Name: _____ DISC: _____ Score: _____ / 20

Instructions:

- Do your own work.
- Answer the questions below in the space provided.
- Make sure you show all your work and any equations that you use.
- Please place a box around your answers.
- Remember to give the correct units with all numerical answers.

Q1	Q2	Q3	Q4
10	5	5	5

1. You drop a ball from the roof of the John Hancock Center (height at the roof: 344 m). The ball has mass $m = 950\ g$.

   a. Which kind(s) of energy does the ball have half-way down the building:

   Selection (1 pt):

   i. Potential Energy ($U = mgh$).
   ii. Kinetic Energy ($K = \frac{1}{2}mv^2$)
   iii. Neither
   iv. Both

   b. Calculate the potential energy of the ball at the roof of the building.

   Potential Energy (3 pts):

   c. Find the velocity of the ball at the height of $172\ m$. Ignore air resistance. (Hint: $E_{Total} = U + K$, and E_{Total} is conserved)

   Velocity (3 pts):

   d. Does the gravitational force do work ($W = F\ d \cos\theta$) on the ball? Explain your answer.

   Answer (3 pts):

2. Impulse changes momentum ($\vec{I} = \Delta\vec{p} = \vec{F}\Delta t$), so momentum and force are related. You throw a ball of mass $m = 750\ g$ straight at the wall of your dorm room. The ball travels with $\vec{v}_i = 5\ m/s$ before hitting the wall.

   a. The ball bounces straight off the wall with velocity $\vec{v}_f = -\vec{v}_i$. Calculate the change in momentum, $\Delta\vec{p} = m(\vec{v}_f - \vec{v}_i)$. Make sure to include a correct *sign*.

Answer (3 pts):

   b. If the ball interacts with the wall for 0.02 s, what is the average magnitude of the force experienced by the ball during the collision?

Answer (2 pts):

3. A block of mass $15\ kg$ slides along a frictionless floor with velocity $\vec{v}_M = 2.7\ m/s$ along the x-direction. It suddenly explodes breaking into two pieces: piece 1, $m_1 = 5\ kg$ and piece 2, $m_2 = 10\ kg$. The pieces still travel along the x-direction on the floor.

   a. Which of the following physical quantities is conserved:

Selection (1 pt):

      i. Momentum
      ii. Kinetic energy

   b. If the velocity of piece 1 after the explosion $\vec{v}_1 = 4.1\ m/s$, what is v_2, the *velocity* of piece 2 after the explosion?

Answer (2 pts):

   c. Which piece has the *larger* kinetic energy:

Solution (2 pts):

      i. Piece 1
      ii. Piece 2
      iii. Both have the same kinetic energy.