Objectives:

1. To understand work and its relation to energy.
2. To understand how energy can be transformed from one form into another.
3. To compute the power from the rate at which work is done.

Introduction:

Energy _____.

Doing work either transfers energy from one object to another or transforms it from one form to another. Power is a measure of how quickly work is done. Energy is always conserved.

Work _____.

The amount of work is calculated as: **Work = Forces * Distance**. It is measured in units of Joules. The Joule (metric unit of energy) is a measure of energy expended (or work done) in applying a force of 1 Newton through a distance of 1 meter (J = N * m).

Energy is the ability to do work. There are different types of energy including:

- Elastic Potential Energy is stored energy by virtue of an objects configuration.
- Energy that exists by virtue of an object's motion is called Kinetic Energy
- Gravitational Potential Energy is stored energy by virtue of an object's height.

_____

_____

_____

As different types of energy are used to do work they all eventually end up as thermal energy.

The Law of Conservation of Energy _____

_____

Power _____

It is calculated as: Power = (Work done)/time or Power = (Energy used)/time. The metric unit of Power is the Watt; it is defined as using one Joule of energy per second. (Watt = Joule/sec)

In the physical world, the possession of *energy* by an object means that it has an ability to do *work*. Word done is a measure of the "effect" the application of a force produces. If the applied force and the displacement of the objet are in the

same direction, then the work done is given by the equation: **Work (done) = Force * Distance** (W = F*D).

Mechanical energy has several forms. *Elastic Potential Energy* is the stored energy by virtue of an objects configuration. When you stretch a spring, you are doing work on the spring and in turn the spring stores that work in the form of elastic potential energy. *Gravitational Potential Energy* is stored energy by virtue of an object's height (position). When gravitational force is the only force acting on an object, the gravitational potential energy is calculated from: **Gravitational Potential Energy = Weight Force * Height (position)**

Energy that exists by virtue of an object's motion is called the *Kinetic Energy*. The *Law of Conservation of Energy* is a universal principle which states the total energy of a system always remains constant. In other words, energy cannot be created nor destroyed but it can be converted from one form to another.

<u>When work is done on an object, any of the following things can happen:</u>

- The object may, in turn, do work on another object,
- The object's speed may increase (gain kinetic energy),
- The object's temperature may rise (gain thermal energy),
- The object may store the energy for later use (gain potential energy),
- The object may rise in the earth's gravitational field (gain gravitational potential energy).

In many situations not only is the amount of work done important. It is also important to know how slowly or quickly the work is done. The rate at which work is done or energy is transformed is called *Power*. Power is calculated by: **Power = (Work done)/time or Power = (Energy used)/time.**

Procedure:

In the first part of this lab you will learn how the work done on an object is stored as potential energy of that object. In the second part you will figure out the work done during various activities and compute the power expended.

Part I

1. Energy stored in a balloon. <u>Blow up a balloon and then release it.</u>

   a. Do you do work when you blow up a balloon? Explain your answer in terms of energy.

   b. In what form is energy stored in a blown up balloon?

   c. How can you get the stored energy out of the balloon?

d. When you release the stored energy from the balloon where does it go? (Hint: other forms of energy should be included in your answer.)

2. Energy stored in a ball. From the ground, raise the ball to a height of about 1 meter and then release it.

   a. Do you do work when you raise the ball to a height of 1 meter? Explain you answer in terms of energy.

   b. In what form is the energy stored at a height of 1 meter?

   c. What happens to the stored energy as the ball falls to the ground? Explain your answer. (Hint: other forms of energy should be included in your answer.)

Part II

TO RECEIVE FULL CREDIT YOU MUST SHOW ALL WORK FOR ALL CALCULATIONS; INCLUDE EQUATIONS, NUMBERS AND UNITS

A **Newton** is the metric unit of force. A force of 1 N on a mass of 1 kg creates acceleration (a change in motion) of 1 m/sec^2.

Convert your weight in pounds into your weight in Newtons using *dimensional analysis* and the following conversion factor: 1 lb. = 4.45 Newons.

Your weight force (Newtons) = _____

Height of one step (meters) = _____

Number of Steps climbed = _____

Total distance climbed (meters) = _____

Work done in climbing steps (Joules) = _____

Time taken while climbing slowly (seconds) =

_____

Time taken while climbing quickly (seconds) =

_____

Power output for slow climb (Watts) =

_____

Power output for fast climb (Watts) =

_____

1. Define the term **Energy**? List several different types of energy.

2. What is the Law of Conservation of Energy?

3. Define the term **Work**? Use an equation in your definition.

4. What is **Power**? Use an equation in your definition.

5. When you drop the ball from a certain height, does it return to the same height after bouncing from the floor?

    a. Does this violate the Law of Conservation of Energy? Explain.

6. In Part II, is the work done greater, or smaller or the same when you climb fast vs. slow? Explain.

7. In Part II, is the power output greater, smaller or the same when you climb fast vs. slow? Explain.

8. Given that 4200 Joules = 1 Food Calorie, calculate the number of Calories used by you in climbing the stairs.