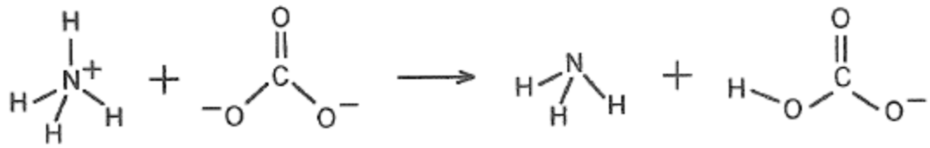
Reaction Kinetics – Part 2

1.) Rank the following three reactions in terms of their expected reaction rates (fastest to slowest) at room temperature.

a.) 2 H-O-O-H → 2 H-O-H + O=O

b.) 

c.) 2 CH_3-CH_2- CH_2- CH_2- CH_2- CH_2- CH_2-CH_3 + 25 O=O → 16 O=C=O + 18 H-O-H

(combustion of gasoline)

Answer – b, a, c. Letter b has the least bonds to break and reform, while c has the most.

2.) Experimentally, it is found that at room temperature the reaction between $Li_{(s)}$ and water is much slower than the reaction between $K_{(s)}$ and water. Which of the first four factors taught in class is affecting reaction rates would best explain this (and why)?

Answer – *Nature of the reactants.* This is most likely as the other three (temperature, concentration, and pressure) are not relevant to this reaction as both reactions are equal in all of these variables. Potassium is faster due to having its valence electron further from its nucleus, resulting in it being more easily donated to form a bond.

3.) Will surface area have an effect on a reaction between two gases? Why? How can this conclusion be generalized to the importance of surface area in homogeneous versus heterogeneous reactions?

Answer – No effect. Gases completely intermix without the ability to have areas where atoms or molecules have "clumped" due to weak molecular forces of attraction.

4.) In each of the following pairs of reactions, which would have the faster reaction rate?

a.) $H_{2(g)} + I_{2(g)} \rightarrow 2\ HI_{(g)}$ or $Ag^+_{(aq)} + I^-_{(aq)} \rightarrow AgI_{(s)}$

b.) $Fe_{(s)} + 2\ H_2O_{(l)} \rightarrow Fe(OH)_{2(s)} + H_{2(g)}$ or $CH_3COOH_{(aq)} + H_2O_{(l)} \rightarrow CH_3COO^-_{(aq)} + H_3O^+_{(aq)}$

c.) $Cu_{(s)} + S_{(s)} \rightarrow CuS_{(s)}$ or $CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2(s)}$

d.) $C_{(S,\ powder)} + O_{2(g)} \rightarrow CO_{2(g)}$ or $C_{(s,\ chunk)} + O_{2(g)} \rightarrow CO_{2(g)}$

e.) $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$ or $2\ H_2O_{2(aq)} + 2\ H^+_{(aq)} \rightarrow 2\ H_3O^+_{(aq)} + O_{2(g)}$

e.) two charged ions will react faster than a neutral and an charged ion.

5.) Which of the reactions in the previous exercise are HOMOGENEOUS reactions?

Answer – a.) Both parts are as the phases of the reactants are what matter and, in both cases, they are in the same phase.

b.) Second part only. Tricky! The acetic acid is (aq) which means dissociated (dissolved) in water and the other reactant IS water.

c.) Neither are! The carbon and sulphur in the first part are indeed both solids BUT carbon and sulphur have different "phases" (properties are different depending where the sample is taken).

e.) Both parts are.

6.) Which of the six factors are important in HOMOGENEOUS reactions? Which are important in HETEROGENEOUS reactions?

Answer – All factors EXCEPT *surface area* are important for homogeneous reactions and all factors are important for heterogeneous reactions. Surface area is not relevant for homogeneous reactions as these types of reactions involve gases, both substances being dissolved in water, or miscible liquids. All of these scenarios don't have a surface area as the chemicals are separated at the atomic/molecular level.

7.) State five ways of increasing the rate of the reaction: $2\ Al_{(s)} + 3\ F_{2(g)} \rightarrow 2\ AlF_{3(s)}$. Assume the reaction is occurring in a closed contained whose volume can be changed.

Answer – 1.) increase pressure 2.) grind up aluminium (increase surface area) 3.) heat vessel

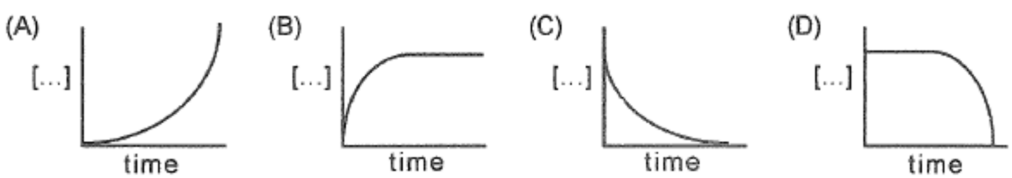
4.) add a catalyst

5.) add more fluorine gas while not changing the volume of the container (increase concentration)

8.) a.) What will happen to the concentration of the reactants as a reaction proceeds? Answer – decrease

b.) What will happen to the rate of a reaction as the reaction proceeds? Answer – decrease

c.) Which of the following graphs would best represent



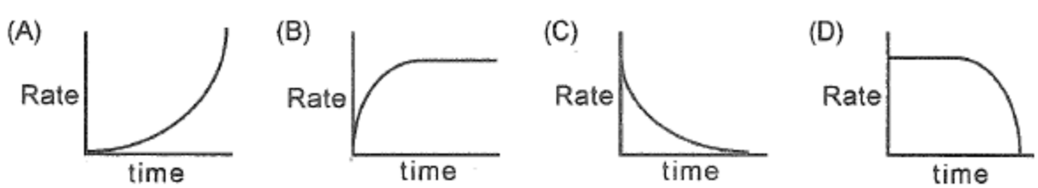
i.) the **product** concentration as time proceeds for a reaction? Explain your choice.

Answer – *letter B*. Initially the products will be created very rapidly, but as the amount or concentration of the reactants are used up the likely hood of proper and numerous collisions will be quickly decreasing, slowing down the product formation.

ii.) the **reactant** concentration as time proceeds for a reaction? Explain your selection.

Answer – *letter C*. Initially the reactants will be used up (reacted) very rapidly, but as the amount or concentration of the reactants are used up the likely hood of proper and numerous collisions will be quickly decreasing, slowing down the product formation.

d.) Which of the following graphs would best represent



i.) the rate at which **reactants** are used as time proceeds for the reaction. Explain.

Answer – *letter C*. Initially the reactants rate will be high (lots of reactants to react), but as the amount or concentration of the reactants are used up the likely hood of proper and numerous collisions will be quickly decreasing, slowing down the rate to a relatively constant but slow rate (equilibrium).

ii.) the rate at which **products** are used as time proceeds for the reaction. Explain.

Answer – *letter C*. Rate of reactants being used up equals the rate of products forming.

9.) The following data were collected for the reaction $Zn_{(s)} + 2\ HCl_{(aq)} \rightarrow H_{2(g)} + ZnCl_{2(aq)}$ in which zinc metal was reacted with $0.200\ M$ HCl.

Time (s)	Mass Zn (g)
0	31.0
60	24.6
120	20.2
180	17.4

a.) Calculate the reaction average reaction rate, in $\frac{g}{s}$, from $0 - 60\ s$.

Answer - $reaction\ rate = \frac{reactant\ used}{time\ interval}$ $rate = \frac{31.0-24.6\ g}{60\ s}$ $rate = 0.106\ \frac{g}{s}$ $rate = 0.1\ \frac{g}{s}$

b.) Calculate the reaction average reaction rate, in $\frac{g}{s}$, from $120 - 180\ s$.

Answer - $reaction\ rate = \frac{reactant\ used}{time\ interval}$ $rate = \frac{20.2-17.4\ g}{60\ s}$ $rate = 0.0466\ \frac{g}{s}$ $rate = 0.05\ \frac{g}{s}$

c.) Explain why the average rate in part (b) is less than in part (a).

Answer – The rate of (b) is less than (a) as for the reasons listed in question (8d).