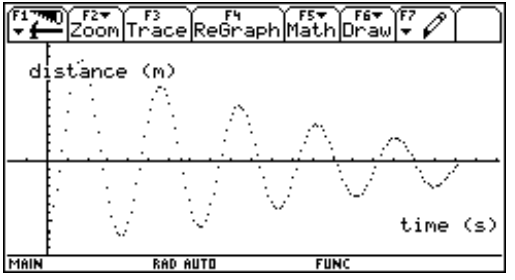
Activity 11
Modeling Damped Motion

Answers to Instructions: Part A

Sample data for this activity is shown in the illustration to the right. Answers to activity questions are based on this data set; as a result, student responses may vary.



Answers to Instructions: Part B

1. $a = 0.168$ meters.
2. time for first maximum = 0.642 seconds
   time for second maximum = 2.092 seconds
3. period = 1.45 seconds
4. $b = 4.33$.
5. $c = 0.642$.
6. A modified b value of 4.40 provides a good fit horizontally.

   The fit is poor vertically because the amplitude is decreasing with time; the constant a should be modified.

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(Continued)

Answers to Instructions: Part B

8. $y = 0.205(0.776)^x$. This equation provides a good fit for the amplitude data.

9. The model in which the amplitudes decay exponentially fits the distance-versus-time data well.

Answers to Questions

1. The b-value remains the same. Because sine and cosine are out of phase by one-quarter period, the new c-value, c', is given by: $c' = c - P/4$, where P is the period of oscillation.

2. Because the amplitude values are increasing with time, the base for the exponential modeling curve would have to be greater than 1. The form of the sinusoidal portion of the model would remain the same.

3. For undamped oscillations, the velocity-versus-distance curve would have an elliptical shape. Because velocity and distance both decay with time, the resulting plot spirals towards the origin.