

SHIFTING REACTIONS B

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.

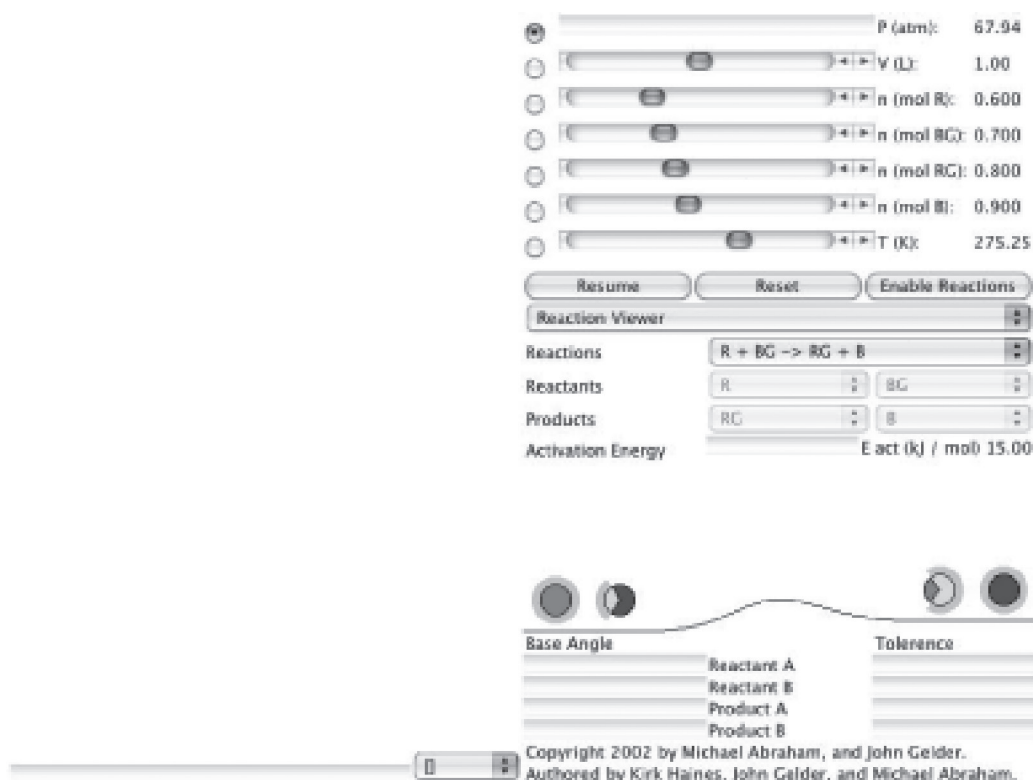


Figure 1.

Problem Statement: How can concentration changes affect a chemical reaction?

I. Data Collection

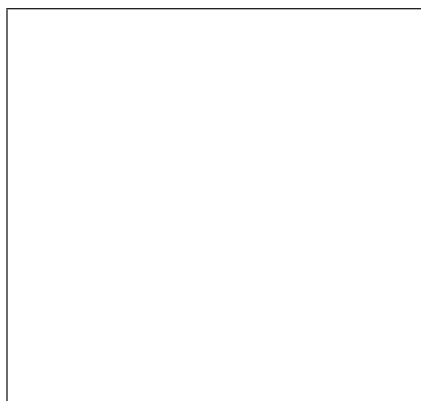
- A. Open the Graphics Simulation program. Using the data from the Control Bar Region, enter the initial concentration of each substance in the equation, along with the initial pressure, volume, and temperature into the table below.

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

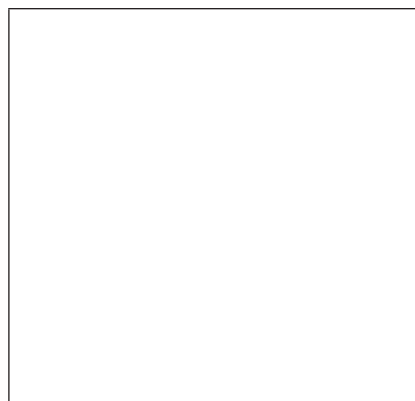
- B. Click on the Resume and then the Enable Reactions button to begin the reaction. When the reaction appears to be complete, click Pause to stop the action. Record the values of the ending concentrations in the table in Section I.A. Calculate the change in concentration of each of the substances in the reaction. In the space below, draw the appearance of the strip chart and label the axes. If necessary, use the scrollbar located under the strip chart to move the chart back to the beginning of the reaction. Identify the chemical substance that corresponds to each of the colored lines.

II. Data Analysis and Interpretation

- A. Mental Modeling: In the following boxes, draw pictures at the level of atoms and molecules that represents the initial and ending states of the reaction.



Initial



Ending

- B. Explain what is happening to each of the reactant and product substances over time. How does the strip chart illustrate the changes you observe?

- C. How can you tell when the reaction is complete? What substances are present when the reaction appears to be complete?

- D. Considering the substances that are present when the reaction appears to be complete, why do the concentrations of the substances cease to change?

III. Data Collection

- A. If necessary, click Pause to stop the action. If you moved the strip chart scrollbar in the previous section, shift it back to as far to the right as it will go. Use the ending concentrations of BG, RG, and B from Experiment #1 (Section I.A.) as the initial concentrations in this experiment. Enter those values in the table below. In the Control Bar Region add R until its concentration is 2.0 M. Record this initial concentration of R in the table below. Click the Resume button. Observe how the concentrations of the substances change over time. When the reaction appears to be complete, click the Pause button. Record the values of the ending concentrations in this table and calculate the change in concentration of each of the substances in the reaction. Draw and label the appearance of the portion of the strip chart for this reaction. (NOTE: If necessary drag the Strip Chart scrollbar to the left.)

EXPERIMENT #2: Increase Reactant R to 2.0 M

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

- B. If you moved the Strip Chart scrollbar in the previous section, shift it back to as far to the right as it will go. Use the ending concentrations of R, RG, and B from Experiment #2 as the initial concentrations in this experiment. Enter those values in the table below. In the Control Bar Region add BG until its concentration is 1.0 M. Record this initial concentration of BG in the table below. Click the Resume button. Observe how the concentrations of the substances change over time. When the reaction appears to be complete, click the Pause button. Record the values of the ending concentrations in this table and calculate the change in concentration of each of the substances in the reaction. Draw and label the appearance of the portion of the strip chart for this reaction. (NOTE: If necessary drag the Strip Chart scrollbar to the left.)

EXPERIMENT #3: Increase Reactant BG to 1.0 M

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

- C. In a manner similar to the previous experiments, remove R until its concentration equals 0.75 M. Record the new initial conditions of all substances in the table below. Click the Resume button. Observe how the concentrations of the particles in the sample change over time. When the reaction appears to be complete, click the Pause button. Record the values of the ending concentrations in the table and calculate the change in concentration of each of the substances in the reaction. Draw and label the appearance of the portion of the strip chart for this reaction.

EXPERIMENT #4: Decrease Reactant R to 0.75 M

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

D. In a manner similar to the previous experiments add RG until its concentration is 2.0 M. Record the new initial conditions of all substances in the table below.

EXPERIMENT #5: Increase product RG to 2.0 M

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

Before initiating the reaction draw what you think the Strip Chart Region will look like during this reaction in the box labeled Your Prediction.

Your Prediction:	Your Observation:

Click the Resume button. Observe how the concentrations of the particles in the sample change over time. When the reaction appears to be complete click the Pause button. Record the values of the ending concentrations in the ICE table (above) and calculate the change in concentration of each of the substances in the reaction. Draw and label the appearance of the portion of the strip chart for this reaction in the Your Observation box.

- E. In a manner similar to the previous experiments remove RG until its concentration is 1.0 M. Record the new initial conditions of all substances in the table below.

EXPERIMENT #6: Decrease product RG to 1.0 M

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

Before initiating the reaction, draw what you think the Strip Chart Region will look like during this reaction in the box labeled Your Prediction.

Your Prediction:	Your Observation:

Click the Resume button. Observe how the concentrations of the particles in the sample change over time. When the reaction appears to be complete, click the Pause button. Record the values of the ending concentrations in the ICE table (above) and calculate the change in concentration of each of the substances in the reaction. Draw and label the appearance of the portion of the strip chart for this reaction in the Your Observation box.

IV. Data Analysis and Interpretation

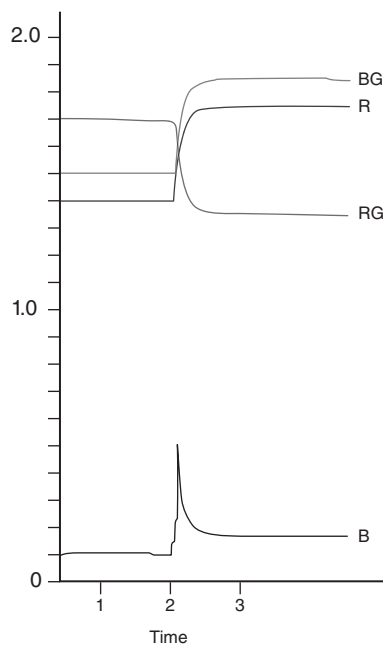
- A. Summarize your observations of Experiments #3–#6 by completing the table below. As an example, the entries for Experiment #2 have been done for you.

Experiment	Stress	Change in [Reactants]	Change in [Products]	Reaction shift
#2	Add reactant [R]	Concentrations decreased	Concentrations increased	Left to Right
#3				
#4				
#5				
#6				

- B. Consider the strip chart recording on the right for a hypothetical experiment.

What was the stress placed on the reaction at time 2?

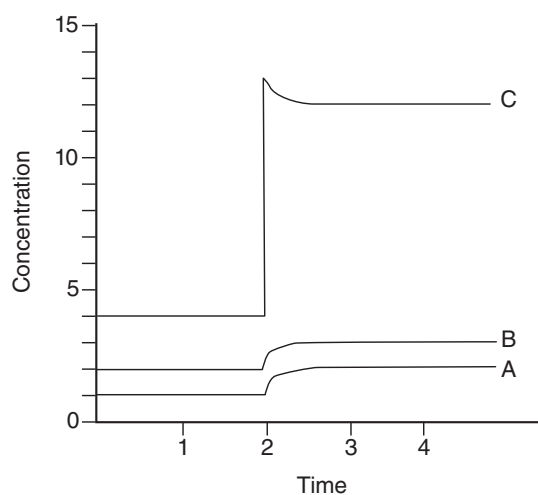
Write an equation to describe this reaction, then set up and complete all the entries in an ICE table.



V. Conclusions

A. Review the summary of your experimental observations that you prepared in Section IV.A. Write a statement(s) that generalizes how stressing a reaction by adding or removing a reactant or product shifts the chemical reaction.

B. Mental Modeling: Consider the strip chart recording on the right for a hypothetical experiment. Write an equation to describe this reaction, then set up and complete all the entries in an ICE table.



In the following boxes, draw pictures at the level of atoms and molecules that represents the progress of the hypothetical experiment from $t=1$ to $t=2$ to $t=3$. Indicate those particles that are added or subtracted from the sample as a result of the stress placed on the system.

time = 1	time = 2	time = 3

If you were to make a drawing for time=4, how would it be similar to the drawing you made for time=3? How would it be different?

