

Potential and Kinetic Energy

By

Ilya Zarankin

1. Introduction

There are two kinds of energy that will be dealt with in this experiment: Kinetic and Potential Energies. Work is equal to the product of force multiplied by distance. Energy is “something” that enables an object to do work. A rubber band has energy stored in it – Potential energy. When stretched and released as in a sling shot, the Potential energy is converted to Kinetic energy. Energy therefore can be interchangeable.

2. Background

In the experiment we will explore the core concepts of kinetic and potential energy, and discover how they are, related to each other. One of the ways an object can store energy is by changing its position as in the case of Gravitational Potential Energy. If you take a pen and rise it in the air the pen will gain Potential Energy which means it will fall harder on the floor if released. In case you lower the pen it will possess less Potential Energy and it won't hit the floor as hard if released. Gravitational potential energy is equal to the work done against gravity in lifting an object.

*Work=Force * distance*

*Gravitational Potential Energy=weight * Height*

*Potential Energy =PE=m*g*h*

If object is already in motion it acquires another kind of energy called Kinetic Energy. Formula for Kinetic Energy is:

*KE=1/2 mass * speed²*

For example throwing a ball requires work to be done on the ball. This work is stored as Kinetic Energy. When the ball hits something it will transform Kinetic energy back in to work.

It is very important to understand that there is a direct relationship between work and Energy. Whenever work is done Energy changes, therefore we conclude that if there is no change in energy there is no work done. This is known as Work-Energy theorem:

Work= change in Energy = ΔE

One of the most basic and most important laws of physics is the law of conservation of energy:

Energy cannot be created or destroyed. It can be transformed from one form into another, but the total amount of energy never changes.

Observing this might be a little difficult but let's go back to the slingshot example. As you load it and pull back the string, the string stores Energy. When you release the string energy is transformed to the stone through work. When the stone hits the target the Kinetic energy is transferred to work. But when you measure the work done on the fence it won't match the kinetic energy of the stone and there might be quite a few reasons for that. Energy was dissipated into temperature, sound, air resistance etc... There are many of the things that come in to play and you must be aware of them.

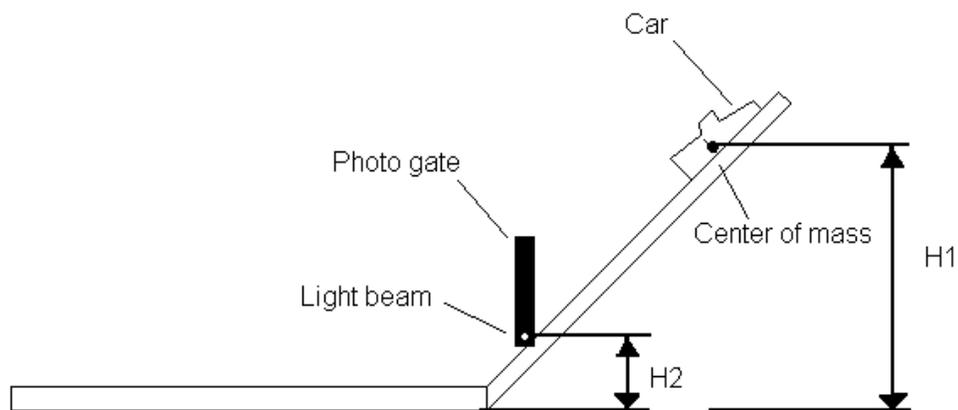
3. Equipment List

- PC computer
- Vernier Data Lab Pro
- LoggerPro software
- Vernier Photogate
- Two straight plastic sections of a HotWheels race track
- One HotWheels car
- Ruler

4. Experimental Procedure:

Part 1, acquiring data

1. Connect the two tracks together raise one side of it with a book or something similar.
2. Place photo gate in to the ring stand and place it as shown in the picture just before the connection between two pieces of the track. Very important place the photo gate just above the side of the track, so that the light beam will be covered along the full length of the car as it passes it.



3. Connect LabPro to your computer and also connect photo gate to the LabPro.

4. Open Logger pro file Energy.cml. This is where you will collect data. Also open an Excel file EnergyCalculation.xls. You will have to paste collected data to get the results.
5. Our objective is to calculate Potential and Kinetic Energies of the cars. To calculate the potential energy we need to know the height, mass and gravitational acceleration. There for we need to acquire these unknowns. We know gravitational acceleration is 9.81 m/s. Mass of the car should be acquired by weighting it on a scale. Enter the weight in grams in to appropriate field in the Excel sheet.
6. It is important to understand that the height H1 is measured not to any point on the object but rather to the center of masses of the object. Ask your lab instructor to help you find the center of mass. Now hold the car at the height from where you will release it, measure the distance from top of your desk to center of mass of the car. Enter the height in meters in the appropriate field in the Excel sheet. Also take a measurement of the height to the point where a car passes the photo gate H2. Enter this result in to Excel.
8. Now it's time to do the experiment. Hold the car at the predetermined height press the collect button. Let the car go. After the car passed the photo gat press the stop button. Copy the results that you collected in to Excel file. Check the results. Compare kinetic and potential energy, accuracy should be in the nineties or high eighties. If your accuracy is too low check if your height measurements are correct and repeat the experiment. If you still can not get acceptable accuracy ask instructor for the assistance. Save the results in to separate file.
9. Change the height from which you launch the car and the height of the photo gate and repeat the experiment.
10. Repeat the experiment with the same heights but a different slope of the incline.

5. Analysis/Questions:

1. Examine your results. Are they accurate? What are the possible reasons for their inaccuracy?
2. Is there a significant difference between 9 and 10? Why is that? Does the energy depend on the pass the object is taking?
3. Would you be able to predict the height to which the car would raise if it track would be raised at both ends?

References:

- [1] Paule G. Hewitt, Conceptual Physics. Prentice Hall, Upper Saddle River, NJ, (2002).
[2] K. Appel, J. Gastineau, C. Bakken, D. Vernier, Physics with Computers. Vernier Software & Technology, Beaverton, Oregon, 3rd Ed., (2003).