Part I

1. Two teams are having a tug-of-war match. Which of the following can be considered an isolated system?

   (a) one team

   (b) both teams

   (c) both teams and the rope

   (d) none of the above systems

2. Two objects with mass m_1 and m_2 approach each other from opposite directions and collide head-on elastically. Object 1 leaves with a final speed greater than its initial speed. How do m_1 and m_2 compare?

   (a) $m_1 > m_2$ (b) $m_1 = m_2$ (c) $m_1 < m_2$ (d) not enough information

3. A basketball dropped (from rest) from a height of 1 meter strikes the earth and returns to a height of 1 meter. The collision between the basketball and the earth is:

   (a) elastic (b) inelastic (c) totally inelastic (d) not enough information.

4. A toy truck with low-friction bearings is rolling on a flat, horizontal surface when a pebble is gently dropped into its bed such that the pebbles horizontal velocity before landing in the truck is zero. Compared to the momentum of the truck before the pebble lands in the bed, the momentum of the truck and pebble after the pebble lands in the truck is

   (a) greater. (b) less. (c) the same.

5. A toy truck with low-friction bearings is rolling on a flat, horizontal surface when a pebble is gently dropped into its bed such that the pebbles horizontal velocity before landing in the truck is zero. Compared to the kinetic energy of the truck before the pebble lands in the bed, the kinetic energy of the pebble and truck afterwards is

   (a) greater. (b) less. (c) the same.

6. An explosion splits an object initially at rest into two pieces of unequal mass. Which piece moves at greater speed?

   (a) The more massive piece.

   (b) They both move at the same speed.

   (c) The less massive piece.

   (d) It depends on the nature of the explosion

7. An explosion splits an object initially at rest into two pieces of unequal mass. Which piece has greater kinetic energy?

   (a) The more massive piece.

   (b) The less massive piece.

   (c) They both have the same kinetic energy.

   (d) It depends on the nature of the explosion.

Part II

1. A 30 cm spring with spring constant 70 N/m is compressed to 10 cm and placed between two carts. Cart A has mass $m_A = 5$ kg and the mass of cart B is unknown. Initially the system is at rest. After it is released it is observed that cart A has three times the velocity of cart B. (Assume no frictional forces act on the carts.)

   (a) What force must be exerted initially to keep the spring compressed?

   (b) What is the work done to compress the spring?

   (c) By considering conservation of momentum determine the mass m_B.

   (d) By considering conservation of energy find the velocities of the carts A and B after the spring is released.

2. A 30 g ball is attached to the end of a string of length $L = 50$ cm to form a pendulum. The ball is pulled back to an angle of 53^o and released. At the lowest point in its path it makes a totally inelastic collision with stationary piece of clay of mass 100 g.

   (a) What was the velocity of the ball just before the collision?

   (b) Assuming the clay originally rested on a frictionless surface how high do the ball and clay rise after the collision?

   (c) What fraction of the initial mechanical energy is lost during the collision?