Conservation of Energy

TOPICS AND FILES

Mechanics Topics

GPE, KE, conservation of energy

Transform energy, conservation of energy

Capstone Files

25 Discover Energy.cap

31 Pendulum Energy.cap

EQUIPMENT LIST

Qty	Items	Part Numbers
1	PASCO Interface (for one sensor)	
1	Motion Sensor	CI-6742
1	Large Rod Base	ME-8735
2	Rod, 45 cm	ME-8736
1	Double Rod Clamp	ME-9873
1	Large Rubber Ball	
1	Rotary Motion sensor	CI-6538
1	Rotation Accessory with pendulum arm and 1 bob	CI-6691
1	Balance	SE-8723
1	Meter Stick	SE-8695
1	Protractor	

INTRODUCTION

This lab has two parts.

The purpose of Experiment 1 is to investigate the relationship between kinetic energy and gravitational potential energy for a falling object.

Use the motion sensor to measure the motion of a ball as it falls away from the sensor. Use *Capstone* to record and display the motion. Compare the calculated values of kinetic energy and gravitational potential energy. Also compare the sum of these two near the beginning of the fall to the sum near the end of the fall.

The purpose of Experiment 2 is to investigate the transformations of energy that happen during the motion of a simple pendulum, and to study the conservation of mechanical energy.

Use the rotary motion sensor to measure the motion of a simple physical pendulum. Use *Capstone* to record and display the motion and to display the calculations of period, kinetic energy, potential energy, and total energy of the pendulum. Compare the total energy at the beginning to the total energy at the end.

BACKGROUND

Kinetic energy is the energy of motion. Gravitational potential energy (GPE) is the energy of an object due to its vertical position relative to a reference point (such as the surface of the Earth).

When an object is lifted a certain vertical distance, it gains gravitational potential energy. How much it has depends on its weight (mg) and the vertical distance. As the object falls, the gravitational potential decreases:

$$\text{GPE} = mgh \tag{1}$$

where m is the mass, g is the acceleration due to gravity, and h is the height.

When an object moves, it has kinetic energy. The amount it has depends on how much mass it has and how fast it moves. As the object falls, the kinetic energy increases because the speed increases:

$$\text{KE} = \tfrac{1}{2}mv^2 \tag{2}$$

where m is the mass and v is the speed.

When a pendulum swings, kinetic energy is transformed into potential energy and vice versa as the speed and the elevation of the pendulum vary during the motion. As shown in the diagram, when the pendulum is moving with speed, v, making an angle θ with the vertical, the kinetic energy, K, and the potential energy, U, are as follows:

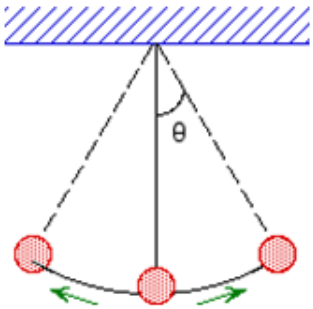

Figure 1

$$K = \frac{1}{2}mv^2, \qquad U = mgh = mg(L - L\cos\theta) \tag{3}$$

where m is the mass of the pendulum bob, L is the length, and g is the acceleration due to gravity.

