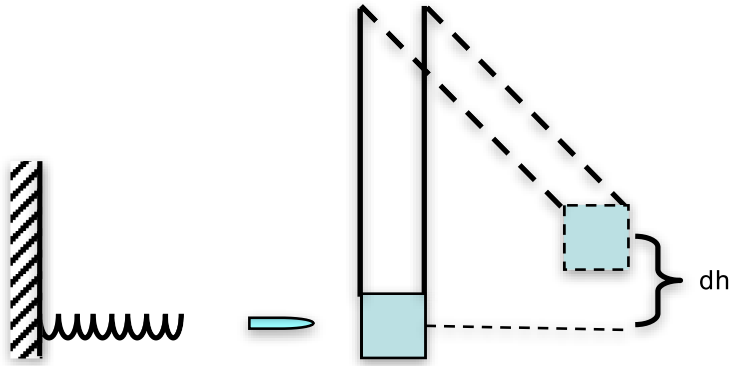
Assessment #4 Klay/Schwartz

1. A spring of spring constant 2500 N/m is compressed 10 cm behind a 250 g projectile. When released, the projectile is fired into and sticks inside of a 2.0 kg block. The block and projectile lift up to a maximum height *dh*. I want to find *dh*. I have a plan to use $U_{sp} = U_g$ to solve for the final height. Does this method work?
   - If this the correct way to find dh, please explain why this is correct, and find dh.
   - If this method doesn't work, please explain why it will not work and what has to be done differently to find dh. You don't have to calculate it.



Use as much paper as you like. Your work is important for us to read!

Below, please see two solutions… one is clear with large writing. However, the second is my favorite because of the reflection indicating, "I did this wrong" and then they did it correctly.

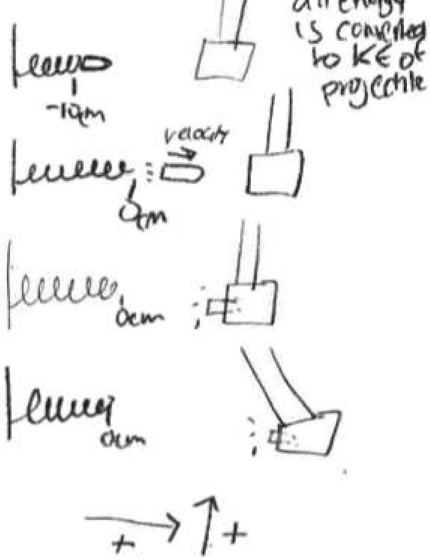
$K = 2500$ N/m

$\Delta x = 10$ cm

$m_p = 250$ g

$m_b = 2$ kg

$\Delta h = ?$



This does not work. If you use an energy lens, the $U_{sp} = KE_{initial}$ of the projectile as it is released from the spring. Once it hits the block, A lot of the energy is converted into heat energy as well as the KE of the system so the total energy, which came from the U_{sp} actually equals KE_{system} + Heat energy. Then the KE_{left} is converted to U_g, but not all the energy of the system will be.

Instead, you should use an energy lens to find the KE of the projectile before it hits the block which is equal to Usp, because all the Usp is converted to KE and there is no other energy source and then use a momentum lens to find the velocity of the block and projectile as one after the collision, because momentum is conserved since there are no other outside forces affecting the system that will affect the collision. Then use that velocity to find the KE

Name

the system was given right once they hit, Then using an energy lens again, the KE at that point is equal to the Ug, as KE is all converted to Ug since no other energies are present and energy is conserved, and use that to find the change in height.

Energy	momentum	Energy
$U_{sp} = KE_{projectile}$	$p_{Before} = p_{After}$	$KE_{b+p} = U_{g\ b+p}$
$\frac{1}{2}kx^2 = \frac{1}{2}m_p v_p^2$ ⇒	$m_p v_p = m_{p+b} V_F$ ⇒	$\frac{1}{2} m_{b+p} V_F^2 = m_{b+p} g \underline{\underline{\Delta h}}$

distance compressed

Here's the second way… where they went down a wrong direction and then realized it!

Looking through an energy lens because we are analyzing various transformations of energy

$$U_{sp} \xrightarrow{\boxed{\text{work}}} KE_{bullet} \xrightarrow{\boxed{\text{inelastic collision}}} KE_{bullet+block} \xrightarrow{\boxed{\text{work}}} U_g$$

~~NA~~ Thermal Energy (negligible) ?

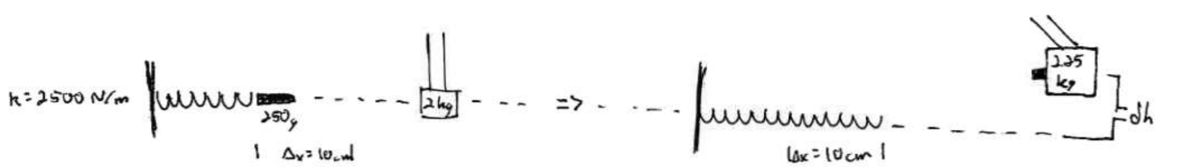
Kinetic energy is conserved in an inelastic collision ?

This shows that, neglecting air resistance and thermal energy generated by the collision, no energy is "lost" in the process, thus the spring's elastic potential energy is equal to the block + bullet's gravitational U.

Can you neglect this?

This means I can use this energy lens to calculate dh

Bad bad bad



$U_{sp} = \frac{1}{2} \cdot 2500\,N/m \cdot (.1m)^2$

$= 1250\,N/m \cdot .01m^2 = 12.5\,Nm$

$= 12.5\,J$

Since all U_{sp} was converted to U_g eventually, U_g also is $12.5\,J$

$12.5\,J = 2.25\,kg \cdot 10\,m/s^2 \cdot h$

$h = \frac{1.25}{2.25}\,m = (\frac{5}{4} \cdot \frac{4}{9})m = \frac{5}{9}\,m$

Hmm I used a momentum lens and I guess proved that you can't actually ~~do what I~~ said, sorry it's small, but if it's worth anything, here

much much better

$12.5\,J = \frac{1}{2} \cdot .25\,kg \cdot v^2$

$12.5\,J = \frac{1}{8}\,kg \cdot v^2$

$v = 10\,m/s$

$P_{bullet} = .25\,kg \cdot 10\,m/s = 2.5\,kg\,m/s$

momentum conserved in inelastic collision

$2.5\,kg\,m/s = 2.25\,kg \cdot v$

$v = \frac{2.5\,kg\,m/s}{2.25\,kg} = \frac{5}{2}\,kg\,m/s \cdot \frac{4}{9}\,m/s = \frac{10}{9}\,m/s$

$KE_{block} = \frac{1}{2} \cdot \frac{9}{4}\,kg \cdot \frac{100}{81}\,m^2/s^2$

$= \frac{9}{8}\,kg \cdot \frac{100}{81}\,m^2/s^2$

$= \frac{1}{2}\,kg \cdot \frac{25}{9}\,m^2/s^2 = \frac{25}{18}\,J$

$\frac{25}{18} \cdot \frac{4}{9} \cdot \frac{1}{10} = \frac{25}{9} \cdot \frac{2}{9} \cdot \frac{1}{10} = \frac{25}{9} \cdot \frac{1}{9} \cdot \frac{1}{5} = \frac{5}{81}$

$\frac{25}{18}\,J = 2.25\,kg \cdot 10\,m/s^2 \cdot h$ // $h = (\frac{25}{18} \cdot \frac{4}{9} \cdot \frac{1}{10})m = \frac{5}{81}\,m$