ACTIVITY 2

Constructing Potential Energy Diagrams

Goal

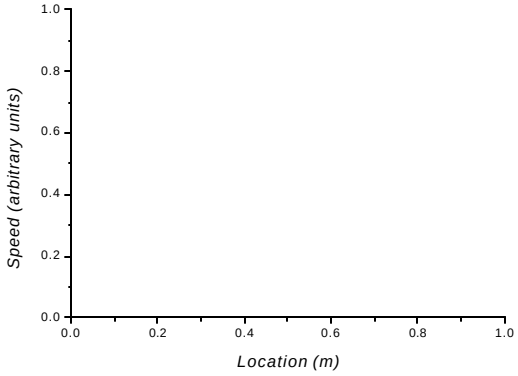
In this activity, you will explore energy diagrams for magnets in repulsive configurations. From these and the previous diagrams you will learn more about how to use these diagrams to describe motion.

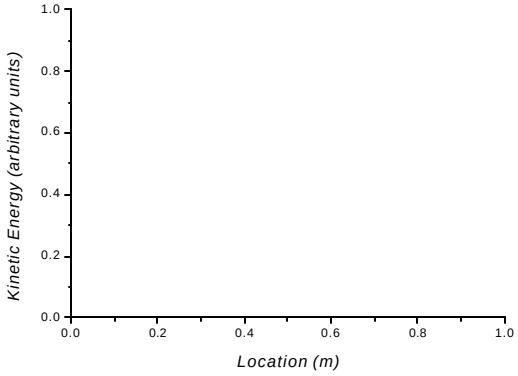
The experimental arrangement in this activity is similar to the previous one. The major difference is that we will arrange the magnets so that the ones along the track repel the one on the car. Again, we will try to imagine what the situation would be if the friction between the wheels of the car and the track was extremely small.

Use the same setup as in the previous activity and arrange the magnets so that the magnets along the track repel the magnets on the car. Push the car and watch carefully as it goes through the magnets. In the first observations we wish to consider a situation in which the car has enough energy to go past the magnets and continue along the track. If the car does not go beyond the magnets, try again with a stronger push.

? How did the speed of the car change as it went through the magnets? Record your observations below.

As you did in Activity 1, plot *approximate* graphs of speed vs. location and kinetic energy vs. location. You may create the graphs by laying a piece of paper along the track and sketching them there. Then, transfer the shape to the graphs below. Mark the position of the magnets on the location axis.

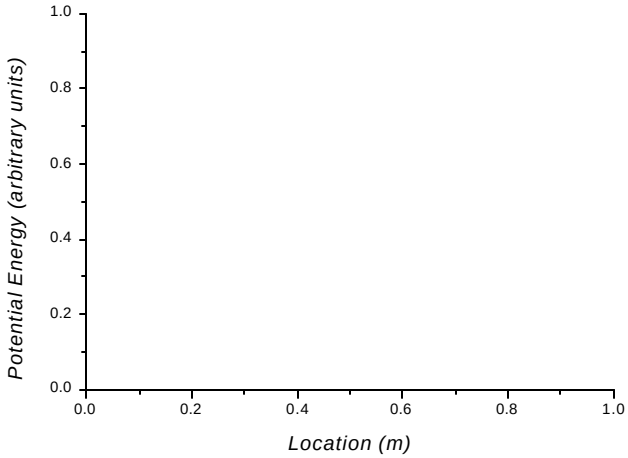




Now try to imagine both the kinetic energy and the total energy with very low friction. Draw a line which represents the total energy of the car if no friction were present.

Add to the graph above the kinetic energy as if there were no friction.

Sketch below the potential energy diagram of the car by applying the conservation of energy.



? How is this potential energy diagram different from the ones for the attractive situation?

? Explain the reason for this difference in terms of how the energy of the car changes.

So far we have tried to imagine the energy diagrams if friction could be removed. Because we cannot magically remove the friction from the toy cars, you will use a computer program to explore the frictionless case further.

Start the *Energy Diagrams Creator* program. With this program you can place a pair of magnets along the track and give the car a push. You can also change the amount of friction with the variable called the coefficient of friction. A coefficient of friction equal to zero means no friction.

Set up a computer version of the experiment that you just completed. Try it with a small amount of friction and describe your results below.

Now, set the coefficient of friction to zero. How do the results change?

Repeat this process for the experiment in Activity 1 — attraction. Describe your results below. If any of the results surprise you, discuss them with your instructor.

To check your partners' understanding of these ideas try a little game. While they are not looking at the computer screen, set up a configuration of magnets and a coefficient of friction. Run the car along the track to get the energy diagrams. Then cover the part of the screen that shows the car and magnets. Your partner(s) should look at the energy diagram and tell you

- the location(s) of the magnets,
- if each set is repulsive or attractive,
- the level of friction (zero, low, high), and
- how the speed changes as the cart moves along the track.

Don't make it too difficult. Your partners should set up a situation for you also. If any of the results surprise you, discuss them with your instructor.

The potential energy diagrams can provide information about many details of the motion other than increasing or decreasing of the speed of the object. Now that you are familiar with the two basic arrangements of magnets and their corresponding energy diagrams, you can use this knowledge to explore a new, more complex situation - an object trapped in a small region of space. In the next activity you will study the condition that allows the trapping and some other concepts such as *turning points* and *binding energy* associated with this type of motion.

Homework

1. The quiz show "Jeopardy" has opened a physics category. Below are two answers in the form of potential energy graphs. In this version of "Jeopardy" you need to give and explain the experimental arrangement and motion.