Physics 3A: Basic Physics I

Quiz #8a: Solutions

Name: XXXXXXXXXXXXXXXXXXXXXXXXXXX

Student ID #:_________________________

Discussion Section:____________________

Date:________________________________

Signature:____________________________

\[ W = \vec{F} \cdot \Delta \vec{r} \quad \vec{A} \cdot \vec{B} = |A||B| \cos(\theta) \quad W = \int_{s_i}^{s_f} F_x \, dx \quad U_s = \frac{1}{2} k x^2 \quad K = \frac{1}{2} m v^2 \]

\[ W_{net} = K_f - K_i \quad U_g = mg y \quad E_{mech} = K + U \quad E_i = E_f \quad U_s = \frac{1}{2} k x^2 \quad \Delta E_{int} = f_x \Delta x \]

\[ U_f = -\int_{s_i}^{s_f} F_x \, dx + U_i \quad F_x = -\frac{dU}{dx} \quad \Delta K = -f_x \Delta x + \sum W_{other \ forces} \quad U_g = \frac{-GMm}{r} \]

\[ \Delta K + \Delta U + \Delta E_{int} = \sum W \]

(circle the letter of your answer)

1. (2 pts) You have two identical blocks. Block A you slid across a horizontal surface, starting with a speed \( v \). It slides until it stops due to friction between the block and the surface. Next you project block B up a 30° incline with the same initial velocity of block A. The incline has the same \( \mu_k \) as the horizontal surface. Block B also comes to rest. Compare the two blocks change in mechanical energy once:
   a.) Block A had a larger decrease in mechanical energy.
   b.) Block B had a larger decrease in mechanical energy.
   c.) Both blocks had the same decrease in mechanical energy.
   d.) Not enough information to tell.
   e.) None of the above.

2. (2 pts) You throw a ball straight up with speed \( v \). Define the system as the ball and the earth. At what point in the ball’s flight is the system’s total energy the greatest? (ignore air resistance)
   a.) Just has you release the ball.
   b.) Just before the ball returns to your hand.
   c.) When the ball reaches its highest point
   d.) The system’s total energy does not change
   e.) Not enough information to tell

3. (6 pts) A simple pendulum consists of a small object suspended by a string which is fixed at the top and the string has negligible mass and does not stretch. Ignore air resistance. The system oscillates by swinging back and forth in a vertical plane. If the string is of length 5.0 m and the initial angle is 40° with the negative vertical direction, calculate the speed of the object at:
   a.) the lowest point in its trajectory and
   b.) when it is 20° from the vertical on the other side, past its lowest point. (circle your final answer and show all work)
a.) Choose system as pendulum and earth. So system is isolated and only conservative forces act. Use: \( \Delta K + \Delta U + \Delta E_{\text{int}} = \sum W \) where internal energy doesn't change and no work is done, so:

\[ \Delta K + \Delta U = 0 \]

\[ K_i - K_f + U_i - U_f = 0 \]

but \( K_f = 0 \) and \( U_i = 0 \) (if we choose \( y=0 \) at bottom of swing, then):

\[ K_f + U_i = K_i + U_i \]

\[ K_f = U_i \]

\[ \frac{1}{2} m v_f^2 = mgh \]

\[ v_f = \sqrt{2gh} = \sqrt{2g(1 - \cos \theta)} = \sqrt{2(9.80)(5.00 - 5.00 \cos(40.0))} = 4.79 \text{ m/s} \]

b.) Same concept and equations apply. Take initial state as part a, and final state at \( \theta = 20^\circ \):

\[ K_f + U_i = K_i + U_i \]

\[ \frac{1}{2} m v_f^2 + mgy_f = 0 + mgy_i \]

\[ v_f = \sqrt{2g(y_f - y_i)} = \sqrt{2g((1 - \cos(40)) - (1 - \cos(20)))} = \sqrt{2gl(\cos(20) - \cos(40))} \]

\[ v_f = \sqrt{2(9.80)(5.00)(\cos(20) - \cos(40))} = 4.13 \text{ m/s} \]