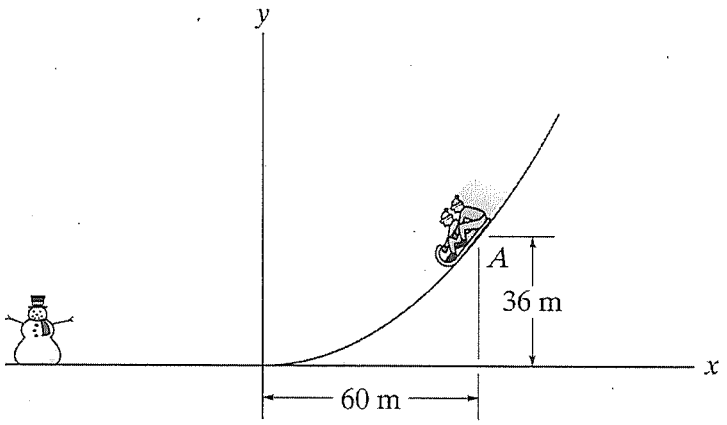
PHYSICS 151 TEST 6

Name: _____

(a.) Two kids ride a toboggan from rest at point A down the hill shown. If the total mass of the kids and the toboggan is $50\,kg$ and they are going $6\,m/s$ the instant before they smash into the snowman, how ~~much work did friction do~~ thermal energy was released during their ride down the hill? *(3pts)*



BOTH GRAVITY AND FRICTION DOING WORK. THERMAL ENERGY WANTED $\Rightarrow$

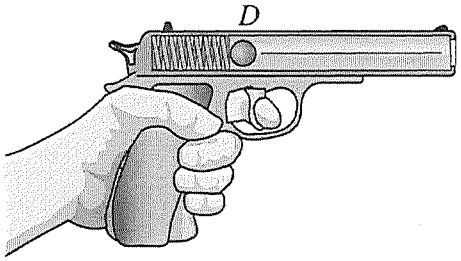
$\frac{1}{2}mv_i^2 + mgy_i = \frac{1}{2}mv_f^2 + mgy_f + \Delta E_{TH}$. At A: $v_i = 0$, $y_i = 36m$
At Bottom, $v_f = 6m/s$, $y_f = 0$

$\Rightarrow 0 + (50kg)(9.8m/s^2)(36m) = \frac{1}{2}(50kg)(6m/s)^2 + 0 + \Delta E_{TH} \Rightarrow 17640J = 900J + \Delta E_{TH}$

$\Rightarrow \Delta E_{TH} = 17640J - 900J = \underline{16740J}$

(b.) A spring gun is loaded by pushing a 0.6-kg ball into the barrel and locking it into place. (During this process the 300-N/m spring is compressed 15 cm.) When the trigger is pulled, the ball is released from rest at point D. Ignoring friction and assuming the spring gun is being held $1.8\,m$ above the ground, how fast will the ball be going when it hits the ground? *(3pts)*

$15cm \times \frac{m}{100cm} = 0.15m$



By time it hits the ground both the spring & gravity will do work $\Rightarrow$

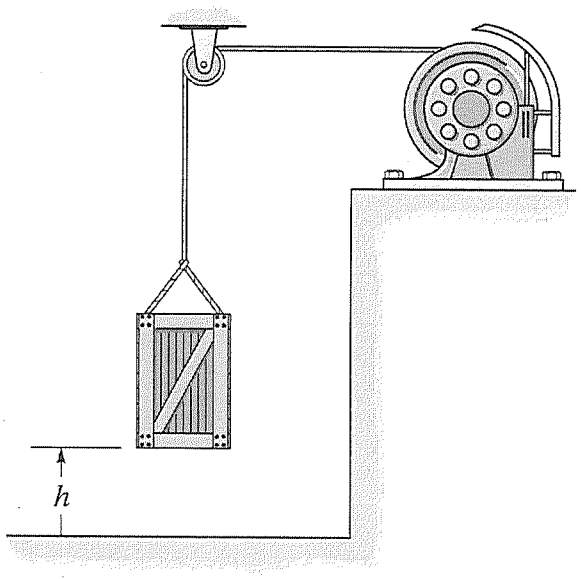
$\frac{1}{2}mv_i^2 + mgy_i + \frac{1}{2}ks_i^2 = \frac{1}{2}mv_f^2 + mgy_f + \frac{1}{2}ks_f^2$

$v_i = 0$, $v_f = ?$ $y_i = 1.8m$, $y_f = 0$, $s_i = 0.15m$, $s_f = 0$

$\Rightarrow (0.6kg)(9.8m/s^2)(1.8m) + \frac{1}{2}(300N/m)(0.15m)^2 = \frac{1}{2}(0.6kg)v_f^2 \Rightarrow 10.584J + 3.375J = 0.3kg\,v_f^2$

$\Rightarrow v_f = \sqrt{\frac{13.959J}{0.3kg}} = 6.82129m/s = \underline{6.8m/s}$

(c.) A motor is used as shown to lift a crate with constant speed. Assuming the height, h, that the crate is lifted is fixed, what are two changes that could be made to this problem that would cause an increase in the power used by the motor. Explain your choices. If there is no way to change the power used by the motor, explain why that is the case. *(4pts)*



Both gravity AND Motor DO work $\Rightarrow \frac{1}{2}mv_i^2 + mgy_i + W_{motor} = \frac{1}{2}mv_f^2 + mgy_f$

$v_i = v_f$ since constant speed $\Rightarrow \frac{1}{2}mv_i^2 = \frac{1}{2}mv_f^2 \Rightarrow$ CANCEL

$y_i = 0$, $y_f = h$

$\Rightarrow 0 + W_{motor} = mgh$

Power: $P = \frac{W_{motor}}{\Delta t}$ To increase power, we could

① decrease the time or ② increase the work.

① Decrease the time by lifting the crate faster

② $W_{motor} = mgh$. Since we can't change h. We could increase the crate's mass.