

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  $m = 0.5 \text{ kg}$ .

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.

Potential Energy (3 pts):

c. Find the velocity of the ball at  $h = 172 \text{ m}$ . 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  $m = 0.5 \text{ kg}$  straight at the wall of your dorm room. The ball travels with  $\vec{v}_i = 3 \text{ m/s}$ . 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 15 kg slides along a frictionless floor with velocity  $\vec{v}_M = 1.5 \text{ m/s}$ . It suddenly explodes breaking into two pieces: piece 1,  $m_1 = 5 \text{ kg}$  and piece 2,  $m_2 = 10 \text{ kg}$ . The pieces travel along the floor.
- a. Which of the following is conserved:
- Momentum:  $p = mv$
  - 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):

- Part 1
- Part 2