TEACHER INFORMATION

Titration Curves: An Application of the Logistic Function

1. There are currently 2 different combinations of equipment that will work for collecting pH data. The most common method, which works for both the TI-83 Plus and TI-84 Plus families of calculators, is to use a pH Sensor attached to a CBL 2 or LabPro.

   The TI-84 Plus calculator has a USB port located at the top right corner. Using the USB port, an EasyLink with a pH Sensor can be connected to collect pH data. For more information on EasyLink refer to Page *ix* located in the front section of this book.

2. When connecting an EasyLink to a TI-84 Plus calculator using USB, the EasyData application automatically launches when the calculator is turned on and at the home screen.

3. Before using the pH sensor, rinse the sensor tip in distilled water.

4. At the completion of the activity, use distilled water to rinse the pH electrode. Tightly secure the storage solution bottle on the electrode tip. Refer to the data sheet that came with the pH Sensor for detailed storage information.

5. Students should wear safety goggles while handling chemicals.

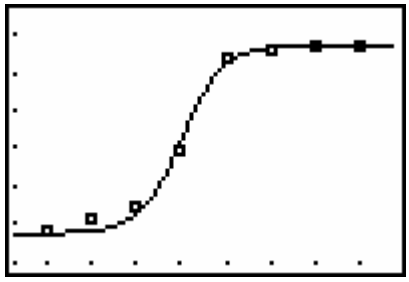
6. Use real ammonia, and not a cleaning solution that includes ammonia, in the activity.

7. Rinse all containers well at the end of the activity, flushing the waste with lots of water.

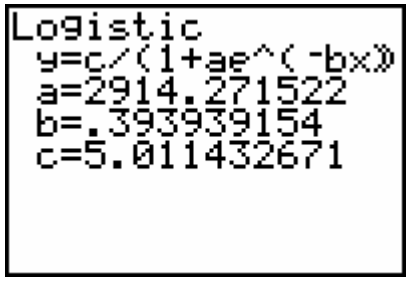
8. The *B* parameter is not well determined by the activity, so that a 10 or 15% change in *B* will produce a barely visible change in the graph. Do not expect consistent values for this parameter, even if students are working with the same data set. For the same reason, the parameter related to *B* will likely be quite different in the calculator curve fit, perhaps even by a factor of five.

9. The logistic function is not an optimum model for a titration curve; chemists use a much more complex model for titration. However, the pH data roughly follow the logistic function, so we use the logistic function as a simplified model.

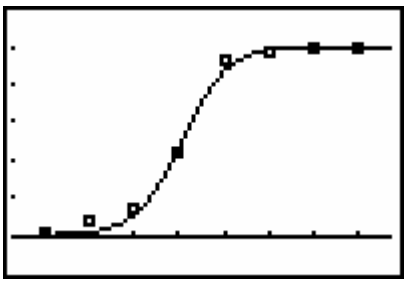
SAMPLE RESULTS



Titration data with model equation



Logistic fit (extension)



Calculator regression and adjusted data

DATA TABLE

A	B	C	D
5.0	0.65	20	5.7

ANSWERS TO QUESTIONS

1. The logistic model fits the titration data very well.

EXTENSION DATA TABLE

	algebraic expression	parameters from calculator	parameters as calculated from model
a (in terms of B and C)	$a = B^{-C}$	2100	5500
b (in terms of B)	$b = -\ln B$	0.39	0.43
c (in terms of A)	$c = A$	5.01	5.00

ANSWERS TO EXTENSION QUESTIONS

1. Answers will vary.
2. The calculator fit looks to be about the same as my model.
3. The data table is completed as shown above.
4. The parameters from the calculator and the model are similar but not exactly the same. From my experience in adjusting the *B* parameter in the original model, noting that a significant change in *B* made for a small change in the observed fit, I'm not surprised to see that the term depending on both *B* and *C* (which is *B* raised to a large power) is not very close to the calculator fit.