Work-Energy Bar Charts

Read from **Lesson 2** of the **Work, Energy and Power** chapter at **The Physics Classroom:**

http://www.physicsclassroom.com/Class/energy/u5l2c.html

MOP Connection: Work and Energy: sublevel 6

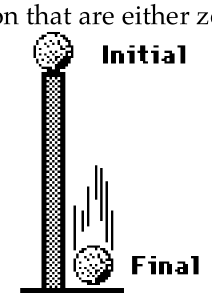
The work-energy relationship is the most important relationship of the unit. The work done by external forces (W_{ext}) is related to the total mechanical energy of the initial (TME_i) and of the total energy of the final state (TME_f) of a system as follows:

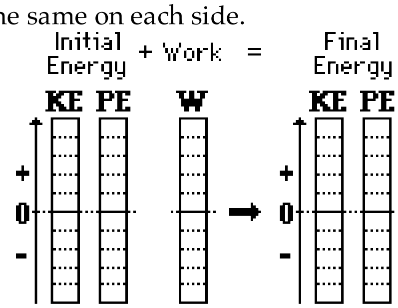
$$TME_i + W_{ext} = TME_f$$

Your goal should be to combine your understanding of kinetic energy, potential energy, and work with the above equation in order to analyze physical situations involving energy changes and transformations and to solve computational problems involving work and energy. One tool that will assist in the analysis of physical situations is a work-energy bar chart. A work-energy bar chart represents the amount of energy present in a system by means of a vertical bar. The length of a bar is representative of the amount of energy present; a longer bar representing a greater amount of energy. According to the work-energy theorem, the initial mechanical energy (kinetic and potential) plus the work done on the system by external forces equals the final mechanical energy (kinetic and potential). Consequently, the sum of the bar heights for any initial condition must equal the sum of the bar heights for the final condition.

Complete the following work-energy bar charts based on the given statement. Then cross out or cancel any terms in the work-energy equation that are either zero or the same on each side.

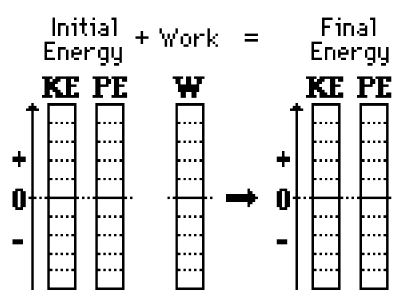
1. A ball falls from the top of a pillar to the ground below. The initial state is the ball at rest at the top of the pillar and the final state is the ball just prior to striking the ground. Ignore F_{air}.





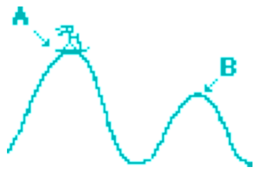
KE_i + PE_i + Wext = KE_f + PE_f

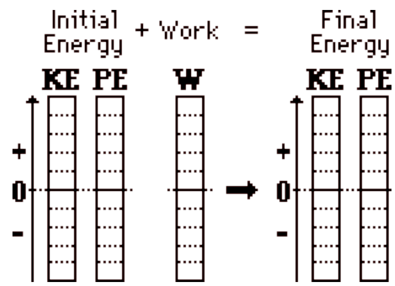
2. A car skids from a high speed to a stop with its brakes applied. The initial state is the car traveling at a high speed and the final state is the car at rest. The force of friction does work on the car, thus changing the total mechanical energy.



KE_i + PE_i + Wext = KE_f + PE_f

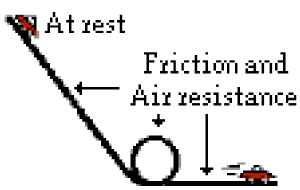
3. A skier starts from rest on top of hill A and skis into the valley and back up onto hill B. The skier utilizes her poles to propel herself across the snow, thus doing work to change her total mechanical energy. The initial state is on top of hill A and the final state is on top of hill B. Ignore frictional forces.

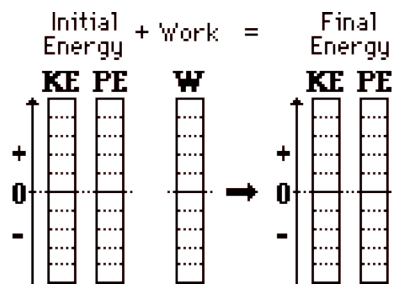




$KE_i + PE_i + W_{ext} = KE_f + PE_f$

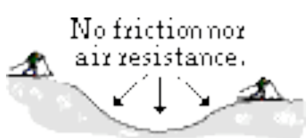
4. A Hot Wheels car starts from rest on top of an inclined plane and rolls down the incline through a loop and along a horizontal surface. The initial state is the car at rest on top of the hill and the final state is the car in motion at the bottom of the hill. Friction and air resistance have a significant effect on the car.

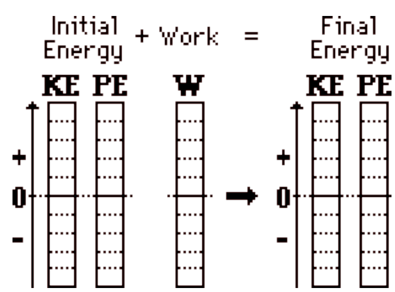




$KE_i + PE_i + W_{ext} = KE_f + PE_f$

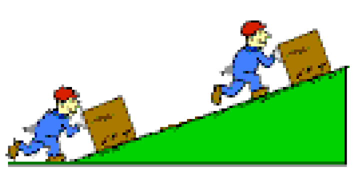
5. A moving cross-country skier skis from the top of a hill down into a valley and up a second smaller hill. The initial state is the skier in motion on top of the first hill and the final state is the skier in motion on top the second hill. He uses his poles to propel himself. Ignore the effect of friction and air resistance.

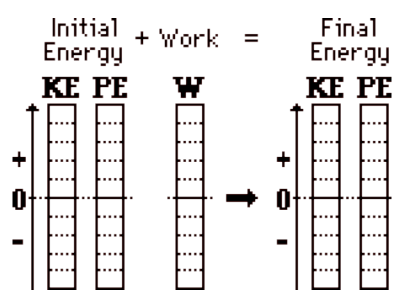




$KE_i + PE_i + W_{ext} = KE_f + PE_f$

6. Ben Laborin applies a force to push a crate from the bottom of an inclined plane to the top at a constant speed. The initial state is the crate in motion at the bottom of the hill and the final state is the crate in motion at the top of the hill. Ignore frictional effects.





$KE_i + PE_i + W_{ext} = KE_f + PE_f$