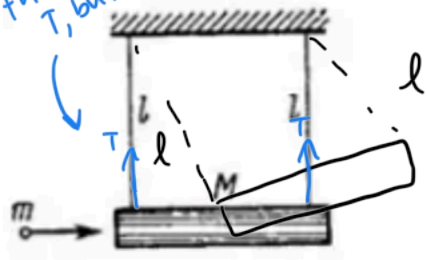
A bullet of mass m is fired at speed v into a block of mass M and gets lodged inside the block. The block hangs on a two strings of length l connected to the ceiling. How high up will the block rise after it is struck by the bullet?

there is T, but it is $\perp$ to distance traveled



$$mv = (M+m)v_f$$

$$v_f = \left(\frac{m}{M+m}\right)v$$

Now, we can use conservation of energy:

$$\frac{1}{2}\cancel{(M+m)}\left(\frac{m}{\cancel{(M+m)}}\right)^2 v^2 = (M+m)gh$$

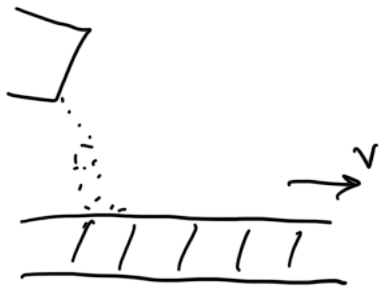
$$\frac{1}{2}\frac{m^2}{M+m^2}v^2 = gh$$

$$h = \frac{1}{2g}\left(\frac{mv}{M+m}\right)^2$$

- Sand is poured at a rate μ (in kg/s) onto a moving conveyor belt of velocity v. The sand matches the speed of the belt when it lands on it. Find the power P exerted by the motor driving the belt. How much of this power goes into the speed of the sand, and how much is lost to heat?

$P = \frac{W}{\Delta t}$ mass of sand: M

$$\Delta t = \frac{M}{\mu}$$



$$P = \frac{\frac{1}{2}Mv^2}{\Delta t} = \frac{\frac{1}{2}\cancel{M}v^2}{\frac{\cancel{M}}{\mu}} = \frac{\mu v^2}{2}$$

Because it's inelastic

Consider the force: $F = \frac{\Delta P}{\Delta t} \rightarrow \Delta P = mv$

$\Delta P = \mu \Delta t v$

$\rightarrow F = \frac{mv}{\Delta t}$

$F = \mu v$

(power) $P = F \cdot v$

$\downarrow$

$P = \mu v^2 \rightarrow$ half is lost to heat