Physics 100 Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Momentum and Impulse

Nerf Darts and Ballistic Pendulums

1. Impulse = change in momentum. Use this concept to explain why darts shoot faster from a compressed air cannon with a longer barrel.

2. Consider a Nerf dart with a mass of 0.0013kg. When the dart is shot from a 2m long barrel, its muzzle velocity (velocity as it leaves the barrel) is 120m/s.

a. What is the dart’s momentum when it leaves the barrel?

b. What is the dart’s Δp as it travels down the barrel?

c. What is the dart’s average velocity as it travels down the barrel?

d. How long does it take the dart to travel down the barrel?

e. What is the “impulse” that acts on the dart as it travels down the barrel?

f. What is the impulse time?

g. What average force propels the dart down the barrel?

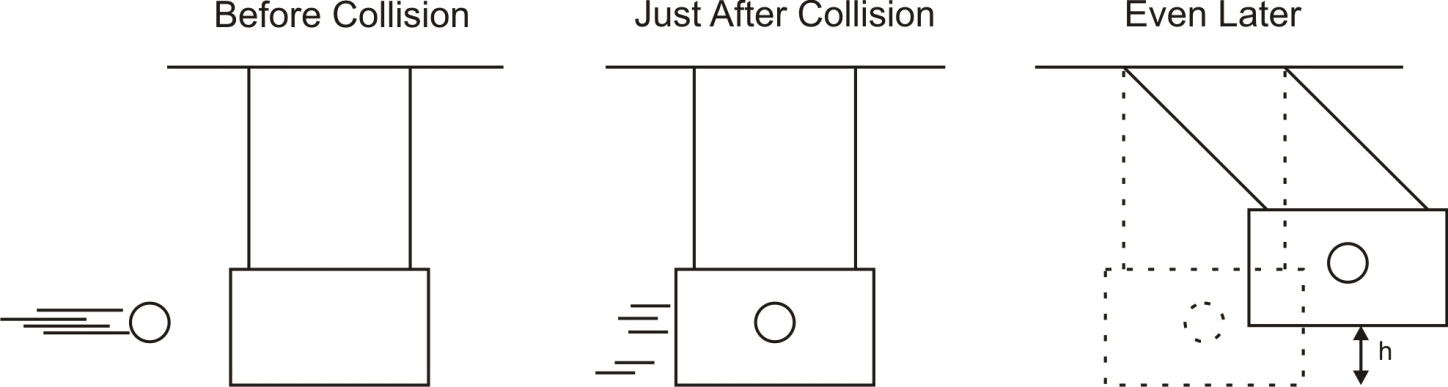
3. Consider a Nerf dart with a mass of 0.001kg. When the dart is shot from a 2m long barrel, its muzzle velocity (velocity as it leaves the barrel) is 150m/s. What average force propels it down the barrel?

4. What was the mass of your fastest Nerf dart (approximate if you must)? \_\_\_\_\_\_\_ What was its muzzle

velocity? \_\_\_\_\_\_\_\_ What was the barrel length, in meters? \_\_\_\_\_\_\_\_ What average force propelled

your dart? \_\_\_\_\_\_\_\_

**Measuring Velocity with a Ballistic Pendulum:**



KE =

v(in term of KE) =

PEgravitational =

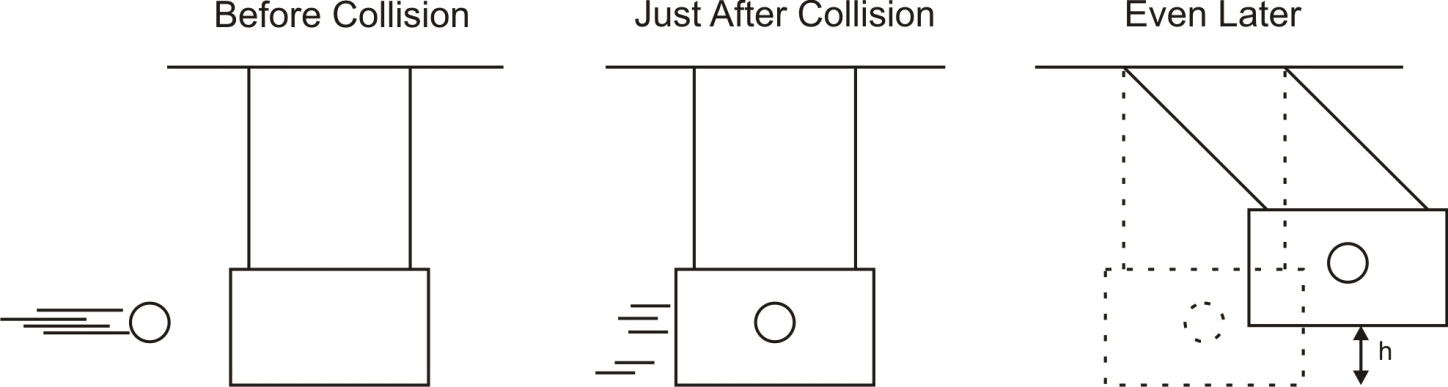
Elastic Collision:

Inelastic Collision:

A ballistic pendulum provides an example of an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ collision.

When the projectile collides with the pendulum, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is not conserved but

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is conserved.



Calculate these projectiles’ initial velocities:

1. Projectile mass = 4kg. Pendulum (target) mass = 0.5kg. Swing height = 6m.

2. Projectile mass = 0.5kg. Pendulum (target) mass = 0.02kg. Swing height = 4m.

3. Projectile mass = \_\_\_\_\_\_ Pendulum (target) mass = \_\_\_\_\_\_ Swing height = \_\_\_\_\_\_\_