Name:

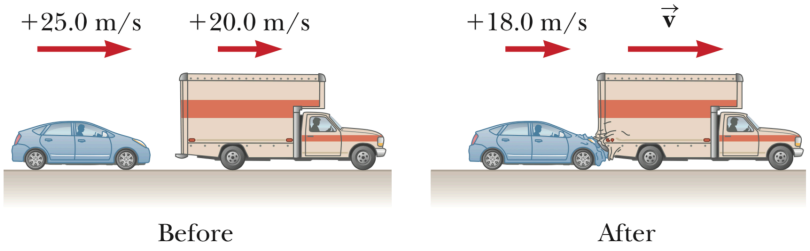
Physics 12
M. Lam

Elastic and Inelastic Collisions

Block:

1. 1. A railroad car of mass 2.00×10^4 kg moving at 3.00 m/s collides and couples with two coupled railroad cars, each of the same mass as the single car and moving in the same direction at 1.20 m/s.
   a) What is the speed of the three coupled cars after the collision?
   b) How much kinetic energy is lost in the collision?

2. A 1200 kg car traveling initially with a speed of 25.0 m/s in an easterly direction crashes into the rear end of a 9000 kg truck moving in the same direction at 20.0 m/s. The velocity of the car right after the collision is 18.0 m/s to the east.



   a) What is the velocity of the truck right after the collision?
   b) How much mechanical energy is lost in the collision?

3. A 90.0 kg fullback running east with a speed of 5.00 m/s is tackled by a 95.0 kg opponent running north with a speed of 3.00 m/s.
   a) Why does the tackle constitute a perfectly inelastic collision?
   b) Calculate the velocity of the players immediately after the tackle.
   c) Determine the mechanical energy that is lost as a result of the collision.

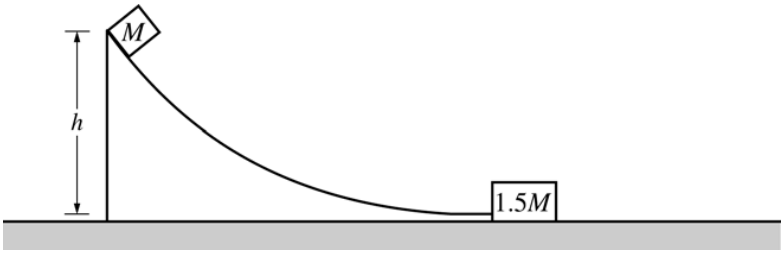
4. A billiard ball moving at 5.00 m/s strikes a stationary ball of the same mass. After the collision, the first ball moves at 4.33 m/s at an angle of 30° with respect to the original line of motion.
   a) Find the velocity (magnitude and direction) of the second ball after collision.
   b) Was the collision inelastic or elastic? Justify your answer.

5. A 0.030 kg bullet is fired vertically at 200 m/s into a 0.15 kg baseball that is initially at rest. How high does the combined bullet and baseball rise after the collision, assuming the bullet embeds itself in the ball?

6. In a Broadway performance, an 80.0 kg actor swings from a 3.75 m long cable that is horizontal when he starts. At the bottom of his arc, he picks up his 55.0 kg costar in an inelastic collision. What maximum height do they reach after their upward swing?

7. Two blocks of masses $m_1 = 2.00$ kg and $m_2 = 4.00$ kg are each released from rest at a height of $h = 5.00$ m on a frictionless track and undergo a totally inelastic head-on collision.Determine the maximum height to which m_1 and m_2 rise after the collision.

8. A small block of mass M is released from rest at the top of the curved frictionless ramp shown below. The block slides down the ramp and is moving with a speed $3.5v_0$ when it collides with a larger block of mass $1.5M$ at rest at the bottom of the incline. The larger block moves to the right at a speed $2v_0$ immediately after the collision. Express your answers to the following questions in terms of the given quantities and fundamental constants.



   a) Determine the height h of the ramp from which the small block was released.
   b) Determine the speed of the small block after the collision.
   c) The larger block slides a distance D before coming to rest. Determine the value of the coefficient of kinetic friction μ between the larger block and the surface on which it slides.
   d) Indicate whether the collision between the two blocks is elastic or inelastic. Justify your answer.

9. A 25.0 g object moving to the right at 20.0 cm/s overtakes and collides elastically with a 10.0 g object moving in the same direction at 15.0 cm/s. Find the velocity of each object after the collision.

10. A tennis ball of mass 57.0 g is held just above a basketball of mass 590 g. With their centers vertically aligned, both balls are released from rest at the same time, to fall through a distance of 1.20 m.
   a) Find the magnitude of the downward velocity with which the basketball reaches the ground.
   b) Assume that an elastic collision with the ground instantaneously reverses the velocity of the basketball while the tennis ball is still moving down. Next, the two balls meet in an elastic collision. To what height does the tennis ball rebound?