

EXPERIMENT #7 - PHYSICS230

Ballistic Pendulum

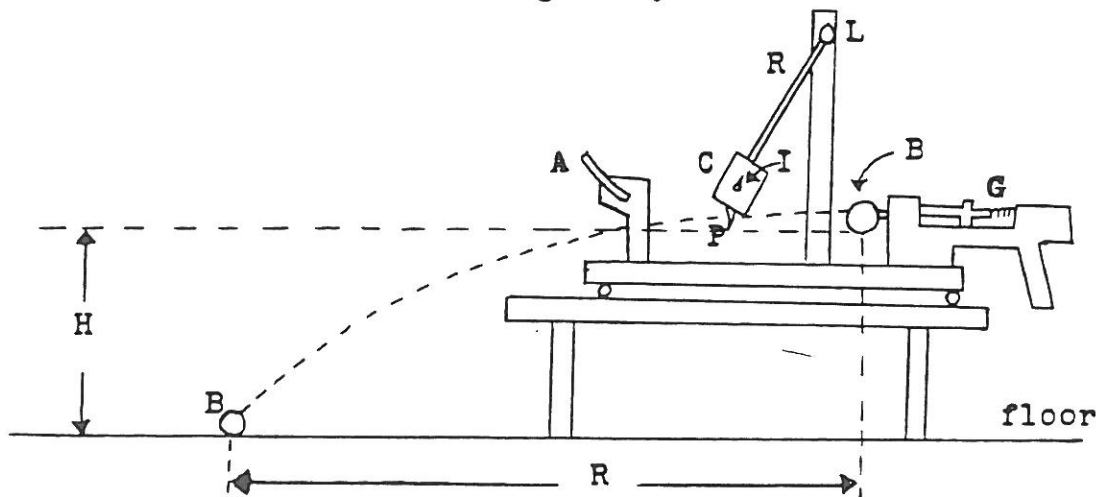
OBJECT: To study conservation of momentum and energy by using a ballistic pendulum.

EQUIPMENT: Blackwood ballistic pendulum
Carbon paper, meter stick, clamps

THEORY: Refer to chapters 7, 8, and 9 of Resnick and Halliday

GENERAL DIRECTIONS:

1. Carefully examine the apparatus and determine its principle of operation. A diagram of the pendulum is shown below. By using the spring gun G a projectile B is shot into a cylindrical bob C which is connected to the end of a rod R. The rod R after impact will swing upward so that the center of mass of the cylinder, rod and projectile (indicator I) will experience a change in height h . A pawl P will engage a tooth in the curved rack A when the cylinder and projectile reach their highest point. By considering the conservation of momentum when the projectile makes an inelastic impact with the cylinder, and by considering the kinetic and potential energy after the impact, one may calculate the initial speed of the projectile in terms of the projectile's mass, the pendulum's mass, the height change of the center of mass, and the acceleration due to gravity.



2. By using a level adjust the base of the pendulum until it is horizontal and then clamp it to the table. Place the cylinder C temporarily on rack A. Place the projectile B on the end of the spring gun's rod and carefully cock the gun by using one hand to hold the apparatus and the other hand to push on the projectile in order to compress the spring. Release the cylinder from the rack and let it hang freely. When the cylinder is at rest, fire the projectile into the cylinder. With the cylinder and ball at rest on the rack measure the height of the center of the mass

(indicator I) of the pendulum and projectile. Let the pendulum hang freely and measure the original height of the center of mass. From this one may find the height change.

3. Carefully depress the spring inside the cylinder and push the projectile out of the cylinder. Place the empty cylinder on the rack temporarily and repeat the procedure outlined in part 2. This part should be repeated several times in order to find the best or average value for the height change.
4. The mass of the projectile and the pendulum should be measured on a scale. The pendulum may be detached at its pivot L.
5. Using the conservation of momentum and energy, find the initial velocity of the projectile before impact.
6. Place the empty cylinder on rack A, load the spring gun, and shoot the projectile so that it falls a distance H and travels a horizontal distance R before hitting the floor. Carbon paper may be helpful in finding the range R. Measure the distance R and H as indicated in the previous diagram. Do this several times in order to find the best or average value of R.
7. Using the best data for R and H calculate the initial velocity of the spring gun using the equations of motion for a constant acceleration. Compare this value of initial velocity with the value computed in part 5 and find the per cent error. Explain why there may be an error.