Motion Graph Practice

Materials needed:
Photocopied sheets, 1 per group as explained, a computer or 2 located in the classroom for student reference.

Teacher Instructions:

1.   The key to getting the students to understand motion is to have them visualize the motion. An excellent way to get students to do this is to have them create their own motion graphs, then use the **VMotion** program for verification.

2.   It is recommended that the teacher demonstrate to the class how the **VMotion** program works before breaking the class into groups.

3.   Print out a copy of **Motion Question Sheet** and **Motion Answer Sheet** found at the **end of this document** and then photocopy the two sheets back-to-back.

4.   Divide the class into small groups and give one copy of the photocopied back-to-back page to each group.

5.   On the answer sheet side have each group generate 4 different motion graphs from which they generate d-t, v-t and a-t graphs. It is best for them to do it in pencil on a rough sheet of paper first until the result has been validated with the **VMotion** Program. Encourage them to generate 2 "easy" graphs with only 2 or 3 types of motion and then 2 "harder" graphs with 4 or 5 motions. (You will find the students will want to do motions with too many stops and starts and backwards and forwards motions if you don't set a limit.)

6.   Once the group has sketched out the motions and have used the **VMotion** program to check the three graphs of each motion, they are ready to copy their 4 sets of graphs onto the **ANSWER** side of the 2-sided copy.

7.   Have them choose whether to transfer the d-t or v-t graph to the question side. (You may want to ask them why you don't want them to plot the a-t graphs.) Once this is done, have the students hand it in for you to "mark" for originality of questions, neatness, etc.

8.   You have now generated, depending of class and group size, over 30 sample motion graphs, with answers, that students can use for review at their leisure. The discussion that occurs during the initial design of the four motions often helps weaker students develop a better understanding of graphical analysis.

Student Instructions:

Work together in your assigned groups to create four sets of motion graphs. The first two sets should have at most two different motions and the second two sets should have no more than five motions.

On a piece of paper sketch the v-t graph first then sketch the d-t graph above the v-t graph and the a-t below. Discuss each motion in your group until agreement is reached that the three graphs for each motion is correct.

Using the **VMotion** program, recreate your v-t graph for each motion and then verify the corresponding d-t and a-t graphs. As a group, discuss any corrections you needed to make.

When all four motions have been verified and corrected, ask the teacher for a sheet to record your motions on.

On the answer side of the page, *neatly* copy your four sets of graphs. On the question side of the page copy either the d-t or the v-t graph from each motion. Hand the graphs in to be evaluated/assessed.

Teacher Demonstrations

Introducing Motion Graphs

When introducing motion graphs, it is often best to have the students be able to visualize the actual motion that matches the graph. Start off with simple motions and then add complexity to them.

1.	Open up a ***.car** that can be downloaded from the Jabe.com website and discuss each motion graph as you go along. Some are the same experiments found in the experiments menu, but you can easily jump to the next experiment by selecting **next question**.

2.	For each experiment, have the students guess how the car should move. Click on **Drive** and have the students determine if they are right. Ask them to describe what each of the missing graphs would look like. Work your way through all the motions. If the students have questions about the motions you can move the "dots" on the v-t graph after you hit the "show all graphs button". This gives you the option to modify the graph to emphasize a key point they may be missing. (i.e. slowly move the last point up and down and they can immediately see the effects to the d-t/a-t graphing when increasing or decreasing the final velocity.)

3.	When done, you can have them work through the other built in experiments from the advanced section or repeat the same procedure by opening another ***.car** file. Start with the easier car files first. You may want them to sketch each motion they see in their notes for future reference

4.	You can use the time scrollbar to illustrate clearly what the car is doing at different parts of the graph. This is ideal where the car reverses direction. Students often think that when the car is below the d-t graph it is going backwards. You can drag the box in the scrollbar to any point in the motion and a bar traces the part of the graph that the motion corresponds to.

5.	You can also create your own "races" so you can compare the two cars motion and save the motion for future reference.

## Teacher Resources

Copying Graphs: Test Creator

A useful feature of the program is creating graphs for quizzes or tests that can be easily added into a word-processed document to make clean looking graphs. No more cutting and pasting of graph paper and getting the "curve" to look right.

You have three main options.

1   ***Copy the entire graph***. This copies all three graphs. Ctrl – E is the short cut. (Note: You have the ability to show only one of the three motions if you feel it appropriate)
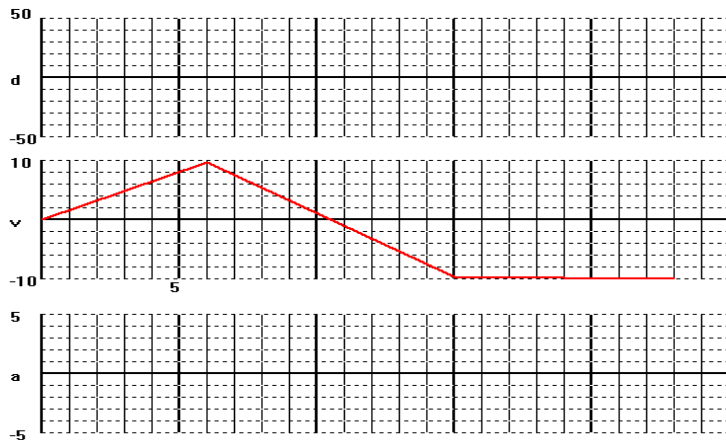

2   ***Copy only one of the graphs***. To copy d-t, v-t **or** a-t graph, you can use the short cut keys F1, F2 and F3 respectively.
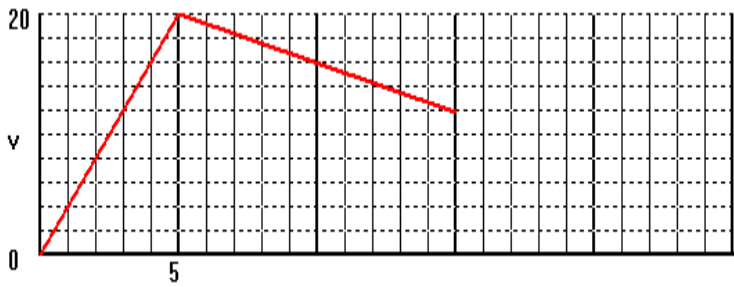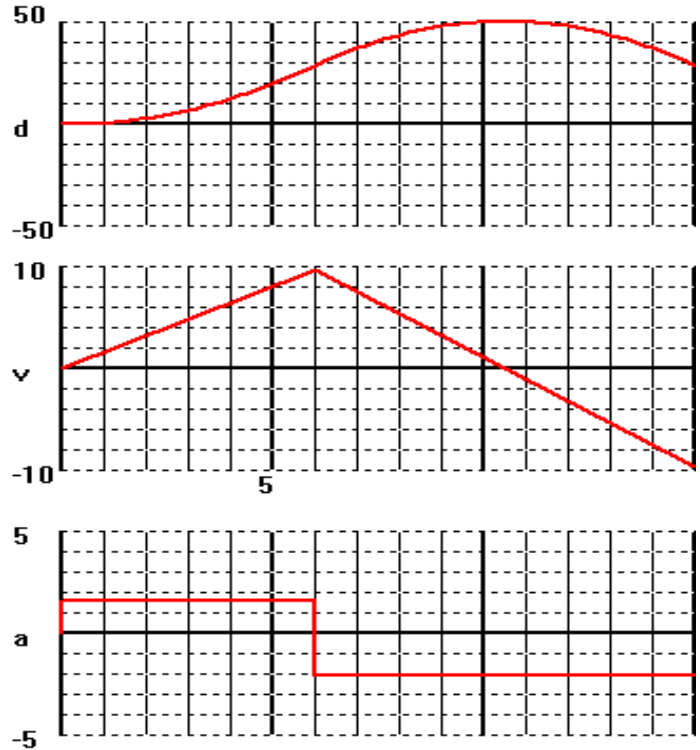
3 ***Copy to the last point*** displayed on the graph. This is ideal for multiple choice questions where you don't need the entire graph just a small part of the motion. To do this make sure you have checked the option **'Copy to Last Point'** in the options Menu.

*Note:*Ensure you have not selected the **Copy to Last Point** option if you want to copy the whole graph.
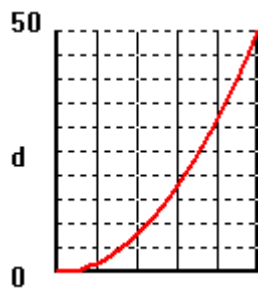
Using a Motion File

For optional download from the Website, a series of additional motions similar to the preloaded experiments, (Each file should have the ***.CAR** extension.) that have been copied on you hard disk. (If installed on your network, see your network administrator to see where it was installed) The benefits of these files are numerous, for example, they can be used to have the students test themselves, as a learning tool for students to work through or as a teaching tool for you to take the students through. To become familiar with the options in these files follow the instructions below.

1.   Load any ***.car** in the **VMotion** Program by going to the **View** menu selecting **Experiments** then selecting **Load Car Motion.** The available files should be listed in the directory or you can download them to the directory from the **JABE.com** web site. Select the a file and click **OPEN**. (If the motions aren't listed, change the directory to where the files are stored or download some files)

2.   This motion shows all three graphs. Clicking the **Drive** button sets the car in the motion that is shown in the graphs. You can change the speed of the car by using the **Speed** slider. The car can be stopped at any point in the motion by clicking the **Stop** button. To repeat the motion after it ends simply slide the **Time** slider all the way to the left and click the **Drive** button. When finished with the first motion click the **Next Question** button and a new motion appears. The section **Creating a Set of Motions** explains how to create and save a set of motions. This way you can have as many different motions as you wish.

3.   Another possibility is to only have one graph appear and the student has to sketch the missing graphs. To see how this option works, be sure to use a ***.car** file that has a "quiz" in its name. The three grids appear but only one graph is shown. Note that the **Show All Graphs** is inactive so if students are working on their own, they can't just view all the graphs and copy. To proceed to the next question click the **Next Question** button. There are four questions in this file but again the next section **Creating a Set of Motions** will show you how to make your own set. Which graph is displayed is determined when you create the file. (note: ensure the file is **READ ONLY** to ensure the student doesn't change the file. See the network administrator for instructions on how to do so. If you want to edit the file you must remove the **READ ONLY** option)

Creating a Set of Motions

The program allows you to create and load a series of graphs similar to the experiments preloaded in the program, with one important addition. You are given an option to **NOT** allow the students to see all the graphs if you don't want them to. This is an important addition if you want to use the program as a testing aid.
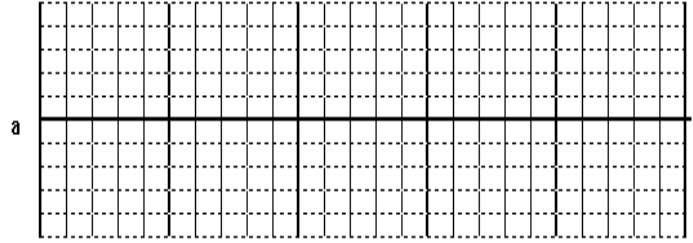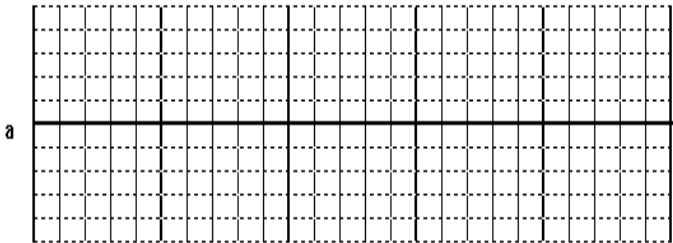
To create a set of motions:
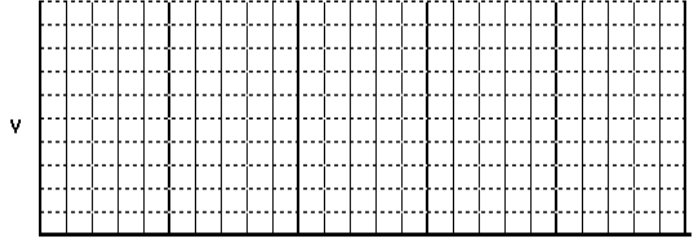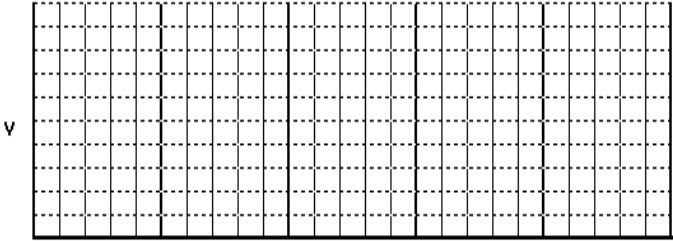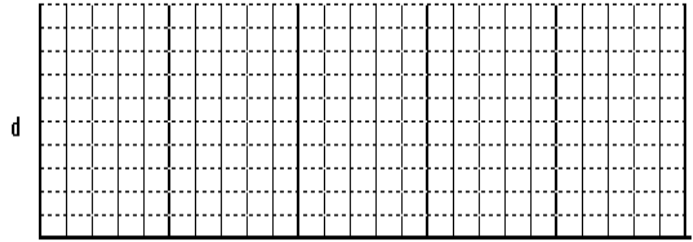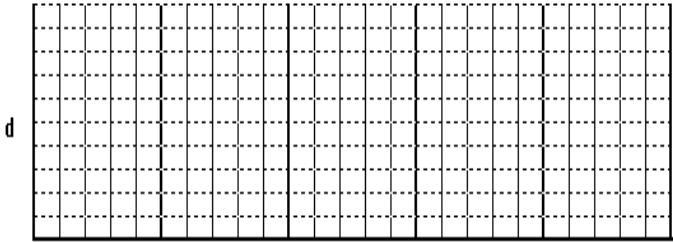
1.   Open the **VMotion** program and create a motion by adding points to the v-t graph and using the mouse to position the points. Scale the graphs appropriately, allow the user to view the appropriate graphs by using the **View** menu and selecting **Show**, set the speed of the car. (Sometimes you may slow down or speed up the motion to make it easier to see the motion.)

2.   Go to the **View** menu and select **Experiment-Save Car Motion**. At this point you have 2 options: **Add to File** or **New File**.

3.   If you select **Add to File** you will need to locate that file. The new motion is automatically added to the file when you click **OK**. Repeat this procedure for as many motions as you wish to add.

4.   If you select **New File**, you will be prompted for a file name and path where you want the file saved. (it will automatically add the ***.CAR** extension) It will then prompt you if you want to allow the user to modify the graph. This means if you select **NO**, the user will **NOT** be able to see the missing graphs, which is beneficial for testing purposes. As well you can prevent users from over writing the file by setting its attribute to Read Only using Windows Explorer.

Motion Question Sheet

Question: _____

d

v

a

Question: _____

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v

a

Question:

d

v

a

Question:

d

v

a

Name(s):

Motion Answer Sheet

Question: ____

Question: ____

Name(s):

d

v

a

Question: ____

Question: ____

d

v

a