

**Physics 03-08 Elastic and Inelastic Collisions**

Name: \_\_\_\_\_

\_\_\_\_\_ - \_\_\_\_\_ energy often \_\_\_\_\_  
\_\_\_\_\_ - \_\_\_\_\_ energy usually not \_\_\_\_\_

- Converted into \_\_\_\_\_
- Converted into \_\_\_\_\_ or \_\_\_\_\_

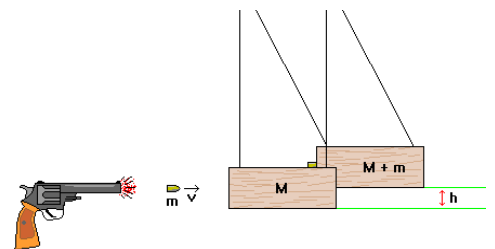
Elastic - \_\_\_\_\_ energy \_\_\_\_\_

Inelastic - \_\_\_\_\_ energy \_\_\_\_\_

Completely inelastic - the objects \_\_\_\_\_ together

You are playing marbles. Your 0.10 kg shooter traveling at 1 m/s hits a stationary 0.05 kg cat's eye marble. If it is an elastic collision what are the velocities after the collision?

A ballistic pendulum can be used to determine the muzzle velocity of a gun. A .01 kg bullet is fired into a 3 kg block of wood. The block is attached with a thin .5m wire and swings to an angle of 40°. How fast was the bullet traveling when it left the gun?



Homework

- In an elastic collision, is the kinetic energy of *each* object the same before and after the collision? Explain.
- What is an elastic collision?
- What is an inelastic collision? What is a perfectly inelastic collision?
- Mixed-pair ice skaters performing in a show are standing motionless at arms length just before starting a routine. They reach out, clasp hands, and pull themselves together by only using their arms. Assuming there is no friction between the blades of their skates and the ice, what is their velocity after their bodies meet?
- In a football game, a receiver is standing still, having just caught a pass. Before he can move, a tackler, running at a velocity of +4.5 m/s, grabs him. The tackler holds onto the receiver, and the two move off together with a velocity of +2.6 m/s. The mass of the tackler is 115 kg. Assuming that momentum is conserved, find the mass of the receiver. (Cutnell 7.25) **84 kg**
- A 2.50-g bullet, traveling at a speed of 425 m/s, strikes the wooden block of a ballistic pendulum, such as that in the picture. The block has a mass of 215 g. (a) Find the speed of the bullet/block combination immediately after the collision. (b) How high does the combination rise above its initial position? (Cutnell 7.28) **4.89 m/s, 1.22 m**
- A 1055-kg van, stopped at a traffic light, is hit directly in the rear by a 715-kg car traveling with a velocity of +2.25 m/s. Assume that the transmission of the van is in neutral, the brakes are not being applied, and the collision is elastic. What is the final velocity of (a) the car and (b) the van? (Cutnell 7.26) **-0.432 m/s, 1.82 m/s**
- A cue ball (mass = 0.165 kg) is at rest on a frictionless pool table. The ball is hit dead center by a pool stick, which applies an impulse of +1.50 Ns to the ball. The ball then slides along the table and makes an elastic head-on collision with a second ball of equal mass that is initially at rest. Find the velocity of the second ball just after it is struck. (Cutnell 7.29) **9.09 m/s**
- A 5.00-kg ball, moving to the right at a velocity of +2.00 m/s on a frictionless table, collides head-on with a stationary 7.50-kg ball. Find the final velocities of the balls if the collision is (a) elastic and (b) completely inelastic. (Cutnell 7.31) **-0.4 m/s, 1.6 m/s; 0.8 m/s**
- A mine car, whose mass is 440 kg, rolls at a speed of 0.50 m/s on a horizontal track, as the drawing shows. A 150-kg chunk of coal has a speed of 0.80 m/s when it leaves the chute. Determine the velocity of the car/coal system after the coal has come to rest in the car. (Cutnell 7.34) **0.56 m/s**
- A 30,000-kg freight car is coasting at 0.850 m/s with negligible friction under a hopper that dumps 110,000 kg of scrap metal into it. (a) What is the final velocity of the loaded freight car? (b) How much kinetic energy is lost? (OpenStax 8.36) **0.182 m/s,  $8.52 \times 10^3$  J**
- During an ice show, a 60.0-kg skater leaps into the air and is caught by an initially stationary 75.0-kg skater. (a) What is their final velocity assuming negligible friction and that the 60.0-kg skater's original horizontal velocity is 4.00 m/s? (b) How much kinetic energy is lost? (OpenStax 8.32) **1.78 m/s, -267 J**
- An automobile has a mass of 2100 kg and a velocity of +17 m/s. It makes a rear-end collision with a stationary car whose mass is 1900 kg. The cars lock bumpers and skid off together with the wheels locked. (a) What is the velocity of the two cars just after the collision? (b) Find the impulse (magnitude and direction) that acts on the skidding cars from just after the collision until they come to a halt. (c) Review: If the coefficient of kinetic friction between the wheels of the cars and the pavement is  $\mu_k = 0.68$ , determine how far the cars skid before coming to rest. (Cutnell 7.33) **8.9 m/s,  $-3.6 \times 10^4$  Ns, 5.9 m**

