

EXTENT OF A CHEMICAL REACTION

NAME _____

SECTION _____

Log on to the Internet. Type the following address into the location-input line of your browser:

<http://introchem.chem.okstate.edu/DCICLA/ERGBN.htm>

This will load a Graphics Simulation. Once you have the simulation running, your screen will look like what is shown in Figure 1 below. If you haven't already done so, read the Graphics Simulation section of the Introduction to MoLEs Activities to learn how to use the simulation.

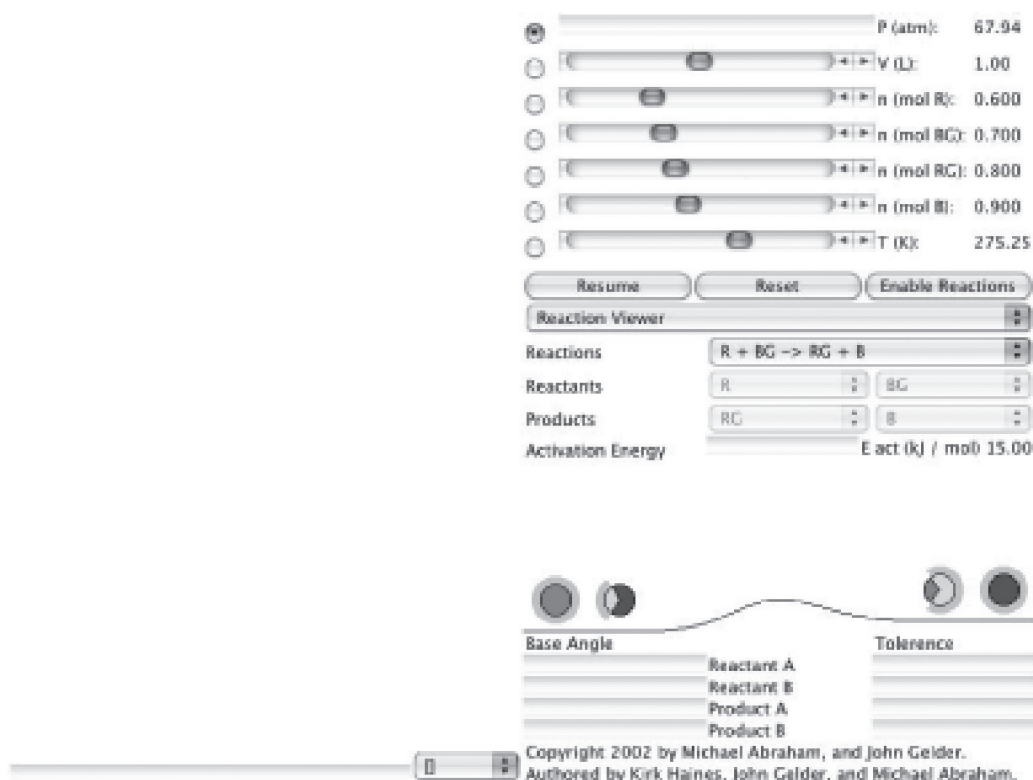


Figure 1.

Problem Statement: What is the relationship between reactant and product concentrations at the end of a reaction?

I. Data Collection

Open the Graphic Simulation program for the R+BG reaction. Using the Control Bar region, adjust the initial conditions of the reaction being studied to those listed in the following table. Record the pressure, volume, and temperature of the sample in the following table. Use the Resume and Enable Reaction buttons to begin the reaction. When the reaction is completed, pause to stop the action. Record the values of the ending concentrations in the following table.

EXPERIMENT #1:	R	+	BG	→	RG	+	B
Initial Concentration – I	2.0		2.0		0		0
Concentration Change – C	_____		_____		_____		_____
Ending Concentration – E	_____		_____		_____		_____
Pressure	_____						
Volume	_____						
Temperature	_____						

II. Data Analysis and Interpretation

- A. Calculate the change in concentration of each of the particles in the reaction and record the values in the above table.

- B. Draw and label the appearance of the strip chart. Identify each kind of particle on the strip chart and explain what is happening to each over time. How does the strip chart illustrate the change in the data in the table?

III. Data Collection

Using the Control Bar region, adjust the initial conditions of the reaction being studied to those listed in the following table. Record the pressure, volume, and temperature of the sample in the following table. Use the Resume and Enable Reactions buttons to begin the reaction. When the reaction is completed, pause to stop the action. Record the values of the ending concentrations in the following table.

EXPERIMENT #2:	R	+	BG	→	RG	+	B
Initial Concentration – I	1.0		1.0		0		0
Concentration Change – C	_____		_____		_____		_____
Ending Concentration – E	_____		_____		_____		_____
Pressure	_____						
Volume	_____						
Temperature	_____						

IV. Data Analysis and Interpretation

- A. Calculate the change in concentration of each of the particles in the reaction and record the values in the above table.
- B. Draw and label the appearance of the strip chart. Identify each kind of particle on the strip chart and explain what is happening to each over time. How does the strip chart illustrate the change in the data in the table?

- C. Given the initial concentrations in the following table, predict what the concentration change and ending concentrations would be. How did you make your predictions?

	R	+	BG	→	RG	+	B
Initial Concentration – I	1.5		1.5		0		0
Concentration Change – C	_____		_____		_____		_____
Ending Concentration – E	_____		_____		_____		_____

V. Data Collection

Using the Control Bar region, adjust the initial conditions of the reaction being studied to those listed in the following table. Record the pressure, volume, and temperature of the sample in the following table. Use the Resume button to begin the reaction. When the reaction is completed, pause to stop the action. Record the values of the ending concentrations in the following table.

EXPERIMENT #3:	R	+	BG	→	RG	+	B
Initial Concentration – I	1.5		1.5		0		0
Concentration Change – C	_____		_____		_____		_____
Ending Concentration – E	_____		_____		_____		_____
Pressure	_____						
Volume	_____						
Temperature	_____						

VI. Data Analysis and Interpretation

- A. Calculate the change in concentration of each of the particles in the reaction and record the values in the above table.
- B. Comment on how your predictions in IV.C. compared to the actual values determined from experiment.

- C. Given the initial concentrations in the following table, predict what the concentration change and ending concentrations would be. How did you make your predictions?

	R	+	BG	→	RG	+	B
Initial Concentration – I	0		0		1.0		1.0
Concentration Change – C	_____		_____		_____		_____
Ending Concentration – E	_____		_____		_____		_____

VII. Data Collection

Using the Control Bar region, adjust the initial conditions of the reaction being studied to those listed in the following table. Record the pressure, volume, and temperature of the sample in the following table. Use the Resume button to begin the reaction. When the reaction is completed, pause to stop the action. Record the values of the ending concentrations in the following table.

EXPERIMENT #4:	R	+	BG	→	RG	+	B
Initial Concentration – I	0		0		1.0		1.0
Concentration Change – C	_____		_____		_____		_____
Ending Concentration – E	_____		_____		_____		_____
Pressure	_____						
Volume	_____						
Temperature	_____						

VIII. Data Analysis and Interpretation

- A. Calculate the change in concentration of each of the particles in the reaction and record the values in the above table.

- B. Comment on how your predictions in VI.C. compared to the actual values determined from experiment.
- C. Compare your data in sections III. (Experiment #2) and VII. (Experiment #4). How do you explain this comparison?
- D. Given the initial concentrations in the following table, predict what the concentration change and ending concentrations would be. How did you make your predictions?

	R	+	BG	→	RG	+	B
Initial Concentration – I	2.0		0.5		0		0
Concentration Change – C	_____		_____		_____		_____
Ending Concentration – E	_____		_____		_____		_____

IX. Data Collection

Using the Control Bar region, adjust the initial conditions of the reaction being studied to those listed in the following table. Record the pressure, volume, and temperature of the sample in the following table. Use the Resume button to begin the reaction. When the reaction is completed, pause to stop the action. Record the values of the ending concentrations in the following table.

	R	+	BG	→	RG	+	B
EXPERIMENT #5:							
Initial Concentration – I	2.0		0.5		0		0
Concentration Change – C	_____		_____		_____		_____
Ending Concentration – E	_____		_____		_____		_____
Pressure	_____						
Volume	_____						
Temperature	_____						

X. Data Analysis and Interpretation

- A. Calculate the change in concentration of each of the particles in the reaction and record the values in the above table.
- B. Comment on how your predictions in VIII.D. compared to the actual values determined from experiment.

XI. Data Collection

- A. Using the Control Bar region, adjust the initial conditions of the reaction being studied to those listed in the following table. Record the pressure, volume, and temperature of the sample in the following table. Use the Resume and Enable Reactions buttons to begin the reaction. When the reaction is completed, pause to stop the action. Record the values of the ending concentrations and the change in concentration of each of the particles in the following table.

EXPERIMENT #6:	R	+	BG	→	RG	+	B
Initial Concentration – I	1.0		0.6		1.2		0.8
Concentration Change – C	_____		_____		_____		_____
Ending Concentration – E	_____		_____		_____		_____
Pressure	_____						
Volume	_____						
Temperature	_____						

- B. Carry out two additional experiments by adjusting the concentrations of the reactants and products to values of your choosing. Be careful that the ending concentrations do not try to exceed the limits of the allowable values. Check to make sure the ending values of volume and temperature do not change.

EXPERIMENT #7:

	R	+ BG	→	RG	+ B
Initial Concentration – I	_____	_____		_____	_____
Concentration Change – C	_____	_____		_____	_____
Ending Concentration – E	_____	_____		_____	_____
Pressure	_____				
Volume	_____				
Temperature	_____				

EXPERIMENT #8:

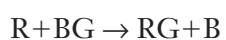
	R	+ BG	→	RG	+ B
Initial Concentration – I	_____	_____		_____	_____
Concentration Change – C	_____	_____		_____	_____
Ending Concentration – E	_____	_____		_____	_____
Pressure	_____				
Volume	_____				
Temperature	_____				

XII. Data Analysis

Summarize the ending concentrations of reactants and products for the eight reactions you studied in this activity by recording your data in the left-hand sections of the following table.

Pressure _____
Volume _____
Temperature _____

Calculation Results



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Experiment #1: Ending Concentration —E _____

Experiment #2: Ending Concentration —E _____

Experiment #3: Ending Concentration —E _____

Experiment #4: Ending Concentration —E _____

Experiment #5: Ending Concentration —E _____

Experiment #6: Ending Concentration —E _____

Experiment #7: Ending Concentration —E _____

Experiment #8: Ending Concentration —E _____

XIII. Data Interpretations and Conclusions

- A. What conclusions can be drawn from these data? Find an algebraic equation that relates the actual concentrations of the reactants and products of the reaction studied. (Hint: Try all possible combinations of the four concentrations by multiplication and/or division. For example, multiply all four together, multiply two and divide by the other two, etc., looking for the combination that gives the most constant result.) Summarize your results for three possibilities in the table above. Label each column with how you combined the four concentrations in the box provided. Discuss your results below.

- B. Use your results to predict the ending concentrations for the following. Show how you made your prediction. Check your prediction with the Graphic Simulation.

	R	+	BG	→	RG	+	B
Initial Concentration – I	<u>1.0</u>		<u>0.6</u>		<u>0</u>		<u>0</u>
Concentration Change – C	_____		_____		_____		_____
Ending Concentration – E	_____		_____		_____		_____
Pressure	_____						
Volume	_____						
Temperature	_____						