Kinetic energy is the energy associated with the state of motion of an object. Potential energy is energy associated with the configuration of a system of objects that exert forces on one another. A typical example of potential energy is the gravitational potential energy defined as the energy associated with the state of separation between objects which are attracted to one another by a gravitational force. The work done by a gravitational force depends only on the initial and final positions of an object, meaning the work done is independent of the path taken between these points. Any force displaying these features qualifies it as a conservative force. In review, kinetic energy $K$ is defined as

$$K = \frac{1}{2}mv^2,$$

the gravitational potential energy of an object is

$$U(y) = mgy,$$

and the relationship between the gravitational potential energy and the work done on an object in changing its relative configuration by a gravitational force is

$$mg(y - y_i) = -W;$$

$$\Delta U = -W.$$  

Here the work done by the gravitational force $mg$, equals the force multiplied by the displacement in the $y$ direction. In the loop to loop demonstration we can determine the quantity of work by the gravitational force in accelerating the ball from the top of the track to the end of the track if we know the mass of the ball and the height from which it is dropped.

The principle of conservation of mechanical energy states that in an isolated system for which only conservative forces cause changes in energy, the kinetic and potential energy can change but their sum cannot change:

$$\Delta E = \Delta K + \Delta U = 0.$$

From this result we can determine the minimum height of the ball such that when it is released it remains on the track yet it is on the verge of fall off the track to be,

$$y = \frac{v^2}{2g}.$$
DESCRIPTION  The loop-the-loop apparatus is a single loop track mounted on a slab of wood. Accessories include several steel balls, a photogate and timer. The timer can be used to measure the final velocity of the ball.

PROCEDURE  1. Calculate the minimum height the ball should be released so that it remains on the track and completes a single loop.
  2. Release the ball from this calculated height.

SUGGESTIONS