Name:____ Table: _______________ Section:________

Discussion : Energy Conservation

Let's apply energy ideas to the situation of a block that is released from rest at the top of an incline. To start with, we'll assume that the block slides down the ramp without friction.

Our goal will be to graph energy as a function of distance traveled, and energy as a function of time. Before doing that, let's think about what we can learn from equations we already know.

Constant-acceleration equations (in the special case that the initial velocity is zero):

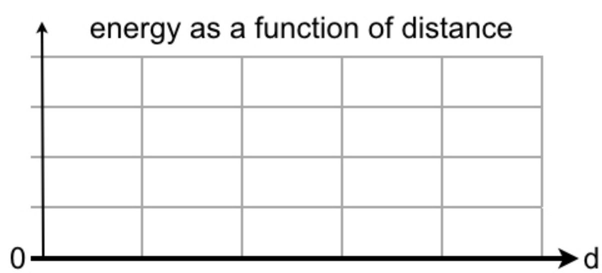
Distance travelled: $d = \frac{1}{2}at^2$ Speed: $v = at$ and: $v^2 = 2ad$

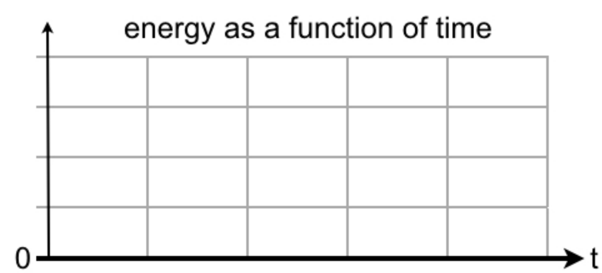
Energy equations:

Kinetic energy: $K = \frac{1}{2}mv^2$ Potential energy: $U = mgh$

Work – kinetic energy theorem (special case of no initial velocity): $\frac{1}{2}mv^2 = F_{net}d$

Make use of these equations to sketch graphs of energy vs. distance traveled, and energy vs. time, for a block sliding (from rest) down a frictionless incline. Define the zero for gravitational potential energy to be the bottom of the ramp. Plot potential energy, kinetic energy, and total mechanical energy (U + K).





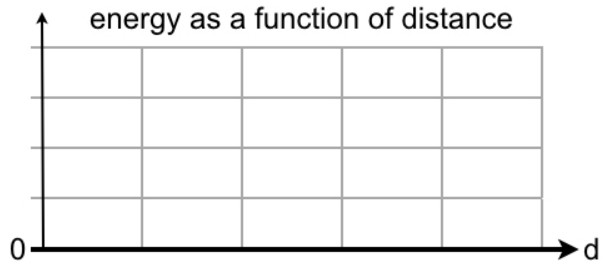
If the block slid for twice the distance down a frictionless ramp of the same angle, the kinetic energy at the bottom would, compared to the original, be increased by a factor of

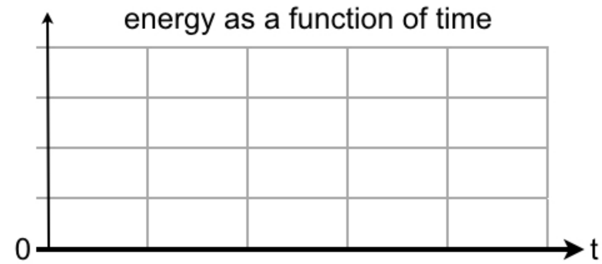
[ ] $\sqrt{2}$ [ ] 2 [ ] 4

If, instead, the block slid for twice the time down a frictionless ramp of the same angle, the kinetic energy at the bottom would, compared to the original, be increased by a factor of

[ ] $\sqrt{2}$ [ ] 2 [ ] 4

For graphs on the previous page - after discussing results in your groups, please check your graphs against those shown in this simulation.
http://physics.bu.edu/~duffy/HTML5/energy_rampslide.html



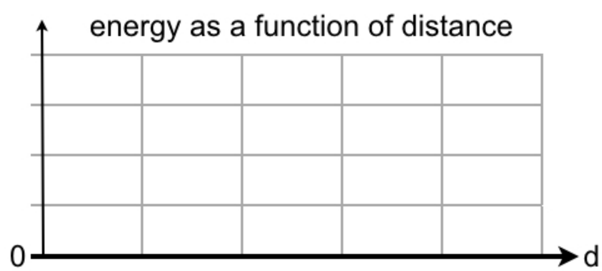


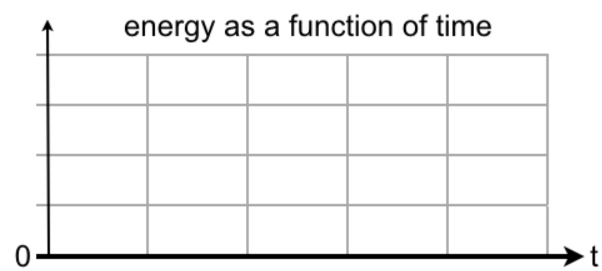
Draw the correct graphs above. Describe and explain the shape of the potential energy, kinetic energy, and total mechanical energy graphs from the simulation, and identify any differences there were between the simulation and your predictions.

Part 2 – include friction: Now, we'll look at the same situation, but account for friction. Assume friction causes the block to have **75% of the kinetic energy** as before when it arrives at the bottom of the ramp.

Work done by friction: $W_f = F_k d \cos\theta$

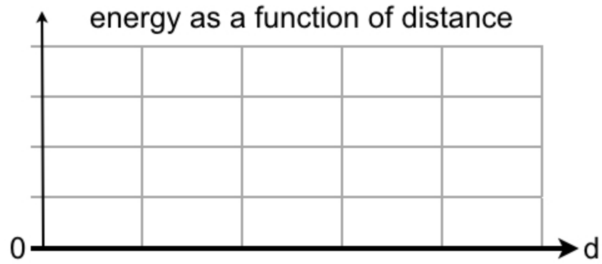
Again, we will graph energy as a function of distance traveled, and energy as a function of time.

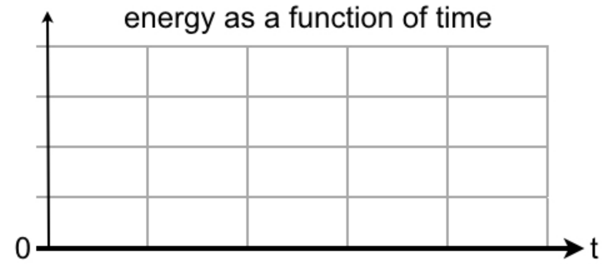




Sketch graphs of energy vs. distance traveled, and energy vs. time, for a block sliding (from rest) down the incline with friction. Define the zero for gravitational potential energy to be the bottom of the ramp. Plot potential energy, kinetic energy, and total mechanical energy (U + K). **Also, plot the thermal energy (this is energy associated with friction, but, while the work done by friction on the block is negative, the thermal energy is positive).**

After completing your graph sketches and discussing the results in your groups, please check your graphs against the simulation.





Draw the correct graphs above. Describe and explain the shape of the potential energy, kinetic energy, total mechanical energy and thermal energy graphs from the simulation, and identify any differences there were between the simulation and your predictions.

Let's say we have a bunch of different ramps, all the same shape and size but from one to the next the coefficient of friction increases. We release the block from rest from the top of each ramp, in turn.
As the coefficient of friction increases … (select all that apply)

[ ] the block arrives at the bottom with smaller and smaller amounts of gravitational potential energy

[ ] the block arrives at the bottom with smaller and smaller amounts of kinetic energy

[ ] the block travels more distance down the ramp

[ ] the block takes more time to travel down the ramp