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 $m = 1.5\ kg$.

   a. Which kind(s) of energy does the ball have half-way down the the building (i.e. when $h = 172\ m$):

   Selection:

   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 $h = 172\ m$. Ignore air resistance. (Hint: $E_{Total} = U + K$, and E_{Total} is conserved)

   Velocity (3 pts):

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

   Answer (3 pts):

2. Impulse changes momentum ($I = \Delta p = F\Delta t$). So momentum and force are related. You throw a ball of mass $m = 0.25\ kg$ straight at the wall of your dorm room. The ball travels with $\vec{v}_i = 7\ m/s$. Change in momentum is $\Delta\vec{p} = m(\vec{v}_f - \vec{v}_i)$.
   a. The ball bounces straight off the wall ($\vec{v}_f = -\vec{v}_i$). Calculate $\Delta\vec{p}$:

Answer (3 pts):

   b. If the ball interacts with the wall for 0.03 s, how large is the force experienced by the ball in the collision?

Answer (2 pts):

3. A block of mass $12\ kg$ slides along a frictionless floor with velocity $\vec{v}_M = 1.5\ m/s$. It suddenly explodes breaking into two pieces: piece 1, $m_1 = 8\ kg$ and piece 2, $m_2 = 4\ kg$. The pieces travel along the floor.
   a. Which of the following is conserved:
      i. Momentum: $p = mv$
      ii. Kinetic energy: $K = \frac{1}{2}mv^2$

Selection:

   b. Using conservation of momentum ($\Delta p = 0\ kg\ m/s$) and $\vec{v}_1 = 1.5\ m/s$, find v_2, the *speed* of part 2.

Answer (2 pts):

   c. Which part has the *larger* kinetic energy:
      i. Part 1
      ii. Part 2

Solution (2 pts):