B2.1 Deduce the rate law of this reaction and determine the rate order w.r.t. each reactant using the data given in the table 1.

Consider the order of the reaction with respect to [S2O8]2- is ‘m’

Consider the order of the reaction with respect to [I-] is ‘n’

1.5x10-5=K [0.038]m [0.060] n------------(1)

2.8x10-5=K [0.076]m [0.060] n--------------(2)

2.9x10-5=K [0.038]m [0.120] n----------------(3)

Dividing equation (3) by (1)

2.9x10-5=K [0.038]m [0.120] n

1.5x10-5=K [0.038]m [0.060] n

2=2n

n=1

dividing equations (2) by (1)

2.8x10-5=K [0.076]m [0.060] n

1.5x10-5=K [0.038]m [0.060] n

2=2m

m=1

therefore, the values of m and n are 1 and 1 respectively therefore the order of the reaction is 2

the rate of the reaction with respect to [S2O8]2- is 1

the rate of the reaction with respect to [I-] is 1

The rate law for this reaction can be written as

Rate = K [S2O8]m [I-]n

B2.2Calculate the rate constant and the reaction rate when the concentration of both reactants is 0.050 mol/L.

The rate constant of the reaction can be calculated by substituting the values of m and n in any one of the equations (1), (2) or (3)

K=1.5x10-5/ [0.038] [0.060]

K= 6.578947368x10-3mol/dm3/sec

Now to calculate the rate of the reaction when the molar concentration of both the reactants is 0.050mol/L

Rate =k [0.050] [0.050]

Rate = 6.578947368x10-3[2.5x10-3]

Rate = 1.644736842x10-5

Therefore, the rate of the reaction when the concentration of the reactants is 0.050 mol/L is 1.644736842x10-5 and the rate constant is 6.578947368x10-3 mol/dm3/sec

𝑙𝑜𝑔𝑘 = 11.899 – 3169/ 𝑇 ---------------(1)

The above given equation is similar to the Arrhenius rate equation which is

*Logk = log A-Ea2.303/RT*

We can equate Ea. (2.303) with 3169

TR T

(2.303) Ea =3169x8.314

**Ea= 26347.066**

**2.303**

**Ea=11440.323925KJ/mols**

The rate constant of the reaction at a given temperature of 298k can be calculated by using the equation (1)

𝑙𝑜𝑔𝑘 = 11.899 – 3169/ 𝑇

Log k=11.899-3169/298

Log k=11.899-10.6342282

Log k=1.2647718

K=101.2647718

**K=18.39805022mol/dm3/sec**

Since we now that the reaction is a 2nd order reaction the half-life of the reaction can be calculated by using the formula

t1/2=

t1/2 =

t1/2=5.43535863 minutes

## B3.2 At 400 °C, the half-life period for the first order thermal decomposition of propylene oxide is 320 min and the energy of activation of the reaction is 217570 J/mole. From these data estimate the time required for propylene oxide to be 75% decomposed at 500 °C

Given

T1=400+273=673K

T2=500+273=773K

t1/2=320 minutes

Ea=217570J/mole

[A0] =100

[A]=25

Since it is given that the reaction is a first order reaction we can calculate the value of K1 when the temperature is 673K

t1/2=

K1=

K1=2.165625x10-3/min

Now since we know the rate constant at 673k and the activation energy we can calculate the value of K2

log =

log=217570/2.303\*8.314[100/673\*77\*]

log[=2.184240701

k2=0.33120min-1

using the value of K2 we found out above we can find the time used to convert 100% propylene dioxide into 75%

t=

t=

t=4.1864 minutes

therefore the time taken for the reaction to complete 75% is 4.1864 minutes when the temperature is 773K