Physics Lab 9 – work-kinetic energy theorem

Purpose: to use the work-kinetic energy theorem to determine the friction on a rolling cart

Theory: Work done on an object is converted into kinetic energy of the object. The work done on the object is equal to the sum of works done by external forces. From the speed of the cart at two locations and the mass of the cart, the change in kinetic energy of the cart can be calculated. The change in KE is the work done on the cart by the forces on the cart: gravity, friction, the string force, and the normal force. From the tension in the string and the distance the cart moves, the work by the string force can be calculated. From the mass of the cart and the change in vertical height of the cart, the work by gravity can be calculated. From these works, the work by friction can be calculated. From the work by friction and the distance the cart moved, the friction can be determined.

Procedure: Record the location of each photogate from the measurements on the track. Measure and record the vertical height **of the track** from the table at the location of each photogate. Start the cart at the highest point. Start the programs collecting data on both computers. Release the cart. Stop the data collection. Record the speed of the cart at the two locations. Record the average tension in the string while the cart is rolling downward between the photogates.

DATA

mass of cart **1.32** kg

location of upper photogate \_\_\_\_\_\_\_\_\_\_ cm 🡪 \_\_\_\_\_\_\_\_\_\_ m

location of lower photogate \_\_\_\_\_\_\_\_\_\_ cm 🡪 \_\_\_\_\_\_\_\_\_\_ m

vertical height of track at upper photogate \_\_\_\_\_\_\_\_\_\_ cm 🡪 \_\_\_\_\_\_\_\_\_\_ m

vertical height of track at lower photogate \_\_\_\_\_\_\_\_\_\_ cm 🡪 \_\_\_\_\_\_\_\_\_\_ m

speed of cart at upper photogate \_\_\_\_\_\_\_\_\_\_ m/s

speed of cart at lower photogate \_\_\_\_\_\_\_\_\_\_ m/s

average tension in the string \_\_\_\_\_\_\_\_\_\_ N

CALCULATIONS

Calculate the following for the motion of the cart **FROM the upper photogate TO the lower photogate**.

***Show your calculations on notebook paper or on the back of this paper.***

1. kinetic energy at upper photogate \_\_\_\_\_\_\_\_ Draw the free-body diagram for the cart.

2. kinetic energy at lower photogate \_\_\_\_\_\_\_\_ forces:

3. change in kinetic energy \_\_\_\_\_\_\_\_

4. work done on the cart \_\_\_\_\_\_\_\_

5. distance the cart moved \_\_\_\_\_\_\_\_

6. work done by string tension \_\_\_\_\_\_\_\_

7. change in vertical height of cart \_\_\_\_\_\_\_\_

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8. work done by gravity \_\_\_\_\_\_\_\_

9. work done by normal force \_\_\_\_\_\_\_\_

10. work done by friction \_\_\_\_\_\_\_\_

11. size of friction \_\_\_\_\_\_\_\_