8: Momentum Midterm Review

Name: Key

Multiple Choice: Choose the best answer for each question and place the answer on the answer sheet provided. Each question is worth one point.

1. A small car collides with a large truck in a head-on collision. Which of the following concerning the magnitude of the average collision force is true?
   a) The truck experiences the greater average force
   b) The car experiences the greater average force
   c) The average forces are equal
   d) Cannot determine from the information given

Third Law

2. Which of the following is an accurate statement?
   a) The momentum of a projectile is constant
   b) The momentum of a moving object is constant
   c) If an object is acted on by a net external force, its momentum will change
   d) If the kinetic energy of an object doubles, its momentum will double

$F\Delta t = \Delta p$

3. When a cannon fires a cannon ball, the cannon will recoil backward because
   a) The energy of the cannon ball is conserved
   b) The momentum of the cannon and cannon ball is conserved
   c) The energy of the cannon is greater than the energy of the cannon ball
   d) The momentum of the cannon is greater than the momentum of the cannon ball

4. A ping-pong ball moving East at a speed of 4.0 m/s, collides with a stationary bowling ball. The ping-pong ball bounces back to the West, and the bowling ball moves very slowly to the East. Which object experiences the greater magnitude impulse during the collision.
   a) Neither: both experienced the same magnitude impulse
   b) The ping-pong ball
   c) The bowling ball
   d) It's impossible to tell since the velocities after the collision are unknown

Third Law

5. In an elastic collision, if the momentum is conserved, then which of the following statements is true about kinetic energy.
   a) Kinetic energy is also conserved
   b) Kinetic energy is gained
   c) Kinetic energy is lost
   d) None of the above

6. A rubber ball and a lump of putty have equal mass. They were thrown with equal speed against the wall. The ball bounces back with nearly the same speed with which it is hit. The putty sticks to the wall. Which object experiences the greater change in momentum.
   a) The ball
   b) The putty
   c) Both are equal
   d) Cannot be determined from the information given

A 2.0 kg block initially hangs at rest at the end of two 1-meter strings as shown below. A 0.003 kg bullet, moving horizontally with a speed of 1000 meters per second, strikes the block and becomes embedded in it. After the collision, the bullet/block combination swings upward, but does not rotate.

a. Determine the following for the 0.003 kg bullet immediately before the impact.
   i. Its linear momentum
   ii. Its kinetic energy

$p = mv = 0.003(1000) = 3 \text{ kg m/s}$

$K = \frac{1}{2}mv^2 = \frac{1}{2}(0.003)(1000)^2 = 1500 \text{ J}$

b. Determine the following for the combined masses immediately after the impact.
   ii. The velocity
   iii. The kinetic energy

$P_i = P_f$

$3 \text{ kg m/s} = 2.003\, v_f \quad \Rightarrow v_f = 1.5 \text{ m/s}$

$K = \frac{1}{2}m v_f^2 = \frac{1}{2}(2.003)(1.5)^2$

$\boxed{K = 2.25 \text{ J}}$

c. Determine the maximum height of the block/bullet combination.

$K_A = U_{gB}$

$2.25 = mgh_B$

$h_B = \frac{2.25}{mg} = \frac{2.25}{2.003(9.8)} = 0.11 \text{ m}$

$\boxed{h_B = 11 \text{ cm}}$