

Extent of a Chemical Reaction

Name _____ Lab Section _____

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

<http://cheminfo.chem.ou.edu/~mra/CCLI2004/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.

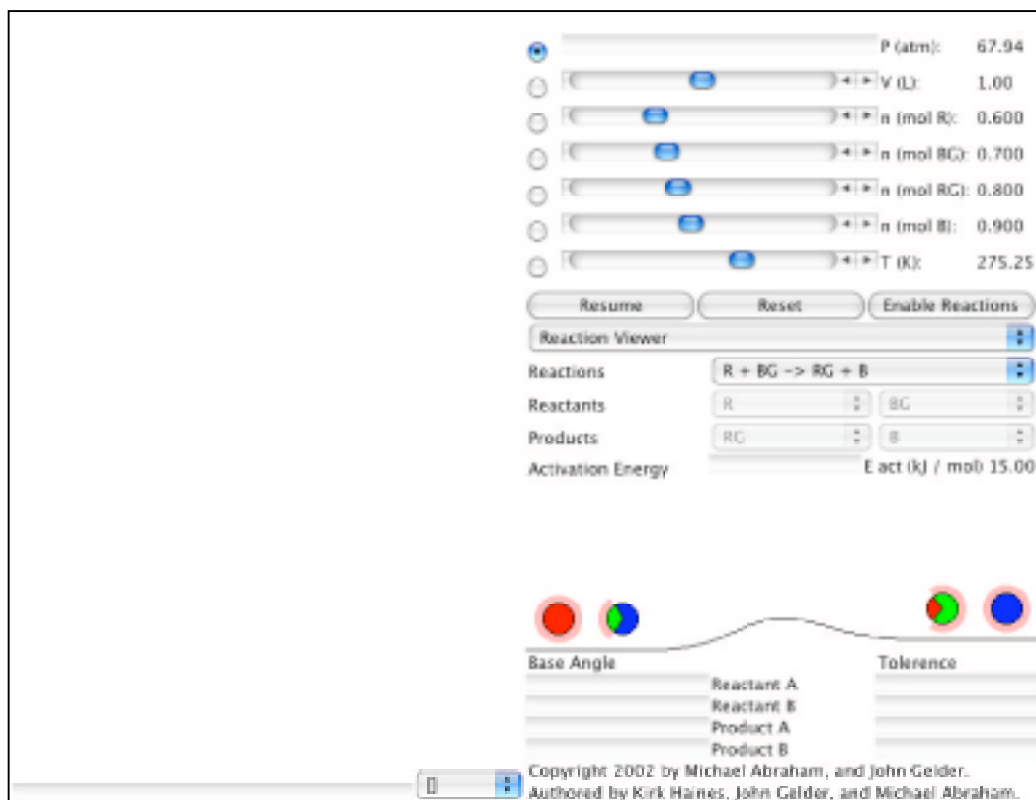


Figure 1.

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:	$R + BG \rightarrow RG + B$
Initial Concentration – I	<u> 2.0 </u> <u> 2.0 </u> <u> 0 </u> <u> 0 </u>
Concentration Change – C	___ ___ ___ ___
Ending Concentration – E	___ ___ ___ ___
Pressure	_____
Volume	_____
Temperature	_____

II. Data Analysis and Interpretation:

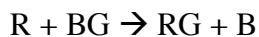
- A. Calculate the change in concentration of each of the particles in the reaction and record the values in the above table.

- B. Draw and label the appearance of the strip chart. Identity 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 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 #2:



Initial Concentration – I	<u>1.0</u>	<u>1.0</u>	<u>0</u>	<u>0</u>
Concentration Change – C	___	___	___	___
Ending Concentration – E	___	___	___	___

Pressure _____

Volume _____

Temperature _____

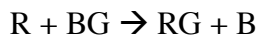
IV. Data Analysis and Interpretation:

- 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. Identity 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?

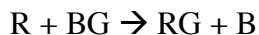


Initial Concentration – I	<u>1.5</u>	<u>1.5</u>	<u>0</u>	<u>0</u>
Predicted Concentration Change – C	___	___	___	___
Predicted Ending Concentration – E	___	___	___	___

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:



Initial Concentration – I	<u>1.5</u>	<u>1.5</u>	<u>0</u>	<u>0</u>
Concentration Change – C	___	___	___	___
Ending Concentration – E	___	___	___	___

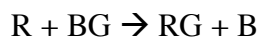
Pressure _____

Volume _____

Temperature _____

VI. Data Analysis and Interpretation:

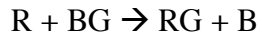
- A. Calculate the change in concentration of each of the particles in the reaction and record the values in the above table.
- B. Comment on how your predictions in IV. C. compared to the actual values determined from experiment.
- C. Given the initial concentrations in the following table, predict what the concentration change and ending concentrations would be. How did you make your predictions?



Initial Concentration – I	<u> 0 </u>	<u> 0 </u>	<u> 1.0 </u>	<u> 1.0 </u>
Predicted Concentration Change – C	—	—	—	—
Predicted 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:

Initial Concentration – I	<u> 0 </u>	<u> 0 </u>	<u> 1.0 </u>	<u> 1.0 </u>
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?

		$R + BG \rightarrow RG + B$			
Initial Concentration – I		<u>2.0</u>	<u>0.5</u>	<u>0</u>	<u>0</u>
Predicted					
Concentration Change – C		—	—	—	—
Predicted					
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.

EXPERIMENT #5:

		$R + BG \rightarrow RG + B$			
Initial Concentration – I		<u>2.0</u>	<u>0.5</u>	<u>0</u>	<u>0</u>
Concentration Change – C		—	—	—	—
Ending Concentration – E		—	—	—	—

Pressure _____

Volume _____

Temperature _____

X. Data Analysis and Interpretation:

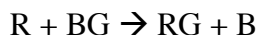
- A. Calculate the change in concentration of each of the particles in the reaction and record the values in the above table.

- 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 Reaction 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:



Initial Concentration – I 1.0 0.6 1.2 0.8

Concentration Change – C ____ ____ ____ ____

Ending Concentration – E ____ ____ ____ ____

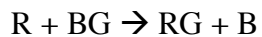
Pressure _____

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:



Initial Concentration – I _____

Concentration Change – C _____

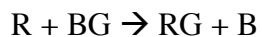
Ending Concentration – E _____

Pressure _____

Volume _____

Temperature _____

EXPERIMENT #8:



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.

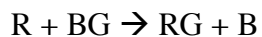
Pressure _____

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.

	$R + BG \rightarrow RG + B$			
Initial Concentration – I	1.0	0.6	0	0
Concentration Change – C	—	—	—	—
Ending Concentration – E	—	—	—	—

Pressure _____

Volume _____

Temperature _____