(10/10)

Chemistry 203

Pre-Lab Assignment: Factors Affecting Reaction Rates Exp 4

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I.D. #: 201001141 **Lab Section:** 8

1. The reaction $A + 2B \rightarrow C$ was found to have the rate law, $rate = k [A] [B]^2$.
   a. Predict by what factor the rate of reaction will increase when the concentration of A is doubled and the concentration of B is also doubled.

   $[A]' = 2[A]$, $[B]' = 2[B]$ $\Rightarrow rate' = k[A]'[B]'^2 = k(2[A])(2[B])^2 = k \times [A] \times [B^2] \times 8$

   $\Rightarrow \frac{\text{new rate}}{\text{old rate}} = 8 \Rightarrow$ rate would increase by 8

   (1)

   b. Determine the unit of the rate constant.

   rate : M/s [A], [B] : M

   $k = \frac{rate}{[A][B]^2} = \frac{M/s}{M \cdot M^2} = \frac{1}{M^2 s}$ unit of k

   c. What would be the rate law of the reaction $2A + B \rightarrow C$?

   The order of reaction in A and B is independent of the coefficients of A and B so actually the rate would not change and would still the same.
   (However, personally I don't know if we do have product C that is obtained either by reaction of (A & 2B) or of (2A & B); If it is not the case, the rate we could not know it.)

2. Using the Arrhenius equation, $k = A e^{-(Ea/RT)}$
   a. Derive the equation of the plot of ln k vs. 1/T .

   $k = A e^{-\frac{Ea}{RT}} \Rightarrow \ln k = \ln(A e^{-Ea/RT})$

   $\ln k = \ln A + \ln e^{-Ea/RT}$ y = a x + b

   $\ln k = \ln A - \frac{Ea}{R} \cdot \frac{1}{T} = \boxed{\ln k = -\frac{Ea}{R}\left(\frac{1}{T}\right) + \ln A}$

   (2)

   b. Knowing that the value of the rate constant (k) for a certain reaction is $1.35\times10^{-4}\ s^{-1}$ at 35°C, and $A= 2.6\times10^{13}\ s^{-1}$, what is the activation energy? R= 8.314 J/K.mol

   $\ln(1.35\times10^{-4}) = -\frac{Ea}{8.314} \cdot \frac{1}{(35+273)} + \ln 2.6\times10^{13}$

   (6)

   $Ea = -\ln\left(\frac{1.35\times10^{-4}}{2.6\times10^{13}}\right)(8.314)(35+273) = 101914.6 = 1.0\times10^{5}$ J

   c. Determine the half-life of the above reaction at the given temperature

   the rate cte k is of unit s^{-1}

   so it is a reaction in first order of its reactant

   $\Rightarrow t_{\frac{1}{2}} = \frac{\ln 2}{k} = \frac{\ln 2}{1.35\times10^{-4}} = \frac{0.693}{1.35\times10^{-4}} = 5133.3$ s

   = ~~51.3×10^{2} sec~~

   = 5.13×10^{3} sec