UNIVERSITY OF OTTAWA
Principles of Physics
PHY1321/1331 FALL 2012
Dr. A. Czajkowski

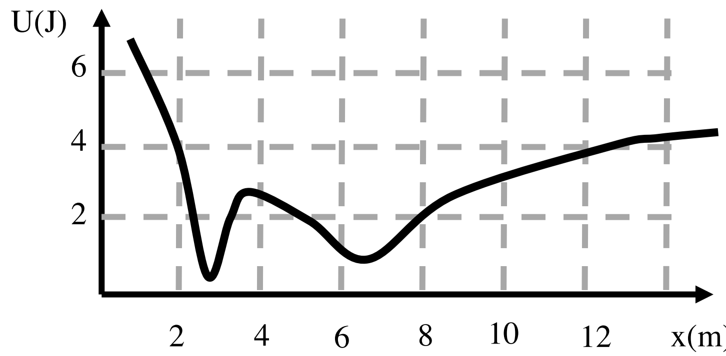
CLASS:	PHY_____
STUDENT #:	____________________
NAME:	________________________

Assignment 5:
Potential Energy, Linear Momentum, Impulse

Assigned: Oct16 12:00 Due: October 19 14:00

Due to short time given as well as the pain and suffering experienced by students during this week,
a substantial help will be provided on question 3,4 and 5
(These questions will be discussed in class –Thursday and Friday respectively)

1 At t=0 particle is at rest x= 2m After its release it can move under influence of conservative force whose potential energy is shown in the diagram.



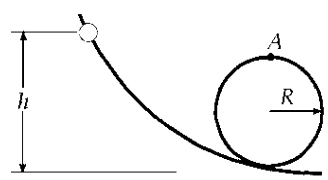
a) What is the total energy of the particle at x=8m

b) What is the position of the right turning point for this particle?

c) what is the kinetic energy of the particle at 10m?

a) **E=U+K = E(8m)=const=E(2m)-4J**
b) **x=12m**
c) **K(10m)=E(10m)-U(10m)=4J-3J**

2. A bead slides without friction around a loop-the-loop (Fig. P8.5). The bead is released from a height $h = 3.50R$. (a) What is its speed at point A? (b) How large is the normal force on it if its mass is 5.00 g?



$U_i + K_i = U_f + K_f$:

$$mgh + 0 = mg(2R) + \frac{1}{2}mv^2$$

$$g(3.50R) = 2g(R) + \frac{1}{2}v^2$$

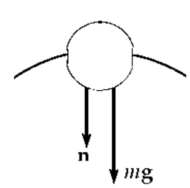
$$\boxed{v = \sqrt{3.00gR}}$$

$$\sum F = m\frac{v^2}{R}: \qquad n + mg = m\frac{v^2}{R}$$

$$n = m\left[\frac{v^2}{R} - g\right] = m\left[\frac{3.00gR}{R} - g\right] = 2.00mg$$

$$n = 2.00\left(5.00\times10^{-3}\ \text{kg}\right)\left(9.80\ \text{m/s}^2\right)$$

$$= \boxed{0.098\,0\ \text{N downward}}$$



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Assignment 5: cont

3. A tennis player receives a shot with the ball (0.060 0 kg) traveling horizontally at 50.0 m/s and returns the shot with the ball traveling horizontally at 40.0 m/s in the opposite direction. (a) What is the impulse delivered to the ball by the racquet? (b) What work does the racquet do on the ball?

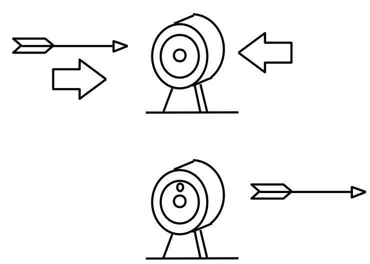
SOLUTION:

Assume the initial direction of the ball in the $-x$ direction.

(a) Impulse, $\mathbf{I} = \Delta\mathbf{p} = \mathbf{p}_f - \mathbf{p}_i = (0.060\,0)(40.0)\hat{\mathbf{i}} - (0.060\,0)(50.0)(-\hat{\mathbf{i}}) = \boxed{5.40\hat{\mathbf{i}}\ \mathrm{N \cdot s}}$

(b) Work $= K_f - K_i = \frac{1}{2}(0.060\,0)\left[(40.0)^2 - (50.0)^2\right] = \boxed{-27.0\ \mathrm{J}}$

4. An archer shoots an arrow towards a target that is sliding towards her with a speed of 2.50 m/s on a smooth, slippery surface. The 22.5-g arrow is shot with a speed of 35.0 m/s and passes through the 300-g target, which is stopped by the impact. What is the speed of the arrow after passing through the target?



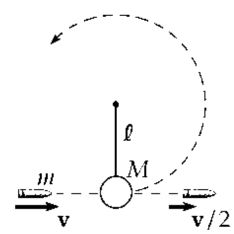
SOLUTION:

$$(m_1 v_1 + m_2 v_2)_i = (m_1 v_1 + m_2 v_2)_f$$

$$22.5\ \mathrm{g}(35\ \mathrm{m/s}) + 300\ \mathrm{g}(-2.5\ \mathrm{m/s}) = 22.5\ \mathrm{g}\,v_{1f} + 0$$

$$v_{1f} = \frac{37.5\ \mathrm{g \cdot m/s}}{22.5\ \mathrm{g}} = \boxed{1.67\ \mathrm{m/s}}$$

5 As shown in Figure P9.24, a bullet of mass m and speed v passes completely through a pendulum bob of mass M. The bullet emerges with a speed of $v/2$. The pendulum bob is suspended by a stiff rod of length ℓ and negligible mass. What is the minimum value of v such that the pendulum bob will barely swing through a complete vertical circle?



Energy is conserved for the bob-Earth system between bottom and top of swing. At the top the stiff rod is in compression and the bob nearly at rest.

$$K_i + U_i = K_f + U_f: \qquad \frac{1}{2}Mv_b^2 + 0 = 0 + Mg2l$$

$$v_b^2 = g4l \ \text{ so } \ v_b = 2\sqrt{gl}$$

Momentum of the bob-bullet system is conserved in the collision:

$$mv = m\frac{v}{2} + M\left(2\sqrt{gl}\right) \qquad \boxed{v = \frac{4M}{m}\sqrt{gl}}$$