Data: Bullet Mass: 7.13 grams Block Mass: 3.713 kg Gun Mass: 2.86 kg

Length of string: 1.50 m Distance Block moved: 82.0 cm Bullet Penetration distance: 20.2 cm

Calculations:

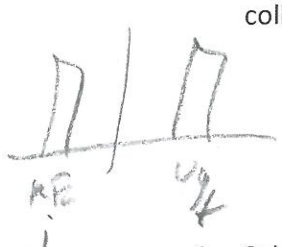
1. Calculate the height that the block traveled.

$$h = L - \sqrt{L^2 - d^2} = 1.5 - \sqrt{(1.5)^2 - (.82)^2} = 0.244\,m$$

2. Calculate the final U_{grav} of the Block and bullet system.

$$U_g = mgh = (3.713 + .00713)(9.8)(.244) = 8.9\,J$$

3. Calculate the velocity of the block and bullet system at the bottom of the swing, after the collision using Conservation of Energy.



$$U_{gf} = KE_i \rightarrow 8.9\,J = \tfrac{1}{2}(3.713 + .00713)v^2$$

$$v = 2.19\,m/s$$

4. Calculate the speed of the bullet before the collision using Conservation of Momentum.

$$.00713\,v_i = (3.713 + .00713)(2.19)$$

$$v_{i_b} = 1142\,m/s$$

5. Calculate the KE of the bullet before it strikes the block. Then us the KE of the block after collision to calculate the % of KE lost in the collision.

$$KE_b = \tfrac{1}{2}(.00713)(1142)^2 = 4646\,J$$

$$\Delta KE = 8.9 - 4646 = -4637\,J$$

$$\% = \frac{4637}{4646} = \boxed{99.8\%}$$

6. If total energy is ALWAYS conserved, explain clearly and in detail where the missing KE went. Be specific and don't use "heat" as your answer. (it may help to look at Figure 15.4)

7. Calculate the acceleration of the bullet during impact.

$v_f^2 = v_i^2 + 2a\Delta x \rightarrow a = \frac{v_f^2 - v_i^2}{2\Delta x} = \frac{(2.19)^2 - (1142)^2}{2(.202)} = -3{,}225{,}504 \frac{m}{s^2}$

8. How many "g"s is this?

$\frac{a}{g} = \frac{3225504}{9.8} = \boxed{329{,}133\ g's}$!!

9. Calculate the force acting on the bullet during impact. How many pounds is this (1 lb = 4.45N)

$F = ma = (.00713)(3225504) = \frac{22998\,N}{4.45\,N/lb} = \boxed{5{,}168\ lbs}$

10. Calculate the recoil speed of the gun.

$\Sigma \vec{p}_i = 0 \therefore \Sigma \vec{p}_f = 0 \therefore \vec{p}_{fb} = -\vec{p}_{fg}$

$8.14\ kg\,m/s = (2.86\ kg)\,v_g$

$v_g = 2.846\ m/s$

11. Calculate the KE of the gun after firing.

$KE = \frac{1}{2}(2.86)(2.846)^2 = \boxed{11.58\ J}$

12. Compare the KE of the gun and the KE of the bullet. Explain why even though the gun and bullet have the SAME momentum after the shot, it is much safer to be on the gun end instead of the bullet end.