PHYS101 Lab: The Work Energy Theorem

Purpose: The relationship between the work done by a force and the change in kinetic energy of an object will be analyzed.

Equipment Needed:

Computer	PASCO 850 Universal Interface
Right Angle Clamp	Blue Mass Set
Aluminum Track	Aluminum Dynamics Cart
Smart Pulley with rod, cable, photogate	Dynamics Cart Weights
Digital Scale	Long piece of black thread (120 cm)
Meter Stick or Tape Measure	No bounce pad

Section 1 Theory: The total amount of work done by a force on an object should be equal to the total change in kinetic energy that object experiences. In this experiment, a small mass hanger will be allowed to fall through some height. This can be used to calculate the net amount of work done on the object while it falls some height, h. If an object experiences only the gravitational force, then:

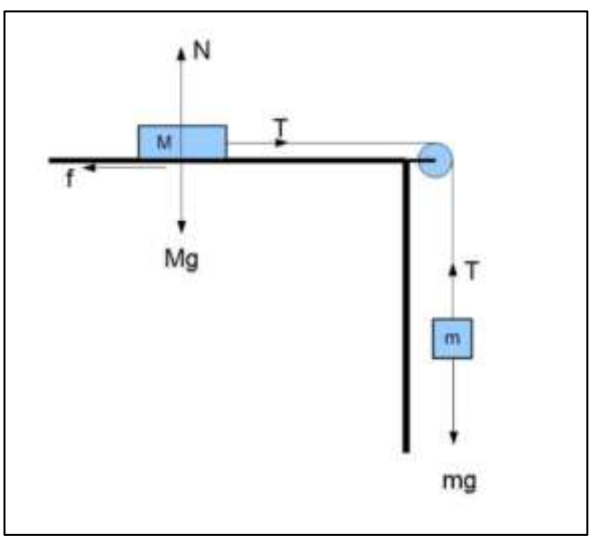
$$W = F_g h = mgh = KE_{theory}$$

If you have a sensor set up to measure the velocity of the system that is moving as a result of this force, then you can also find the kinetic energy of the system:

$$KE = \frac{1}{2}mv^2$$

We are interested in the change in the kinetic energy of the system because that should be equal to the work that the gravitational force does:

$$\Delta KE = KE_f - KE_i = KE_{experimental}$$



Section 2: Building the Apparatus

To start, set the aluminum track on your lab station, measure the mass of your cart, and put the aluminum dynamics cart on the track. You will need a piece of black thread about 120 cm long.

To Connect the Smart Pulley:

- Attach the right angle clamp to the end of the aluminum track, and assemble the smart pulley on the right angle clamp (see pictures on next page).

- If the track is not level place some books on one end. That should force it down to the table.

- Tie one end of the thread to the dynamics cart, run the string over the smart pulley, and tie the other end to a small mass hanger from the mass set.

- Use one of the cables to connect the smart pulley to data channel 1 on the black Pasco box. Make sure that the black Pasco box is plugged in and on (you should see a small green light on the front).

- Go to the PHYS101 Google Drive and go to the Lab 6 folder. There should be a program file called "Atwood and Friction.cap". Download this program and run it on your computer.

- Spin the little pulley. You should notice that a small red LED light on the back of the device blinks when you spin the pulley. If you spin the pulley slowly you should notice that the LED blinks slower.

- In the lower right-hand corner is a button that says "record". If you click on that button it will start the computer collecting data.

- If you spin the pulley, just to get some sample data, you should see data points appear on the graph. You should end up with a straight line for the majority of your data.

- On the ribbon there is a small cross hair button: click this to add a coordinate tool to your plot. This will allow you to figure out the velocity of the system at some point along its motion.

- Make sure to place a no bounce pad beneath your mass hanger.




Pictures of the apparatus. The photogate, threaded rod, and pulley unassembled (top). The assembled photogate unit (bottom left). The Assembled photogate unit on the right angle clamp with track (bottom right).

Taking Data: Taking Data

1. Raise the mass hanger, and keep track of how high you raise it above the no bounce pad. Have the hanger fall the same height for each run.
2. Place 100 grams of mass on the mass hanger.
3. Let the mass hanger fall and use the data to figure out how fast the cart was moving when the mass hanger hit the pad. Record your data in the table below. **Do not let the cart run into the pulley!**
4. Place one of the smaller large black cart mass on your cart. Make sure to keep track of the total mass of the cart. Continue doing this, so that you end up doing the experiment 4 times with 4 different masses of cart.
5. Record your data. The suggested data tables are given on the next page.

Questions:

1) What do you think is the cause of the % difference in the experiment?
2) Do you think the Work-Energy Theorem has been confirmed? Does your data support this?
3) What role do you think friction plays in this experiment? How does it affect the data? What are the sources of friction in the apparatus?

Calculate Work of Gravity

Run	Fall Dist. (m)	Hanger Mass (kg)	Work (J)
Run 1			
Run 2			
Run 3			
Run 4			

Calculate Change in Kinetic Energy

Run	V_0 (m/s)	$V_{f\ exp}$ (m/s)	KE_0 (J)	KE_f (J)
Run 1				
Run 2				
Run 3				
Run 4				

Calculate % Error

Run	$\Delta KE_{experiment}$ (J)	ΔKE_{theory} (J)	% error
Run 1			
Run 2			
Run 3			
Run 4			