PH141
Fall 2009
HW 8
Conceptual Questions: 1, 2, 3 (from Handout)
Ch 7, Problems: 23, 32, 53, 54

Question 1:

(a) Yes
(b) No

(a) Momentum is a vector quantity that dependant on the mass times the velocity. Out of mass and velocity only velocity is a vector and therefore the direction of the velocity is also the direction of the momentum.

$$\overline{P} = m\overline{v}$$

(b) The only case where the objects have the same magnitude of velocity is if each mass were the same, so the velocity of each object does not have to be the same just because the momentum is the same.

Question 2:

(a) **No**

Kinetic energy is energy in motion and is dependant on the mass and the magnitude of the velocity of an object. If the system has no kinetic energy, it must have a velocity of zero. If an object has a velocity of zero, its momentum (P = mv) must also be zero.

(b) **Yes**

With a system of particles or objects it is possible to have a non-zero kinetic energy with a momentum equal to zero. Kinetic energy is a scalar quantity that is dependant on the magnitude of velocity. So as long as one or more object is in motion there will always be a positive kinetic energy associated with the system. However, momentum is a vector quantity so it is dependant on the direction of the objects in the system. It is possible that each individual momentum will cancel with two or more objects making it possible to have a non-zero kinetic energy while having a momentum equal to zero.

Question 14:

Yes

Floating in outer space the asteroid and the rocks on it are part of the same isolated system, so we know that the total momentum of these two objects will be conserved. This is easy to imagine if we think of the asteroid as being stationary at first. Both the asteroid and the rocks are initially at rest so the total momentum of the system is zero. Momentum is conserved so if anything is sent with a momentum in one direction it must be met with an equal and opposite momentum in the opposite direction. The more rocks you throw with the catapult off the asteroids away from the earth, the faster the asteroids will be going in the opposite direction, towards the earth.

Problems

(23)

$$P_o = P_f$$

$$0 = 0$$

$$m_1 V_1 + m_2 V_2 + m_3 V_3 = m_1 V_1 + m_2 V_2 + m_3 V_3$$

Before After

X

$$0 = m_1 V_1 \cos\theta_1 + m_2 V_2 \cos\theta_2 + m_3 V_3 \cancel{\cos\theta_3}$$

(+) (−) → 0

$$\theta_3 = 90° \rightarrow \cos\theta_3 = 0$$

$$|F_{1x}| = |F_{2x}|$$

$$m_1 V_1 \cos\theta_1 = m_2 V_2 \cos\theta_2$$

$$\frac{m_1}{m_2} = \frac{V_2 \cos\theta_2}{V_1 \cos\theta_1} = \frac{(1.79)\cos(45)}{(3)\cos(90-25)} = 1$$

$$\therefore\ m_1 = m_2$$

Y

$$0 = m_1 V_1 \sin\theta_1 + m_2 V_2 \sin\theta_2 - m_3 V_3 \sin\theta_3$$

$$m_3 V_3 \sin\theta_3 = m_1 (V_1 \sin\theta_1 + V_2 \sin\theta_2)$$

$$m_1 = m_2 = \frac{m_3 V_3 \sin\theta_3}{(V_1 \sin\theta_1 + V_2 \sin\theta_2)}$$

over →

23 cont

$$m_1 = m_2 = \frac{m_3 V_3 \sin\theta_3}{(V_1 \sin\theta_1 + V_2 \sin\theta_2)} = \frac{(1.3)(3.07)\sin(90)}{(3\sin(90-25) + (1.79)\sin(45))}$$

$$\boxed{m_1 = m_2 = 1\,\text{Kg}} \quad *$$

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(32)

$$P_o = P_f$$

$$m_1 V_1 + m_2 V_2 = 0$$

$$(1100)(32) + (2500)(-V_2) = 0$$

$$V_2 = \frac{(1100)(32)}{(2500)} \rightarrow \boxed{V_2 = 14.1\ m/s}$$

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(53) $\boxed{m_J = 98\ \text{Kg} \qquad m_{Log} = 230\ \text{Kg}}$

Log 1

$$P_o = P_f$$

$$0 = m_{Log} V_{Log} + m_J V_J \rightarrow -m_{Log} V_{Log} = m_J V_J$$

$$-(230) V_{Log} = (98)(3.6)$$

$$\boxed{V_{Log} = -1.5\ m/s}$$

Log 2 $\rightarrow$

53 cont

Log 2

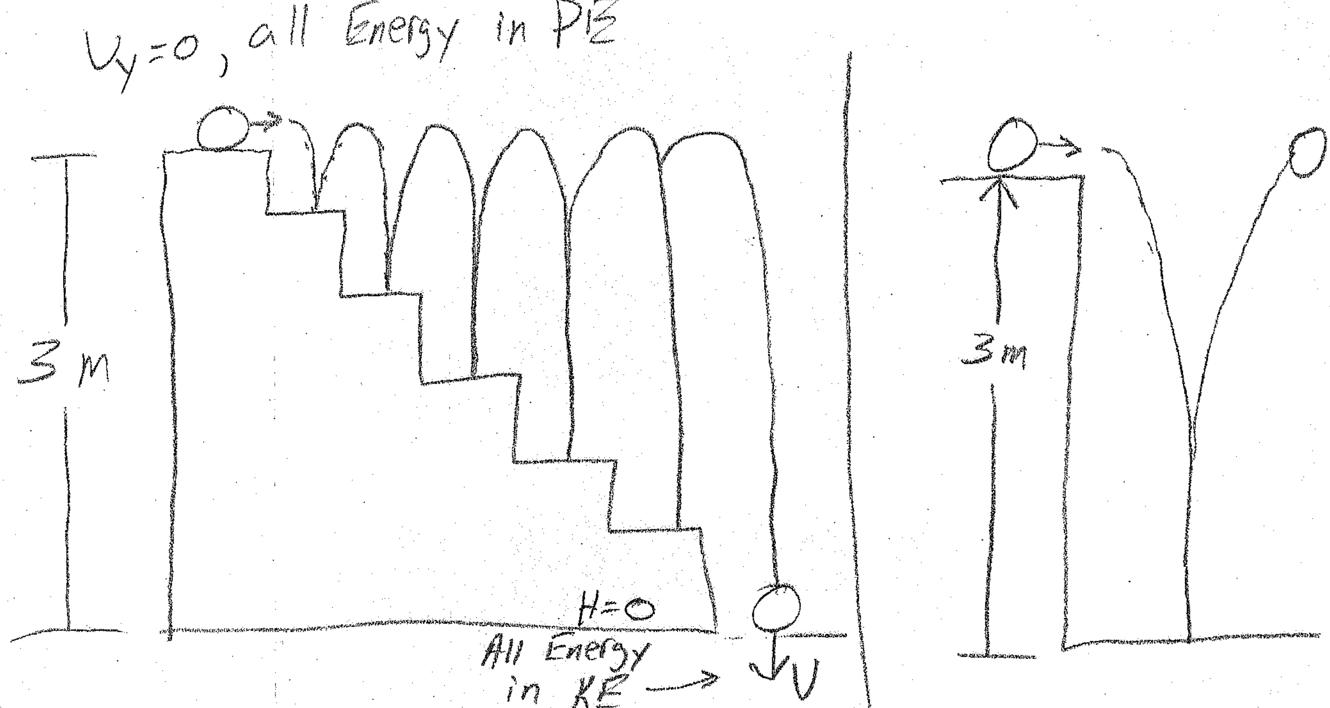
$$P_o = P_f$$

$$m_{Log} V_{Log} + m_J V_J = (m_{Log} + m_J) \bar{V}$$

$$0 + (98)(3.6) = (230 + 98) \bar{V}$$

$$\bar{V} = \frac{(98)(3.6)}{(230+98)} \longrightarrow \boxed{\bar{V} = 1.1 \text{ m/s}}$$

54



Fully Elastic Collision

100% of Mechanical Energy is conserved!

- The Ball will allways bounce to same starting Point

Bounce Height

$H = 3.0 m$