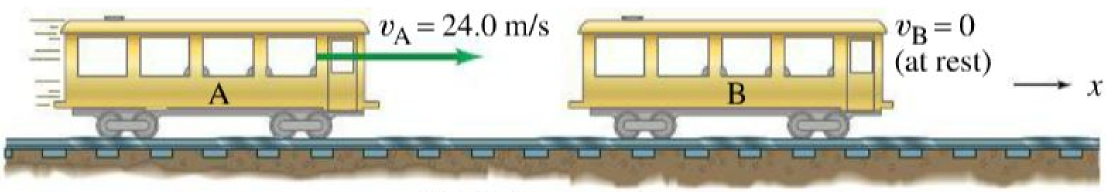
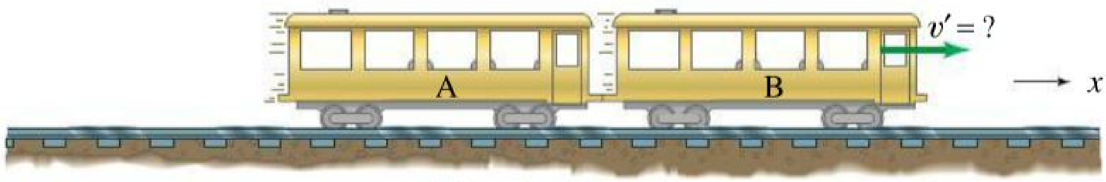
PHYSICS 121 WORKSHEET 11 10/18/2017

NAME: SECTION:

1. ***Conservation of Momentum:*** A 10,000kg railroad car, A, traveling at a speed of 24.0m/s strikes an identical car, B, at rest. If the cars lock together as a result of the collision, what is their common speed just afterward?



(a) Before collision



(b) After collision

2. ***Inelastic Collisions:*** In an inelastic collision, kinetic energy is not conserved even though momentum is. One such example is when two bodies stick together after a collision such as in **1.** above. This is known as a perfectly inelastic collision. If a perfectly inelastic collision occurs between a body of mass m_A moving at speed v_A and a body of mass m_B initially at rest, find their common speed V after the collision in terms of v_A, m_A, and m_B.

3. ***Impulse:*** Estimate the impulse and average force delivered by a punch if the hand is moving at 10m/s, comes to a stop over a distance of 1cm, and has an effective mass of 1kg. *Hint:* use the average speed in your calculation of the average force.

4. Read the following and solve for the final height h in terms of the initial velocity v and mass m of the bullet, the mass M of the block, and g.

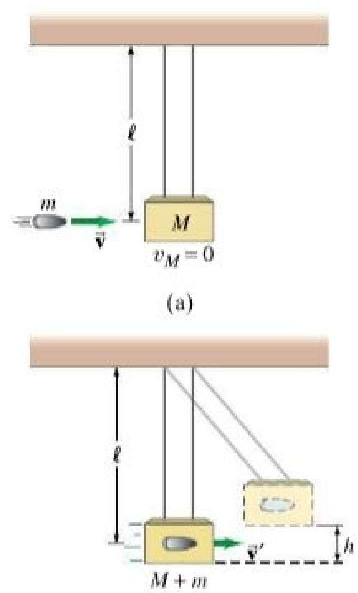
EXAMPLE 7–9 **Ballistic pendulum.** The *ballistic pendulum* is a device used to measure the speed of a projectile, such as a bullet. The projectile, of mass m, is fired into a large block (of wood or other material) of mass M, which is suspended like a pendulum. (Usually, M is somewhat greater than m.) As a result of the collision, the pendulum and projectile together swing up to a maximum height h, Fig. 7–16. Determine the relationship between the initial horizontal speed of the projectile, v, and the maximum height h.

PHYSICS APPLIED
Ballistic pendulum

APPROACH We can analyze the process by dividing it into two parts or two time intervals: (1) the time interval from just before to just after the collision itself, and (2) the subsequent time interval in which the pendulum moves from the vertical hanging position to the maximum height h.

In part (1), Fig. 7–16a, we assume the collision time is very short, so that the projectile is embedded in the block before the block has moved significantly from its rest position directly below its support. Thus there is effectively no net external force, and we can apply conservation of momentum to this completely inelastic collision.

In part (2), Fig. 7–16b, the pendulum begins to move, subject to a net external force (gravity, tending to pull it back to the vertical position); so for part (2), we cannot use conservation of momentum. But we can use conservation of mechanical energy because gravity is a conservative force (Chapter 6). The kinetic energy immediately after the collision is changed entirely to gravitational potential energy when the pendulum reaches its maximum height, h.



SOLUTION In part (1) momentum is conserved:

$$\text{total } p \text{ before} = \text{total } p \text{ after}$$