Virtual Energy

Go to the following website: http://phet.colorado.edu/web-pages/simulations-base.html
Select the "Work, Energy & Power" topic on the left.

THE RAMP

Click on the applet entitled "The Ramp". Do not select "The Ramp: Forces & Motion". This applet allows you to look at the forces, the work associated with those forces, and the energy associated with an object moving along an incline. You, the user, are able to change many of the parameters: the angle of the incline, the force you apply, the coefficient of friction, the mass of the object on the incline, the initial velocity, and the starting position.

Explore how the applet works for a couple of minutes. Attempt to change the object, the applied force, the ramp angle, and the starting position and watch the resulting motion by pressing "Go". Variables can be changed as the applet proceeds. Also explore the various things that can be displayed.

Now that you are familiar with the applet, do the following:

1. For the following set-up (piano with friction, incline at 25^{o}, no applied force, starting at 15 meters), calculate the following (BEFORE YOU TRY IT):
    a. The component of the force of gravity acting down the incline.
    b. The force of friction on the incline.
    c. Will the piano move? Explain.
    d. The work gravity does on the piano by the time it reaches the bottom of the ramp.
    e. The work friction does on the piano by the time it reaches the bottom of the ramp.
    f. The speed of the piano at the bottom of the ramp?
    g. The distance from the end of the ramp at which the piano comes to a stop.

2. Try it to verify your answers above. Your final resting position will need to be checked with the measuring tape tool on the "More Features" tab.

3. Re-run this trial as required to answer the following:
    a. Why is the work done by gravity initially a negative value when the object is at the top, before it is released? Explain.
    b. Explain how the gravitational potential energy at the top of the ramp relates to the initial value of the work of gravity at the top of the ramp.
    c. Why does the force of friction increase after the object reaches the bottom of the ramp and begins to slide over the horizontal surface?
    d. Fully describe how energy is stored and transferred as the object moves from the top of the ramp to its final resting place on the horizontal ground.
    e. Ultimately, where does all of the energy present initially when the object is at the top of the ramp, and all the work done on the object, end up?

4. Now you can select your own trial to analyze. Your trial:
    - must incorporate friction
    - must have an initial non-zero velocity
    - must employ an applied force so that the object does go down the incline
    - must result in your object coming to rest BEFORE striking the wall.

- Use the "More Features" tab at the top of the screen to adjust all of these variables. Once you have identified a combination of variables to analyze, **RECORD THE VALUE OF ALL OF YOUR VARIABLES** in your write-up. If Mr. K cannot find your values listed, he won't grade your work. Once all of your values are set, calculate the following and then verify your answers by running your trial:
    a. The force of gravity down the incline.
    b. The force of friction.
    c. The work gravity does on the object by the time it reaches the bottom of the ramp.
    d. The work friction does on the object by the time it reaches the bottom of the ramp.
    e. The speed of the object at the bottom of the ramp?
    f. The distance from the end of the ramp at which the object comes to a stop.

5. What, specifically, have you learned about physics content by using this applet? BE SPECIFIC. What can you do now (or understand), if anything, that you could not do (or did not understand) prior to using this applet?

The Energy Skate Park

Click on the applet entitled "The Energy Skate Park". In this applet, you have the ability to design and modify the track that the skater uses. In addition, you have the ability to modify friction, the force of gravity, the skater's mass, and the skater's "bounciness". There are a number of graphs that allow you to monitor the various types of energy associated with the skater as he moves along your track.

As before, explore how the applet works for a couple of minutes. Attempt to change the track, friction, and the force of gravity. Variables can be changed as the applet proceeds. Also explore the various displays of energy that are a part of the applet.

Now that you are familiar with the applet, do the following:

1. Create your own track with a loop. Draw a sketch of your track, complete with distances and measurements. Record the skater's characteristics you are using, as well as the value of gravity. Write these values down. Then, do the following:
    a. Predict what the *energy vs. time* graph for KE, PE, and Thermal energy will look like. Include numbers on the axes.
    b. Predict what the *energy vs. position* graph for KE, PE, Thermal, and Total Energy will look like. Include numbers on the axes.
    c. Run the trial and compare your predictions to the actual curves. Discuss similarities and differences.

2. Reset the applet. Modify the track so that the skater leaves the track and lands on the visible portion of the screen (i.e. make it look like a ski jump – you will probably need to lower it). Once done, do the following (recording the path of your skater might be helpful here).
    a. Calculate the speed the skater leaves the end of your track at.
    b. Calculate the horizontal distance from the end of the track at which the skater lands (think projectiles).
    c. Calculate the speed with which the skater hits the ground at.

3. Reset the applet. When you reset the applet, the skater returns to earth and begins going back and forth on the simple parabolic track. Watch this for a period of time. Describe how the energy bar chart behaves with time. Connect the bar chart to both time and the skater's position.

4. Now, suppose you were to, all of a sudden while the skater is moving, add friction. Ultimately what will happen to the skater? Predict what the energy bar chart will look like and draw it on your paper.

5. Check your answer.

6. Reset the applet. Now, suppose you were to *increase* the size of gravity at the moment the skater is at the bottom of the track? Predict what would happen and how it would influence the skater's various energies.

7. Check your predictions. Explain any discrepancies between what you observe and what you predicted.

8. Reset the applet. Now, suppose you were to *decrease* the size of gravity at the moment the skater is at the bottom of the track? Predict what would happen and how it would influence the skater's various energies.

9. Check your predictions. Explain any discrepancies between what you observe and what you predicted.

10. Discuss three situations you observed, while using the applet, in which energy was conserved. Include numbers in your discussion.