including conservation of momentum and conservation of energy: for example, ballistic pendulum)

- **Lesson video:** https://www.loom.com/share/19ac7ade53e348f891ab90a0defe7e12

Ballistic pendulum

- Mass of wooden block pendulum: m_W = 3.00 kg; Mass of bullet: m_b = 20.0 g
- length of hanging pendulum: L = 0.50 m
- The bullet is shot toward the block pendulum and becomes embedded within the block.
- After being hit by the bullet the pendulum swings to a height of h = 0.20 m above the low point

Determine the speed of the bullet before it hit the block.



cons. of $\vec{P}$

cons. of energy

$\vec{P}_T = P'_T$

$m_b\vec{v}_b = (m_b + m_w)v'$

$\vec{v}_b = \dfrac{(m_b + m_w)v'}{m_b}$

After bullet hits

$E_{Ti} = E_{Tf}$

$\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f$

$v_i^2 = 2gh_f$

$v_i = \sqrt{2gh_f}$

$$v_b = \frac{(m_b + m_w)\sqrt{2gh_f}}{m_b}$$

$$v_b = \frac{(0.02 + 3.00)\sqrt{2(9.8)(0.20\text{m})}}{0.020\text{kg}}$$

$v_b = 3.0 \times 10^2$ m/s