

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 $m = 0.25 \text{ kg}$.

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

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 ($h = 344 \text{ m}$).

Potential Energy (3 pts):

c. Find the velocity of the ball at $h = 200 \text{ m}$. 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 $m = 0.25 \text{ kg}$ straight at the wall of your dorm room. The ball travels with $\vec{v}_i = 6 \text{ m/s}$. 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 0.02 s, how large is the force experienced by the ball in the collision?

Answer (2 pts):

3. A block of mass 8 kg slides along a frictionless floor with velocity $\vec{v}_M = 1.5 \text{ m/s}$. It suddenly breaks into two pieces: piece 1, $m_1 = 3 \text{ kg}$ and piece 2, $m_2 = 5 \text{ kg}$. The pieces travel along the floor in a straight line along the x-axis.

- 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 $\vec{v}_1 = 2 \text{ m/s}$, 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