

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 2 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  $m = 0.2 \text{ kg}$  straight at the wall of your dorm room. The ball travels with  $\vec{v}_i = 5 \text{ m/s}$ . 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 0.1 s, how large is the force experienced by the ball in the collision?

Answer (2 pts):

3. A block of mass  $10 \text{ kg}$  rests on a frictionless floor. It suddenly explodes breaking into two pieces: piece 1,  $m_1 = 2 \text{ kg}$  and piece 2,  $m_2 = 8 \text{ kg}$ . The pieces travel in opposite directions along the floor.

a. Which of the following is conserved:

- 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.

Selection:

Answer (2 pts):

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

Solution (2 pts):

- i. Part 1
- ii. Part 2