INTRODUCTORY LABORATORY 0:
DETERMINING AN EQUATION FROM A GRAPH

Throughout this course, you will use computer programs to graph physical quantities. Before measuring, you enter equations to represent predictions for the quantities to be measured. After measuring, you determine the equations that best represent (*fit*) the measured data, and compare the resulting Fit Equations with your Prediction Equations. This activity will familiarize you with the procedure for fitting equations to measured data.

EXPLORATION

Log on to the computer. Open the *PracticeFit* program by double-clicking its icon on the desktop. The "Instruction" box provides instructions that change as you progress. Holding the mouse over a button or the graph also provides some help.

You will try to fit equations to data generated by a Mystery Function. There are several sets of "Mystery Functions" to choose from; ranging from simpler (1) to more varied and complicated (10). The parameters, and in some cases the function types, are randomly chosen; you can try each Mystery Function several times until you are comfortable with it.

Follow the instructions on the screen until you are asked to select a "Fit Function" to approximate the Mystery Function data graphed on the screen. (You may need to change the graph's axis limits to locate the Mystery Function data!) The curve graphed for the Fit Function will change to match parameters you select; try to find the equation that gives the best possible fit to the Mystery Function data. The Method Questions below are designed to help. Once you are satisfied with an equation, press "Accept Fit Function" to reveal the equation of the Mystery Function.

WARM-UP

The following questions should help you determine the equation that best matches the curve:

1. Determine the type of Fit Function that can best approximate the Mystery Function data. Examine the data's graph. Is it a straight line? If the graph bends, does it have a parabolic shape, an exponential shape, or a repeating pattern? Use your knowledge of functions to select the best equation type from the choices offered by *PracticeFit*.

2. Next you need to determine the constants in the equation. Examine the graph where the horizontal coordinate is zero:

- At this point, what is the *value* of the vertical coordinate of the graph? What constant in the Fit Function equation is represented by this vertical coordinate?
- At this same point, what is the *slope* of the graph, and what constant does it represent? (If you have taken some calculus, you will know that the derivative of a function represents the slope of its graph.)

If there are more constant parameters to determine for the Fit Function, you must look at other points on the graph; your knowledge of functions and calculus will help. You might

examine points on the horizontal axis, points with zero slope, and/or the graph's asymptotic behavior. It may also be useful to consider the derivative of the Fit Function.

During the rest of this physics course, you will deal with real physical situations. You can usually determine the form of the best Fit Function and estimate its constant parameters based on your physics knowledge and what you observe in the laboratory; this can greatly simplify the fitting process.

CONCLUSION

How close was your equation to the Mystery Function used to generate the each curve? If your equation was not exactly the same as the actual equation, how would you determine what would be an acceptable degree of difference?

If the horizontal axis represents time and the vertical axis represents position, what type of motion might this curve represent?