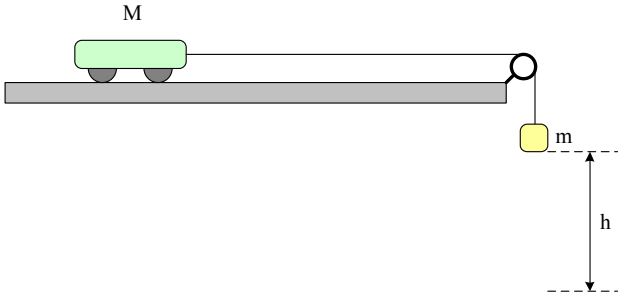
Work and Energy

Name:_____ TA:_____

Partners:_____

Course Number:_____ Section Number:_____ Date:_____

Atwood's Machine



Final velocity: $v_f = \frac{2h}{t}$. (Use $\overline{v} = \frac{v_f + v_i}{2}$, $v_i = 0$ and $\overline{v} = \frac{h}{t}$)

Kinetic energy: $\frac{1}{2}(M+m)v_f^2$.

Potential energy: mgh.

Work done by friction: $f_k = E_k - E_p$

1. Conservation of Energy

M (kg)	m (kg)	h (m)	t (s)	v_f (m/s) $\left[\frac{2h}{t}\right]$	E_k (J) $\left[\frac{1}{2}(M+m)v_f^2\right]$	E_p (J) $[mgh]$	f_h (J) $\left[E_k - E_p\right]$
cart only	0.02 kg						
cart only	0.05 kg						
cart only	0.10 kg						
cart + 1 bar	0.05 kg						
cart + 1 bar	0.10 kg						
cart + 2 bars	0.10 kg						

- Is the energy conserved? Discuss it with your results. If no, find the possible errors and try them again.

2. Work and Energy (Put the friction pad to the cart.)

M (kg)	m (kg)	h (m)	t (s)	v_f (m/s) $\left[\frac{2h}{t}\right]$	E_k (J) $\left[\frac{1}{2}(M+m)v_f^2\right]$	E_p (J) $[mgh]$	f_h (J) $\left[E_k - E_p\right]$
cart only	0.02 kg						
cart only	0.10 kg						
cart + 1 bar	0.10 kg						

- What factors does the work against friction, f_h, depend on?

Lab Procedure and Notes for Work and Energy

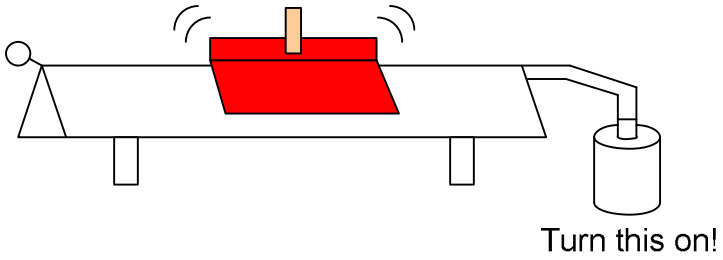
Important Tips:

1. For the first part, please make sure the hanging object is not wobbling before the release.
2. For the first part, please make the glider as close to the first gate as possible.
3. Use SI units, which are (m), (kg), and (s) through the experiment

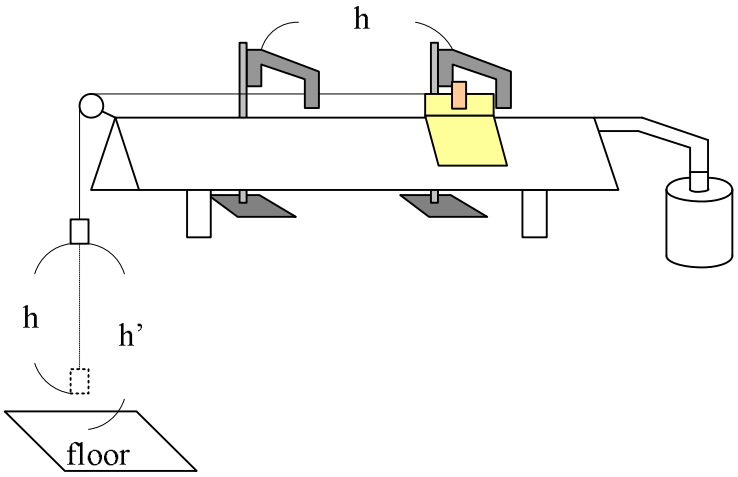
- **<u>Conservation of Energy</u>**

  1. **Level the (air) track before you start the experiment.**
     <u>For the dynamic cart,</u> put the cart on the precision track. If the cart stays still, the track is leveled. If the cart slides, level the track using papers.

     <u>For the air track,</u> put a glider on the track and turn the air on. When the glider does not go to either left or right sides, it is leveled. If it is not leveled, adjust it with papers by putting under the legs of the track, etc.

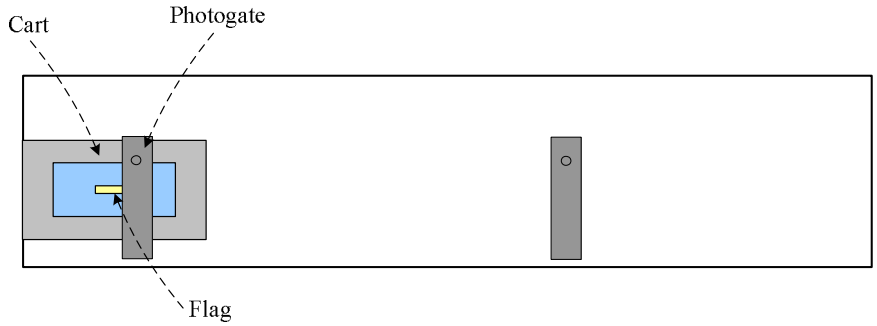


  2. **Measure the falling distance.**
     The falling distance corresponds to the distance between photo gates. You do not have to get $h = h'$ exactly; however, h' MUST be larger than h (where h' is the distance from the initial height of the hanging mass to floor.)

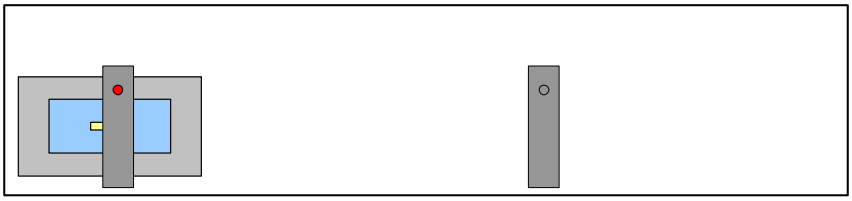


3. **Make the initial velocity zero.**
   This causes most significant errors in this experiment. The time interval is measured by two photo gates. No initial velocity means that the distance between the flag and the first photo gate must be zero. Follow the procedure.

   ① Set up two photo gates and a cart with a flag as follows. (Top view)



   ② Make the cart enter the first photo gate slowly until it flashes.



   ③ Pull it back a little bit, then hold the cart when the light is just turned off. Ask your partner to click start, and then release the cart.

4. **Measure the time between gates.**
   This is to obtain the final velocity of the glider. The average velocity is h/t. Assuming that the acceleration is constant, the final velocity is twice the average one; therefore, $v_{\text{final}} = 2v_{\text{average}} = 2h/t$.

- **Work and Energy**

For this part, put the friction pad to the cart to have a work done by friction. Other procedures are exactly the same as the first part.