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SCH4U: 3-4 I: Factors Affecting Rates of Reaction: Simulation

CONTENT FORMATIVE

In this simulation, you will explore how different factors affect the rate of a reaction by measuring the appearance of one of the product molecules over time. You will be investigating a reversible reaction with the formula:

$$A + BC \leftrightarrows AB + C$$

Instructions:

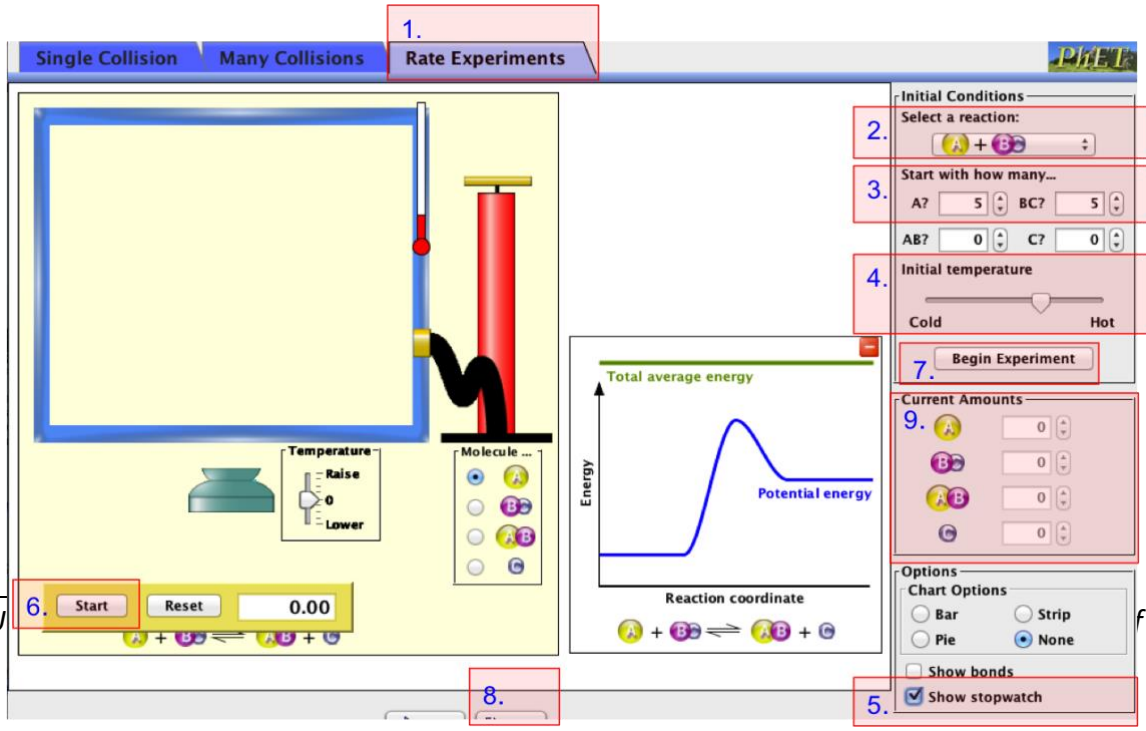
To open the simulator, click the following link:
http://phet.colorado.edu/en/simulation/reactions-and-rates

Note: If you are unable to view the simulator , talk to your CT and get sample data from them.

Experiment #1a: Effect of Concentration - Low Concentration:

Setup:

1. Click on the "Rate Experiments" tab at the top of the simulator
2. "Select a reaction": choose the first option
3. Start with how many….
   i) A?: **5**
   ii) BC?: **5**
4. Initial Temperature**:**
   i) move the sliding bar approximately 3/4 of the way towards the "Hot" end
5. Select the box at the bottom that says "Show stopwatch"
6. Click the "Start" button on the stopwatch, located in the yellow rectangle in the lower left corner
7. Click "Begin Experiment"
8. When the stopwatch passes 500 click "pause"
9. Record the amount of each reactant and product in Table 1 below.



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Experiment #1b: Effect of Concentration - High Concentration

1. Click "Reset All"
2. Start with how many….
    i) A?: **20**
    ii) BC?: **20**
3. Initial Temperature**:**
    i) move the sliding bar approximately 3/4 of the way towards the hot end
4. Select the box at the bottom that says "Show stopwatch"
5. Click the "Start" button on the stopwatch
6. Click "Begin Experiment"
7. When the stopwatch passes 500 click "pause"
8. Record the current amounts of each reactant and product in Table 2 below.

Results:

NOTE: The values given on the simulator are in moles/litre.

Table 1: Effect of Low Concentration

Reactant/Product	Initial Amount (mol/L)	Final Amount (mol/L)
A	5	
BC	5	
AB	0	
C	0	

Table 2: Effect of High Concentration

Reactant/Product	Initial Amount (mol/L)	Final Amount (mol/L)
A	20	
BC	20	
AB	0	
C	0	

Experiment #2.a: Effect of Temperature on Reaction Rate – Cold

1. Click on the tab at the top "Rate Experiments"
2. Select a reaction: select the first option
3. Start with how many….
    i) A?: **20**
    ii) BC?: **20**
4. Initial Temperature**:**
    i) move the sliding bar all the way to the "Cold" end
5. Select the box at the bottom that says "Show stopwatch"
6. Click the "Start" button on the stopwatch, located in the yellow rectangle in the lower left corner
7. Click "Begin Experiment"
8. When the stopwatch passes 500 click "pause"
9. Record the current amounts of each reactant and product in Table 3 below.

Experiment #2.b: Effect of Temperature on Reaction Rate – Warm

1. Click "Reset All"
2. Start with how many….
    i) A?: **20**
    ii) BC?: **20**
3. Initial Temperature**:**
    i) move the sliding bar approximately *halfway* between "Cold" and "Hot"
4. Select the box at the bottom that says "Show stopwatch"
5. Click the "Start" button on the stop watch, located in the yellow rectangle in the lower left corner
6. Click "Begin Experiment"
7. When the stopwatch passes 500 click "pause"
8. Record the current amounts of each reactant and product in Table 3 below.

Experiment #2.c: Effect of Temperature on Reaction Rate – Hot

1. Click "Reset All"
2. Start with how many….
    i) A?: **20**
    ii) BC?: **20**
3. Initial Temperature**:**
    i) move the sliding bar all the over to the "Hot" side
4. Select the box at the bottom that says "Show stopwatch"
5. Click the "Start" button on the stop watch, located in the yellow rectangle in the lower left corner
6. Click "Begin Experiment"
7. When the stopwatch passes 500 click "pause"
8. Record the current amounts of each reactant and product in Table 3 below.

Name_____

Table 3: Effect of Temperature

Reactant/ Product	Initial Amount (mol/L)	Final Amount (mol/L)
Cold		
A	20	
BC	20	
AB	0	
C	0	
Warm		
A	20	
BC	20	
AB	0	
C	0	
Hot		
A	20	
BC	20	
AB	0	
C	0	

Analysis

1. Calculate the rate of reaction for the formation of the product AB from each table using the following formula:

$$\text{Rate} = \Delta[AB]/\Delta t$$
$$= [AB_{final}] - [AB_{initial}] / (t_{final} - t_{initial})$$

*For each calculation use the following assumptions:

- The values for the amount of AB are in moles/Litre.
- The final time for each trial was 500s.

E.g.,If the initial amount of AB is 0 mol/L and the final amount is 4 mol/L the rate would be calculated:

(4 mol/L - 0 mol/L) / (500s - 0s) = 0.008 mol/L*s

Calculated Rates of Reaction:

Condition	Rate of Reaction calculations (mol/L*s)	Rate of Reaction (mol/L*s)
Concentration		
Low Concentration		
High Concentration		
Cold		
Warm		
Hot		

2. In your own words, explain how an increase in concentration affects the rate of reaction.

3. In your own words, explain how an increase in temperature affects the rate of reaction.