

# AP Physics: Short Lab 5-A

## Graphs of Energy

Name \_\_\_\_\_ Hour \_\_\_\_\_

Lab Partners \_\_\_\_\_

### Purpose:

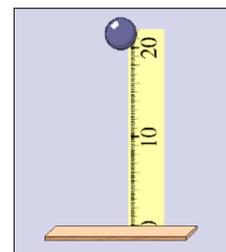
Analyze relationships between potential energy, kinetic energy, and total energy.

### Equipment:

- Interactive Physics computer software

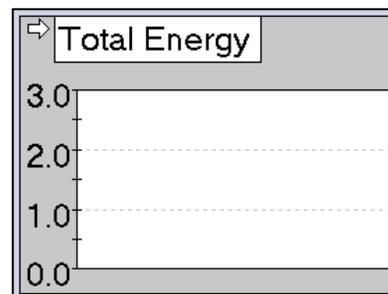
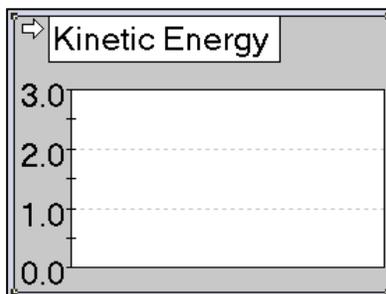
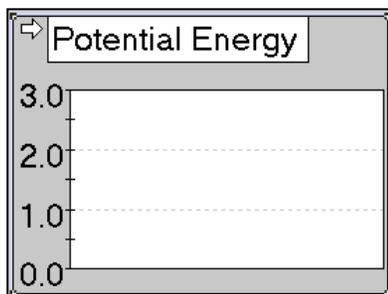
### Procedures: Dropping Ball

1. In the situation at right, a ball begins at a height of .20 meters above the surface of a table and is dropped to the table below. Calculate the potential energy of the ball at its initial position. Then use conservation of energy to calculate the final velocity of the ball when it reaches the surface of the table. Show your work in the space below.



2. Open the Interactive Physics file “*Graphs of Energy (I)*”. Run the simulation and observe the final velocity of the ball as it hits the table. Were your calculations for the ball’s final velocity in Question #1 correct? If not, correct your calculations.

3. Run the simulation in “*Graphs of Energy (I)*” again and observe the changes in the ball’s height and velocity as it falls. What do you think a graph of **Potential Energy vs. Time** would look like for the ball as it falls to the table? Sketch your prediction on the graph below. Sketch predictions for graphs of **Kinetic Energy vs. Time** and **Total Energy vs. Time** for the ball as it falls on the graphs below as well.



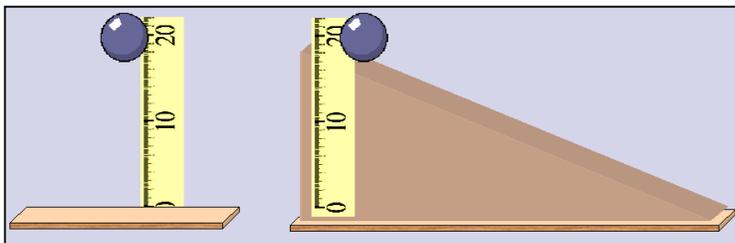
4. Open the Interactive Physics file “*Graphs of Energy (II)*”. Run the simulation and study the graphs of **Potential Energy, Kinetic Energy, and Total Energy vs. Time**. (NOTE: All 3 graphs are shown on the same axis. Potential Energy is shown in red, Kinetic Energy is shown in blue, and Total Energy is shown in green.) How do the graphs compare to your predictions in Question #3? If the graphs are significantly different from your predictions, add a sketch of the actual graphs to your predictions on the graphs above.

5. Use the changing height of the ball as it falls to explain the shape of the **Potential Energy vs. Time** graph. Why is the graph curved? (HINT: You may want to use the equation  $d = d_o + v_o \cdot t + \frac{1}{2} \cdot a \cdot t^2$  in your answer.)

6. Use the changing velocity of the ball as it falls to explain the shape of the **Kinetic Energy vs. Time** graph. Why is the graph curved? (*HINT: You may want to use the equations  $v_f = v_o + a \cdot t$  and  $KE = \frac{1}{2} \cdot m \cdot v^2$  in your answer.*)
7. What is important about the shape of the **Total Energy vs. Time** graph?

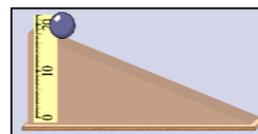
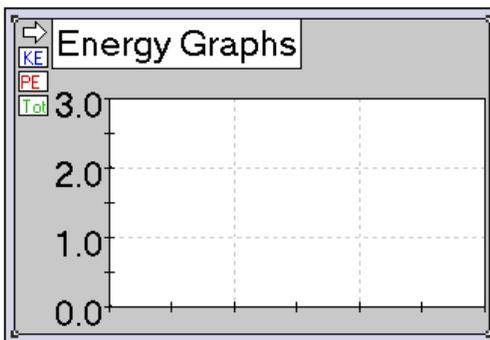
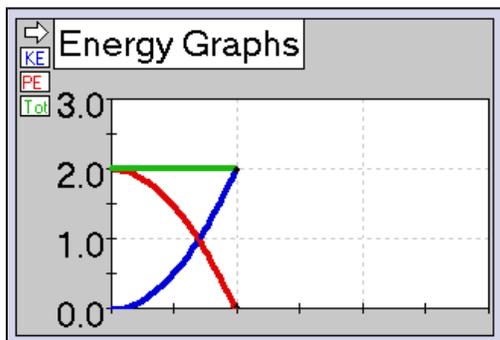
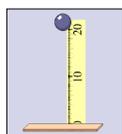
### Procedures: Ball Rolling Down a Ramp

1. In the situation at right, another ball begins at a height of .20 meters above the surface of a table and rolls down a ramp to the table below. How should the ball's final velocity rolling down the ramp compare to the ball's final velocity when it is dropped from the same height?



2. Open the Interactive Physics file “*Graphs of Energy (III)*”. Run the simulation and observe the final velocity of both balls as they reach the table. Was your prediction in Question #1 correct? (*NOTE: The simulation will pause when the dropped ball reaches the table. Click “Run” again to continue the simulation and allow the rolling ball to finish down the ramp.*)

3. The graphs of **Potential Energy, Kinetic Energy, and Total Energy vs. Time** for the dropping ball are shown on the axis below. How do you think the graphs of **Potential Energy, Kinetic Energy, and Total Energy vs. Time** for the rolling ball on the ramp will compare? Sketch your predictions on the axis below. (*NOTE: Use different colors to show all 3 graphs together on the same axis.*)

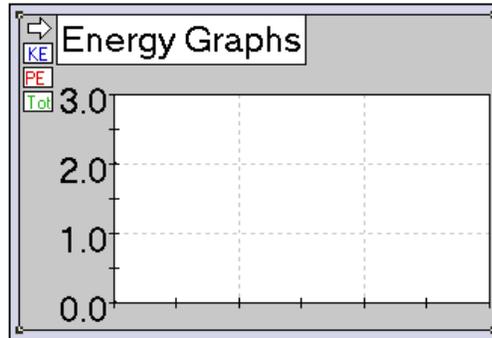
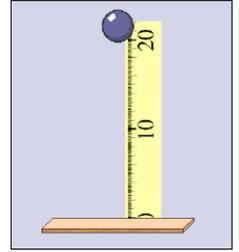


4. Open the Interactive Physics file “*Graphs of Energy (IV)*”. Run the simulation and study the graphs of **Potential Energy, Kinetic Energy, and Total Energy vs. Time**. (*NOTE: All 3 graphs are shown on the same axis. Potential Energy is shown in red, Kinetic Energy is shown in blue, and Total Energy is shown in green.*) How do the graphs compare to your predictions in Question #3? If the graphs are significantly different from your predictions, add a sketch of the actual graphs to your predictions on the graphs above.

5. How does the addition of the ramp affect the shape of the **Potential Energy, Kinetic Energy, and Total Energy vs. Time** graphs?

## Procedures: Bouncing Ball and Other Graphs

1. In the situation at right, a ball begins at a height of .20 meters above the surface of a table and is dropped to the table below. Then it bounces off of the table without any loss of energy (which would be a highly unlikely situation in reality.) What do you think the graphs of **Potential Energy, Kinetic Energy, and Total Energy vs. Time** for the bouncing ball will look like? Sketch your predictions on the axis below. (NOTE: Use different colors to show all 3 graphs together on the same axis.)



2. Open the Interactive Physics file “*Graphs of Energy (V)*”. Run the simulation and study the graphs of **Potential Energy, Kinetic Energy, and Total Energy vs. Time**. (NOTE: All 3 graphs are shown on the same axis. Potential Energy is shown in red, Kinetic Energy is shown in blue, and Total Energy is shown in green.) How do the graphs compare to your predictions in Question #1? If the graphs are significantly different from your predictions, add a sketch of the actual graphs to your predictions on the graphs above.

3. The Interactive Physics file “*Graphs of Energy (VI)*” shows graphs of **Potential Energy, Kinetic Energy, and Total Energy vs. Time** for a variety of situations. Open the file and run the simulation. How are all of the graphs similar to each other? How are they different?