

Rate of Reaction

SCH 4U1

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vendredi 29 avril

Chemical Kinetics

- With thermochemistry now behind us, we are starting chemical kinetics
- Chemical kinetics is the study of ways to make chemical reactions go faster or slower.

Rate of Reaction

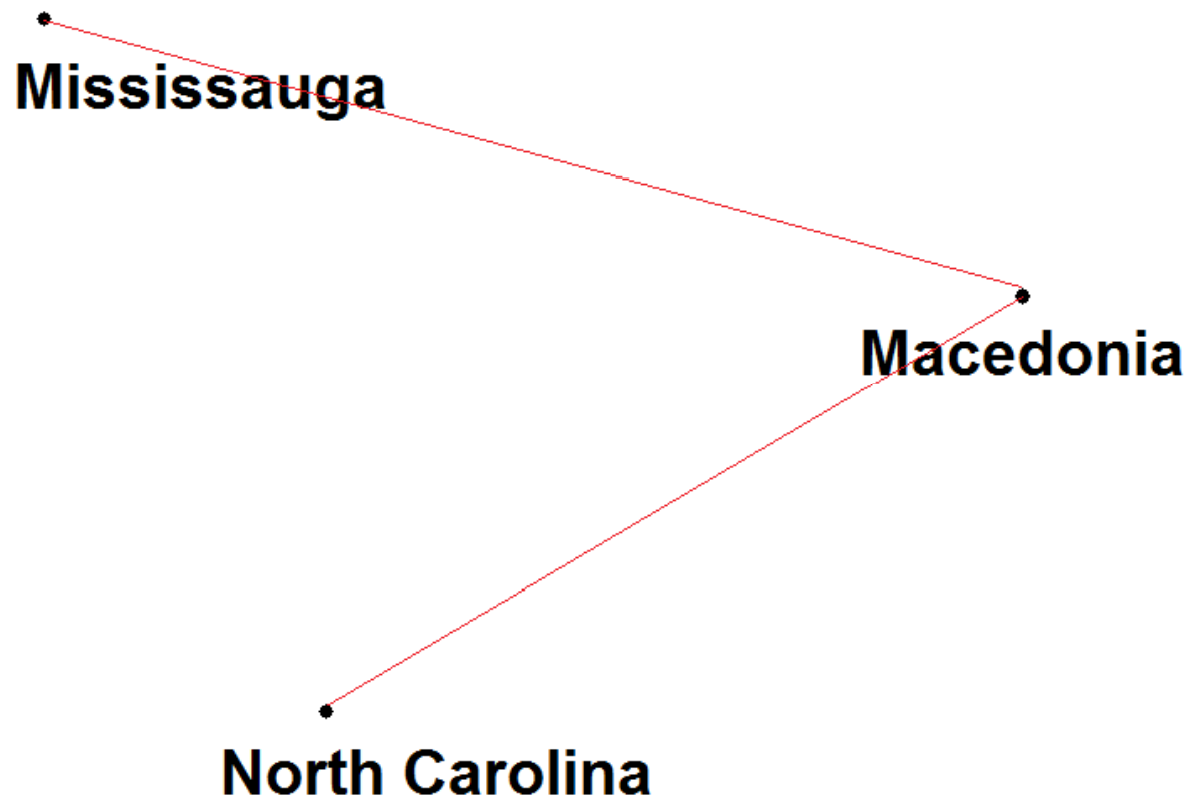
Rate of reaction refers to how quickly or slowly reactants are consumed or products are formed in a reaction.

Properties such as mass, colour, conductivity, volume, pressure can be measured depending on the particular reaction.



**Mr. D's Basketball
Team**

**15 000 km in 150 hours,
the average speed for
the trip is 100 km/h**



Rate of Reaction

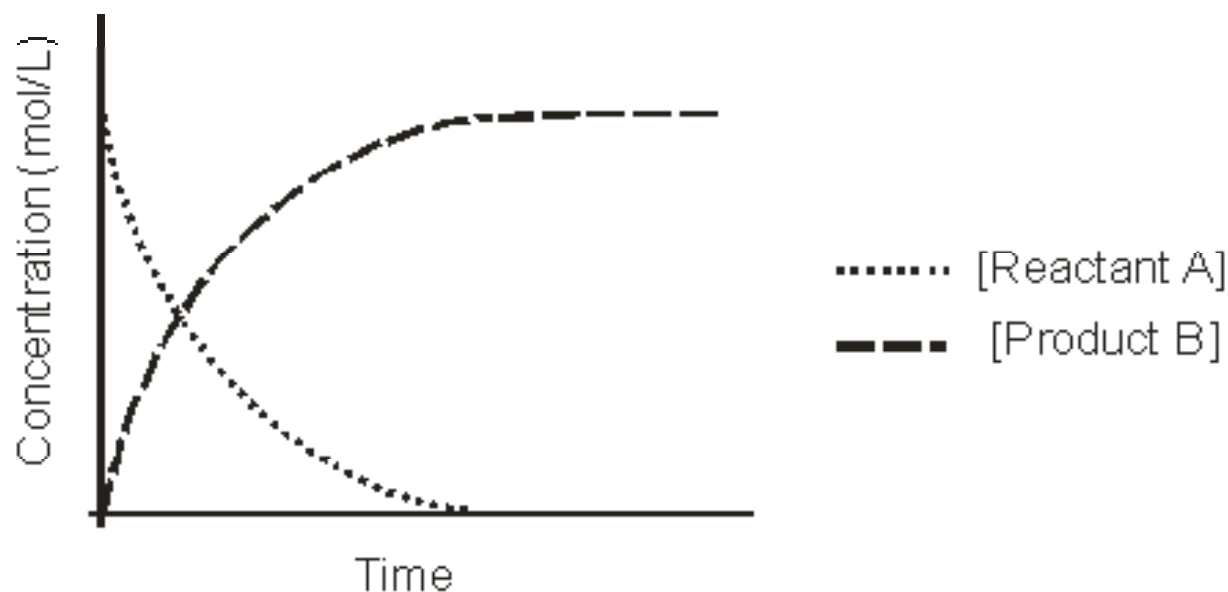
- In the same way we can express average rate of reaction as for example 100 mmol/min.
- There are several ways we can express rate of reaction (see handout)

To allow for easy comparison of many different reaction types, we often express reaction rates as “change in concentration per unit time”.

Average Reaction Rate = $\frac{\text{Concentration Change}}{\text{Time}}$

$$r = \frac{\Delta c}{\Delta t}$$

↑
elapsed
time



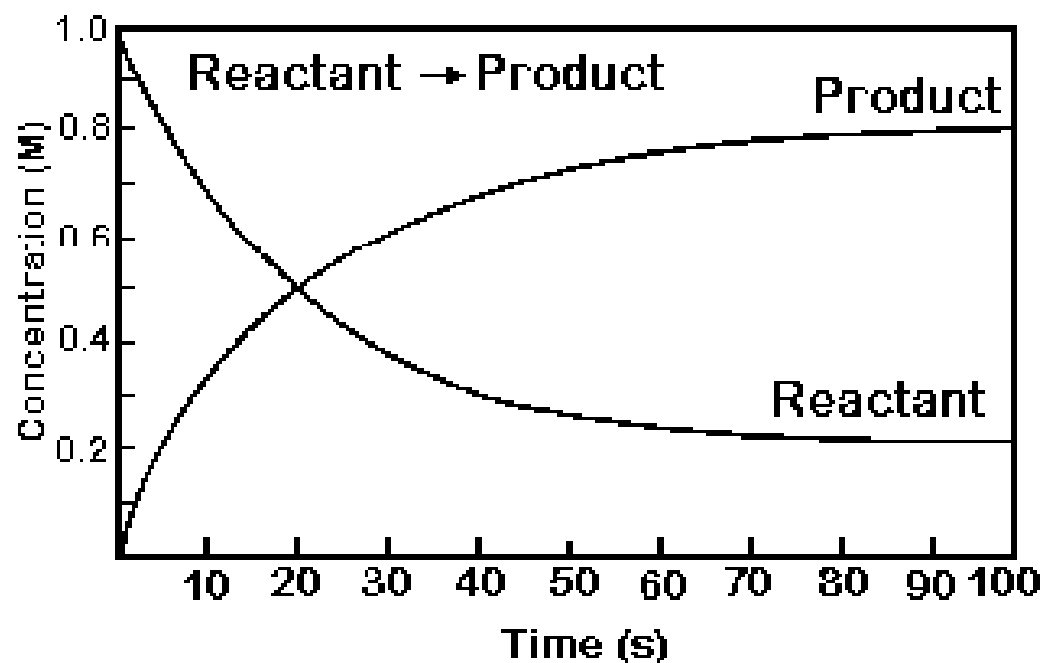
As a reaction proceeds, the rate slows as the reactants are consumed and the products are produced. Reaction rates are usually measured at the start of the reaction, where the rate of reaction is approximately linear.

144 g of carbon dioxide gas are produced in 1.00 minutes during a chemical reaction, calculate the average rate of reaction in terms of moles of CO₂ produced per second.

11.2 L of ethane gas (C_2H_6) at STP are consumed in a natural gas furnace every minute. calculate the rate of formation of CO_2 gas in grams per second.

e.g.3) Examine the following concentration-time curves:

a) What is the average rate of reaction between 0 and 50 seconds?



**Nature of
Reactants**

**Surface
Area**

**Concentration
of Reactants**

**The Five Factors
Affecting Rate**

Temperature

Catalysts

Nutella

1. Nature of Reactants



Reaction (A) is *fast* since no bonds are broken. Reaction B is *slow* since bonds are broken and formed.

-reactions involving monatomic ions are extremely fast, while molecular reactions are usually much slower.

2. Concentration of Reactants

Increasing the concentration leads to more frequent collisions between reactants, increasing the rate of reaction.

$$\text{rate} \propto [\text{reactants}]$$

3. Temperature

Increasing the temperature increases the kinetic energy of the reactants. This leads to more frequent and more effective collisions.

$$\text{rate} \propto \text{Temperature}$$

For every 10°C increase, the rate doubles.

4. Surface Area

The greater the surface area of a reactant in the solid state, the faster the rate of reaction.

$$\text{rate} \propto \text{Surface Area}$$

- For example, a metal reacts in acid, the reaction only takes place where the metal surface is in contact with the acid solution. A reaction with finely divided iron is much faster than with one solid piece of iron.

5. Catalysts

Catalysts alter the reaction mechanism. They can increase OR decrease the rate of reaction without being consumed.