DEVICE   Loop the Loop

TOPIC   Conservation of Energy

THEORETICAL   Kinetic energy is the energy associated with the state of motion of
BACKGROUND   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

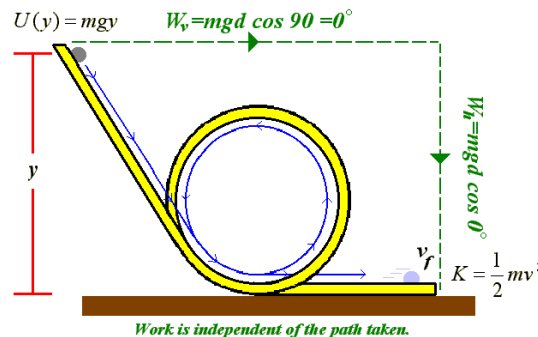$$mg(y - y_0) = -W;$$
$$\Delta U = -W$$

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,

$$y = \frac{v^2}{2g}.$$

$U(y) = mgy$ $W_v = mgd \cos 90 = 0°$

y

$W_h = mgd \cos 0°$

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

Work is independent of the path taken.

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