

ANSWERS TO EVEN-NUMBERED CONCEPTUAL QUESTIONS

2. The glass, concrete, and steel were part of a rigid structure that shattered upon impact of the airplanes with the towers and upon collapse of the buildings as the steel support structures weakened due to high temperatures of the burning fuel. The sheets of paper floating down were probably not in the vicinity of the direct impact, where they would have burned after being exposed to very high temperatures. The papers were most likely situated on desktops or open file cabinets and were blown out of the buildings as they collapsed.
4. No. Only in a precise head-on collision with equal and opposite momentum can both objects end up at rest. Yes. In the second case, assuming equal masses for the two objects, if object 2, originally at rest, is struck head-on by object 1, object 2 will depart with the original velocity of object 1. Then object 1 is left at rest.
6. Since the total momentum of the skater-Frisbee system is conserved, the momentum transferred to the skater equals the magnitude of the change in the Frisbee's momentum. This is greatest when the skater throws the Frisbee back after catching it.
8. A certain impulse is required to stop the egg. But, if the time during which the momentum change of the egg occurs is increased, the resulting force on the egg is reduced. The time is increased when the sheet billows out as the egg is brought to a stop. The force is reduced low enough so that the egg will not break.
10. The resulting collision is intermediate between an elastic and a completely inelastic collision. Some energy of motion is transformed as the pieces buckle, crumple, and heat up during the collision. Also, a small amount is lost as sound. The most kinetic energy is lost in a head-on collision, so the expectation of damage to the passengers is greatest.
12. The passenger must undergo a certain momentum change in the collision. This means that a certain impulse must be exerted on the passenger by the steering wheel, the window, an air bag, or something. By increasing the time during which this momentum change occurs, the resulting force on the passenger can be decreased.
14. Its speed decreases as its mass increases. There are no external horizontal forces acting on the box, so its momentum cannot change as it moves along the horizontal surface. As the box slowly fills with water, its mass increases with time. Because the product mv must be constant, and because m is increasing, the speed of the box must decrease.