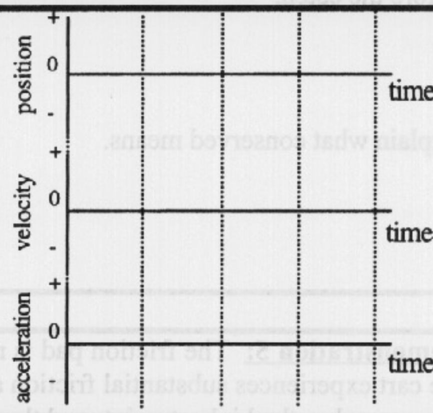
Hand in this sheet **Name** ______________________________

INTERACTIVE LECTURE DEMONSTRATION

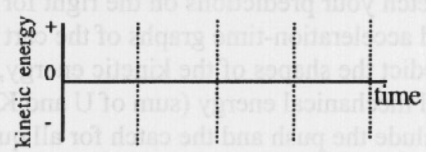
PREDICTION SHEET—**ENERGY OF A CART ON A RAMP**

Directions: This sheet will be collected. Write your name at the top to record your presence and participation in these demonstrations. Follow your instructor's directions. You may write whatever you wish on the attached Results Sheet and take it with you.

Demonstration 1: Consider a cart (with almost no friction) given a quick push up an inclined ramp away from the motion detector which is chosen to be the origin. Sketch on the right your prediction of the position-time, velocity-time and acceleration-time graphs for the cart. It moves up, slows down, then rolls back down the ramp where it is stopped at the same place it was pushed. Include the push and the catch on your graphs.



Demonstration 2: Sketch on the right your prediction of the kinetic energy of the cart (the energy due to motion) over time as it moves as described above. Keep in mind that the kinetic energy $K = \frac{1}{2}mv^2$, where m is the mass of the cart and v is its velocity.



Where is the kinetic energy zero?

Where is it a maximum?

Is kinetic energy conserved?

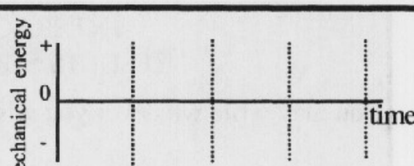
Demonstration 3: Sketch on the right your prediction of the potential energy of the cart (the energy due to raising a mass in the gravitational field of the earth) over time as it moves as described above. Define the potential energy to be zero at the height where the cart is first pushed. Then $U^{grav}=mgh$ where h is the height above the starting point, g is the acceleration due to gravity, and m is the cart's mass. h can be calculated from x--the cart's distance from the motion detector using $h=(x-x_o)\sin ø$ where x_o is the initial position and $ø$ is the angle the track makes with the horizontal.

Where is the potential energy zero?

Where is it a maximum?

Is the potential energy conserved?

Demonstration 4: Sketch on the right your prediction of the mechanical energy (the sum of the kinetic and potential energies) of the cart over time as it moves as described above.



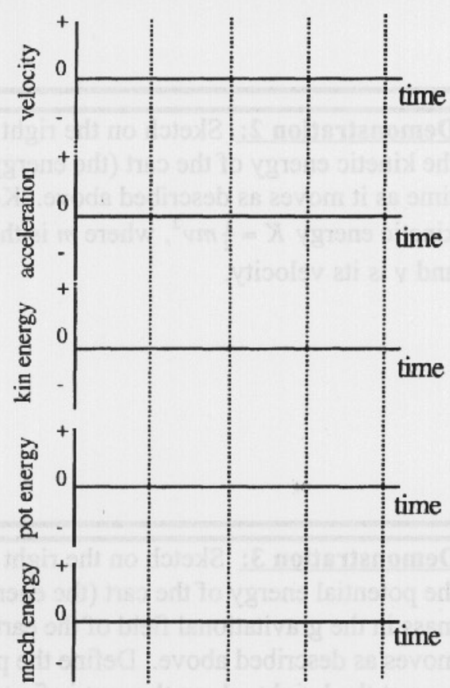
Describe the mechanical energy of the cart after the push and before the catch.

Is the mechanical energy conserved?

Explain what conserved means.

Where does the cart get its initial energy?

Demonstration 5: The friction pad is now lowered so that the cart experiences substantial friction as it moves up the ramp, reaches the highest point, and then moves back down. Sketch your predictions on the right for the velocity-time and acceleration-time graphs of the cart with friction. Also predict the shapes of the kinetic energy, potential energy, and mechanical energy (sum of U and K) for the motion. Include the push and the catch for all quantities. *Remember that friction can no longer be ignored.*



Is the mechanical energy conserved? Explain.

Do you expect the shape of the kinetic energy graph for the push and catch to be different from the case with no friction? Explain.

Keep this sheet

INTERACTIVE LECTURE DEMONSTRATION
RESULTS SHEET—ENERGY OF A CART ON A RAMP

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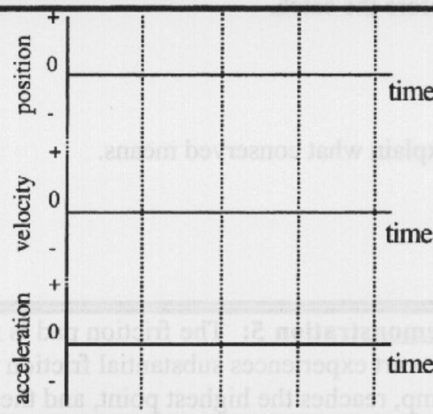

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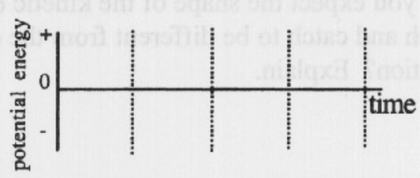
Where is the kinetic energy zero?

Where is it a maximum?

Is kinetic energy conserved?

Demonstration 3: Sketch on the right your prediction of the potential energy of the cart (the energy due to raising a mass in the gravitational field of the earth) over time as it moves as described above. Define the potential energy to be zero at the height where the cart is first pushed. Then $U^{grav}=mgh$ where h is the height above the starting point, g is the acceleration due to gravity, and m is the cart's mass. h can be calculated from x--the cart's distance from the motion detector using $h=(x-x_o)\sin ø$ where x_o is the initial position and $ø$ is the angle the track makes with the horizontal.

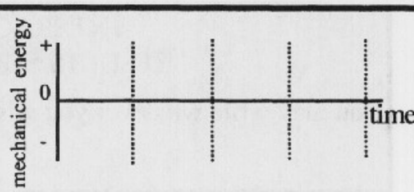


Where is the potential energy zero?

Where is it a maximum?

Is the potential energy conserved?

Demonstration 4: Sketch on the right your prediction of the mechanical energy (the sum of the kinetic and potential energies) of the cart over time as it moves as described above.



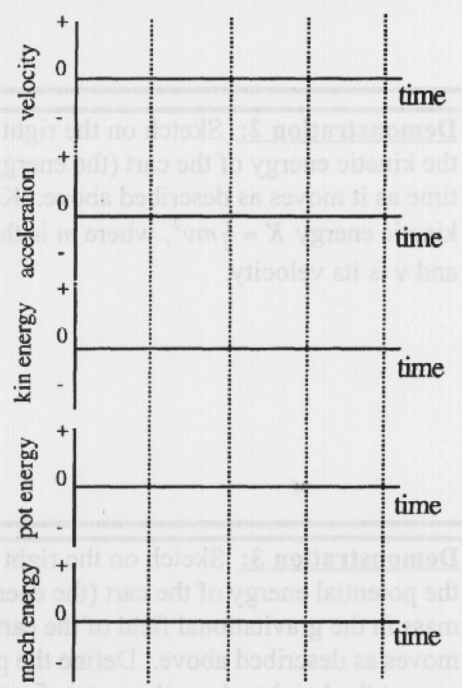
Describe the mechanical energy of the cart after the push and before the catch.

Is the mechanical energy conserved?

Explain what conserved means.

Where does the cart get its initial energy?

Demonstration 5: The friction pad is now lowered so that the cart experiences substantial friction as it moves up the ramp, reaches the highest point, and then moves back down. Sketch your predictions on the right for the velocity-time and acceleration-time graphs of the cart with friction. Also predict the shapes of the kinetic energy, potential energy, and mechanical energy (sum of U and K) for the motion. Include the push and the catch for all quantities. *Remember that friction can no longer be ignored.*



Is the mechanical energy conserved? Explain.

Do you expect the shape of the kinetic energy graph for the push and catch to be different from the case with no friction? Explain.