

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 is of mass 4 kg.

a. Which kind of energy does the ball have just before you drop it:

Selection:

- Potential Energy ($U = mgh$).
- Kinetic Energy ($K = \frac{1}{2}mv^2$)
- Neither

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 just as it hits the ground (ignore air resistance).

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 $m = 0.3 \text{ kg}$ straight at the wall of your dorm room. The ball travels with $\vec{v}_i = 4 \text{ m/s}$. 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 0.05 s, how large is the force experienced by the ball in the collision?

Answer (2 pts):

3. A block of mass 8 kg rests on a frictionless floor. It suddenly explodes breaking into two pieces: piece 1, $m_1 = 6 \text{ kg}$ and piece 2, $m_2 = 2 \text{ kg}$. The pieces travel in opposite directions along the floor.

a. Which of the following is conserved:

Selection:

- i. Momentum: $p = mv$
- ii. Kinetic energy: $K = \frac{1}{2}mv^2$

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

Answer (2 pts):

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

Solution (2 pts):

- i. Part 1
- ii. Part 2