AR Chemistry: Reaction Rates Problem Set

1: Effect of Concentration

a. Write Rates of Reaction Equations for the following reactions

i. H_2 + Cl_2 --> 2 HCl	Rate = k $[H_2][Cl_2]$
ii. I_2 + H_2 --> 2 HI	Rate = k $[I_2][H_2]$
iii. Ca + S --> CaS	Rate = k [Ca][S]
iv. Mg + Cl_2 --> $MgCl_2$	Rate = k Mg]$[Cl_2]$
v. NO + CO_2 --> NO_2 + CO	Rate = k [NO]$[CO_2]$
vi. Sc + P --> ScP	Rate = k [Sc][P]
vii. Cu + S --> CuS	Rate = k [Cu][S]

b. Solve the following Relative Rate Problems

i. You run a reaction and then triple the concentration for the first reactant and double the concentration for the second reactant. What is the relative rate for the second reaction compared to the first?

Let $Rate_1$ = k [1] [1] = 1 k so $Rate_2$ = k [3] [2] = 6 k

R_2 / R_1 = 6 k / 1 k = **6**

ii. You run a reaction and then double the concentration for the first reactant and double the concentration for the second reactant. What is the relative rate for the second reaction compared to the first? R_1 = k[1][1]=k R_2 = k[2][2] = 4k R_2/R_1 = 4k/k = **4**

iii. You run a reaction and then quadruple the concentration for the first reactant and halve the concentration for the second reactant. What is the relative rate for the second reaction compared to the first? R_1 = k[1][1]=k R_2 = k[4][1/2] = 2k R_2/R_1 = 2k/k = **2**

iv. You run a reaction and then quadruple the concentration for the first reactant and triple the concentration for the second reactant. What is the relative rate for the second reaction compared to the first? R_1 = k[1][1]=k R_2 = k[4][3] = 12k R_2/R_1 = 12k/k = **12**

v. You run a reaction and then halve the concentration for the first reactant and halve the concentration for the second reactant. What is the relative rate for the second reaction compared to the first? R_1 = k[1][1]=k R_2 = k[1/2][1/2] = .25k R_2/R_1 = .25k/k = **0.25**

vi. You run a reaction and then triple the concentration for the first reactant and halve the concentration for the second reactant. What is the relative rate for the second reaction compared to the first? R_1 = k[1][1]=k R_2 = k[3][1/2] = 41.5k R_2/R_1 = 1.5k/k = **1.5**

2. Effect of Surface Area

a. You triple the surface area of a reactant. What happens to the reaction rate? Triples
b. You quadruple the surface area of a reactant. What happens to the reaction rate? Quadruples
c. You increase the surface area of a reactant by 10,000 x. What happens to the reaction rate?10,000x
d. You increase the surface area of a reactant by a factor of 'X'. What happens to the reaction rate? Rate is 'X' times faster

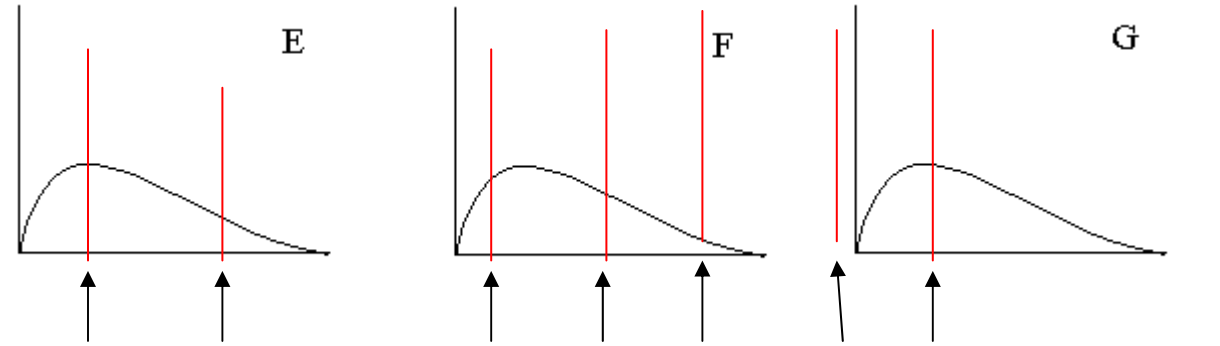
3. Effect of Temperature

a. What does temperature measure (in terms of molecular movement)? average kinetic energy
b. What is the 10 degree Celsius rule? each 10 C change doubles the reaction (or halves)
c. What happens to the poisson distribution diagram as temperature rises? shifts to right
d. For each 10 degrees Celsius increase, what is the approximate change in speed of molecules? 1%
e. For each 10 degrees Celsius increase, what is the approximate number of molecules with enough energy to react? double the number of molecules
f. Answer the following temperature questions
   i) What happens to the rate of reaction if temperature is increased 30 C? 8 x faster
   ii) What happens to the rate of reaction if temperature is decreased 40 C? 16 x slower

iii) What happens to the rate of reaction if temperature changes from 25 C to 75 C? 32 x faster

4. Effect of Catalysts on Activation Energy

a. What is activation energy? Energy required to react or vaporize
b. What is an activated complex? an intermediate step that has Ea and correct alignment
c. What is a catalyst? speeds up a reaction without being changed
d. What does a catalyst do that enables it to do it's job (has to do with activation energy) lowers Ea
e. For diagram 'e', show i) the temperature line, ii) an Ea line, iii) the effect of a 10 C increase
Questions f and g are based on vaporization of liquids, not reaction rates (same diagrams)
f. For diagram 'f', show the Ea lines for material 'X' that has low IMA, material 'Y' that has a high IMA, and material 'Z' that has a very high IMA.
g. For diagram 'g', show the room temperature line and the Ea line for vaporization of Carbon Dioxide gas.



Whale shifts to right with 10 C

h. Draw Heat Content Diagrams for the following chemical reactions

i.	Ea = +20	ΔH = +10
ii.	Ea = +30	ΔH = –10
iii.	Ea = +40	ΔH = +30
iv.	Ea = +20	ΔH = –20
v.	Ea = +30	ΔH = +30
vi.	Ea = +40	ΔH = –30
vii.	Ea = +20	ΔH = –30
viii.	Ea = 0	ΔH = –10