

Ch. II

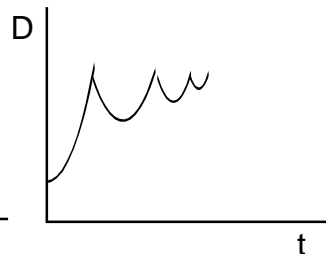
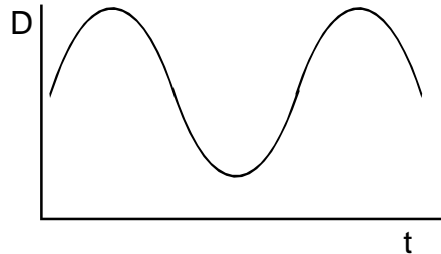
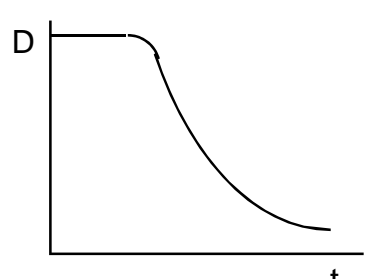
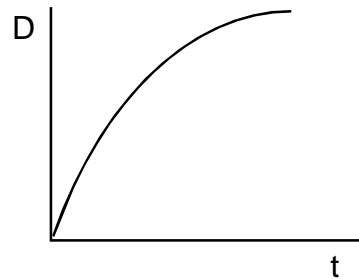
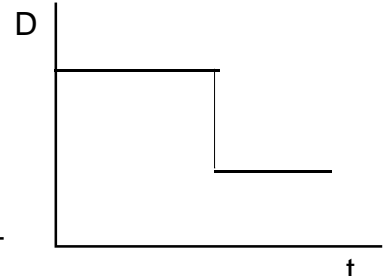
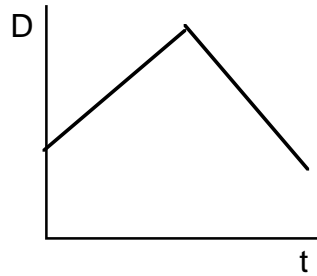
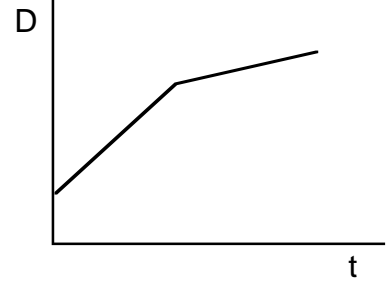
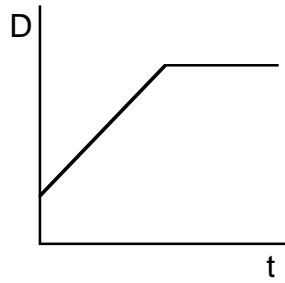
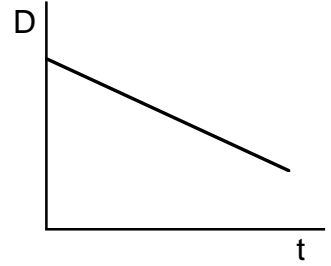
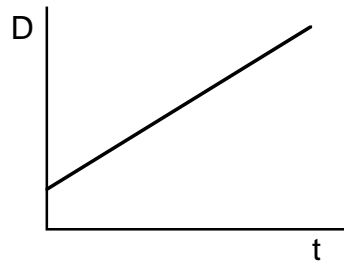
Displacement-Time Graphs

15C

One way to describe the motion of an object is with a “displacement-time graph”, which shows how far away an object is at any time. A “sonic ranger” connected to a computer can record the motion of an object and make such a graph for you.

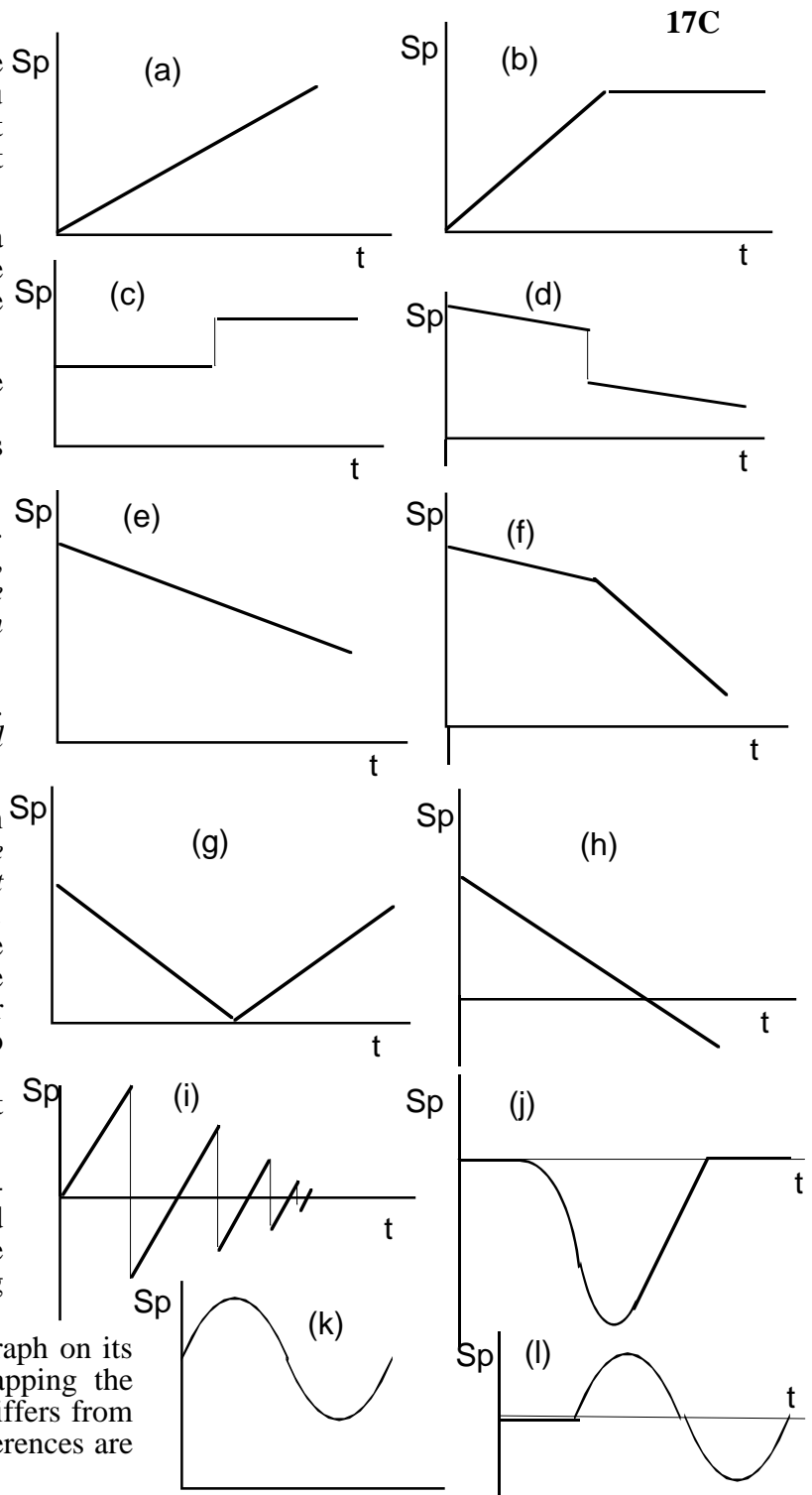
Objects moving in different ways will have graphs with different shapes. Several different examples are sketched at the right.

1. Use a stationary sonic ranger to record the motion of a cart or other object. (To record a motion, use the arrow keys and return key to select “RUN EXPERIMENT”, and then select “START”. Begin the motion when you hear the sonic ranger clicking.) Moving the object by hand, try to produce graphs on the computer screen which resemble the ones at the right. To delete a graph from the screen so that you can make a new one, use the “F8” key. Don’t use F9.
2. For each case in which you are successful, try to describe the object’s motion in words. (Use the back of this paper.) Illustrate each description by copying the D-t graph carefully from the screen..
3. For each case in which you are *not* successful, try to explain what makes it so difficult. Illustrate by copying the graph, and describe what happens when you try it.
4. Select one or two types of motion described by these graphs. Try *not* to duplicate the choices of other teams. Invent a way to make your cart or other object move in the manner described by the graph that you have chosen *without* being touched by hand. Use ramps, pulleys, springs, weights, or any other clever mechanisms that you can devise. After you initiate the motion it should be completed automatically.
5. Demonstrate your method for your teacher and for the rest of the class.
6. Briefly describe and illustrate your method on the back of this paper. Tell how many times the speed changes, what causes the changes in speed, and whether those changes are sudden or gradual.
7. If the object is moving *toward* the clicker then the displacement-time graph has a ___tive slope because the distance between the clicker and the object is ___creasing.
8. To get a D-t graph with a *great* slope, you must move the object with great _____
9. The sonic ranger can only record distances that are greater than _____ but less than _____.



Speed-Time Graphs

A sonic ranger can make graphs of speed vs time to describe the motion of an object, telling you how *fast* the motion is at any given time. Different motions are described by graphs with different shapes. Examples are sketched at the right.



- Set up a sonic ranger to record the motion of a ball. Moving the object by hand, try to produce speed-time graphs resembling some of the ones at the right. It gives _____ive speed values when the ball is moving *toward* the clicker. It gives _____ive speed values when the ball is moving *away* from the clicker.
- For each success, describe the motion in words. For each case in which you are unsuccessful, explain what makes it so difficult. *Use the back of this paper. Illustrate each description with a speed-time graph.*
- Try to find similar written descriptions on 15C. Sketch their displacement-time graphs *and* speed-time graphs side-by-side.
- Select one the more interesting types of motion described by these graphs. *Do not duplicate the choices made by other teams. Do not repeat the choice you made on page 15c.* Devise a way to make your object move in the manner described by that graph. You may use ramps, pulleys, springs, weights, or any other clever methods that enable the object to complete its motion automatically. Demonstrate your method. Then describe it briefly and illustrate your description.
- When you have successfully produced a speed-time graph on the screen of the computer and the graph resembles one of the sketches at the right, try to predict the shape of corresponding displacement-time graph. (Sketch them both.) Then instruct the computer to transform the graph on its screen into a displacement-time graph by tapping the "F2" key. Describe how the resulting graph differs from your prediction, and decide whether those differences are significant. *Illustrate your description.*
- Produce a *different* displacement vs time graph by one of the methods on page 15C. Predict the shape of the corresponding speed-time graph, and sketch it beside the D-T graph. Then instruct the computer to transform the graph on its screen into a *speed-time* graph by tapping the "F2" key. Describe how the resulting graph differs from your prediction, and decide whether those differences are significant. Please *illustrate* your description.
- Which graphs above describe gradual changes in speed? _____ Which ones show *sudden* changes in speed? _____ Which ones show sudden changes in *acceleration*? _____