CHEMICAL KINETICS –C14

1. The activation energy for a simple chemical reaction AB is Ea in forward direction. The activation energy for reverse reaction

1) Is always double of Ea 2) Is negative of Ea

3) Is always less than Ea **4) Can be less or more than Ea**

**Ans: (4) In exothermic and endothermic reaction will be less or more than Ea respectively.**

1. t1/2 of first order reaction is 10min. Starting with 10 mol/L, rate after 20 min is

1) 0.0693 mol/L/min **2)0.0693x 2.5 mol/L/min**

3)0.0693 x 5 mol/L/min 4) 0.0693 x 10 mol/L/min

**Ans: 2**

**If t1/2 =10min and initial concentration is 10mol/L then after half life 5 mol/L is remaining and after 20 mins 2.5mol/l is remaining**

**Rate =k [A]=(0.693/ t1/2 ) [A] = 0.693/10 x 2.5 = 0.0693x 2.5 mol/L/min**

1. For a reaction A + B → Products, it is found that the order of reaction with respect to A is 2 and the order with respect to B is 3 in the rate expression. When the concentration of both A and B are doubled the rate will increase by a factor.

1)10 2) 16 **3) 32** 4) 28

**Ans: (3) r= k(2A)2(2B)3**

1. The rate of a first order reaction A → Products is 7.5 × 10 – 4 molL– 1 s – 1 when the concentration of A is 0.5 mol litre – 1. The rate constant is

1) 3.75 x 10 – 4 sec – 1  2) 2.5 × 10 – 5 sec – 1  **3) 1.5 × 10 – 3 sec – 1** 4) 8 × 10 – 4 sec – 1

**Ans : (3)**

**Rate = k [A].** ∴ **k =**  **=**  **= 1.5** × **10–3 sec – 1**

1. If rate=k[H+]n and it becomes 100 times when the pH changes from 2 to 1, then the order of reaction is

1) 0 2) 1 **3) 2** 4) 3

**Ans: 3 At pH=2 , [H+] =10-2M**

**Thus r=k(10-2)n ----------------(1)**

**At pH=1 , [H+] =10-1M**

**Thus 100r = k (10-1)n ------------------(2)**

**Eq (2)/(1) 100r/r = 10-n/ 10-2n or 100=10n**

**Thus n =2**

1. The rate law for a reaction between the substances A and B is given by, rate=k[A]y[B]x. On doubling the concentration of A and halving the concentration of B, the ratio of the new rate to the earlier rate of the reaction will be as

1) 1/ 2(x+y) 2) 2(x+y) 3) (y-x) **4) 2 (y-x)**

**Ans. 4, R = k(A)y(B)x**

**R' = k (2A)y (B/2)x = k (A)y (B)x 2y-x**

**R'/R= 2 y-x**

1. For a reaction A+B→C+D, if the concentration of A is doubled without altering the concentration of B, the rate gets doubled. If the concentration of B is increased by nine times without altering the concentration of A, the rate gets tripled. The order of the reaction is

1) 1 **2) 1.5** 3) 2 4) -1

**Ans: 2) for reaction: A+B→C+D**

**r1=k[A]a[B]b------(1)**

**r2=2r1=k[2A]a[B]b------(2)**

**r3=3r1=k[A]a[9B]b------(3)**

**and**

**from (1) and (2) a=1**

**from (1) and (3) b=**

* + **order=a+b=1+=1.5**

1. In the catalytic conversion of N2 to NH3 by Haber’s process, the rate of reaction was expressed as change in the concentration of ammonia per time is  Then rate of the reaction as expressed in terms of H2 is

**1) **** 2) 

3)  4) 

**Ans 1)**

**For the reaction  rate in terms of H2 and NH3 is**



1. The half life of a reaction is halved as the initial concentration of the reactant is doubled. The order of reaction is

1) 0.5 2) 1 **3) 2** 4) 0

**Ans: 3**

**t1/2 α 1/ an-1 where a is initial conc.**

**Thus (t1/2)1/ (t1/2)2 = ( a2/ a1)n-1**

**t /(t/2) = (2a/a )n-1 thus 2 = 2n-1**

**i.e., 1=n-1 or n =2**

1. For a first order reaction A → Products, the concentration of A changes from 0.1 M to 0.025 M in 40 minutes. The rate of reaction when concentration of A is 0.01 M

1) 1.73 × 10-4 M/min 2) 1.73 × 10-5 M/min

**3)3.73 × 10-4 M/min**  4) 3.73 × 10-5M/min

**Ans: (3)**

**k= 2.303/t log [A]0/[A]**

**=2.303/40 log 0.1/0.025 =2.303/40 log 4=2.303/40 x 0.6021 = 0.0347 min-1**

**Rate = k[A] = 0.0347 × 0.01 =3.4× 10-4**

1. A substance A decomposes in solution following the first order kinetics. Flask I contains 1 litre of 1M solution of A and flask II contains 100ml of 0.6M solution A. After 8 hours the concentration of A in flask I becomes 0.25M. What will be the time required for A in flask II to become 0.3M?

1) 0.4 hours 2) 2.4 hours

3) 4 hours 4) unpredictable as rate constant is not given

**Ans: 3**

**For flask I k=2.303/8 log (1/0.25) =2.303/8 log 4 = 2.303/8 x 0.6021**

**For flask II . the concentration reduces from 0.6 to 0.3 means t½  has to be calculated**

**t½ = 0.693/k = 0.693/[2.303/8x0.6021] = 4 hours**

1. For a chemical reaction Y + 2Z→ P, rate controlling step is Y + ½ Z → Q. If the concentration of Z is doubled, the rate of reaction will be

1)remain the same 2) becomes four times

**3) become 1.414 times**  4) become double

**Ans :(3) Rate = k[Y][Z]1/2**

**New rate= k[Y][2Z]1/2 =√2 k [Y][Z]1/2**

1. The time taken for 90% of a first order reaction to complete is approximately

1) 1.1 times that of half life 2) 2.2 times that of half life

**3) 3.3 times that of half life** 4) 4.4 times that of half life

**Ans: 3**

**t 90% =2.303/k log 100/(100-90) =2.303/k log 10 =2.303/k**

**t50% = 0.693/k**

**thus t 90%/ t50% = 2.303/0.693 =3.3**

1. A drop of a solution (volume=0.05ml) contains 6x10-7 mol of H+. If rate of disappearance of H+ is 6x105 mol/L/s, how long will it take for the H+ in the drop to disappear?

1) 2x 10-2 s **2) 2x10-8 s** 3) 8x10-8 s 4) 6x10-6 s

**Ans: 2**

**[H+] = 6x10-7 / 0.05x10-3 = 6/5 x10-4 mol/L**

**r = ∆[H+]/ ∆t**

**6x105 = (6/5 x10-4) / ∆t**

**∆t = 2x10-8 s**

1. The temperature coefficient of most of the reactions lies between

1) 1and 3 **2) 2 and 3**  3) 1 and 4 4) 2 and 4

1. Catalyst increases the rate of the reaction by

1) decreasing enthalpy 2) decreasing internal energy

**3) decreasing activation energy** 4) increasing activation energy

1. Activation energy of a chemical reaction can be determined by

1)evaluating the rate constant at standard temperature

2)**Evaluating the rate constants at two different temperature**

3)Evaluating velocities of reaction at two different temperatures

4)Changing concentration of reactants

1. The rate A B follows first order kinetics. The time taken for 0.8mole of A to produce 0.6mole of B is 1 hour. What is the time taken for conversion of 0.9mole of A to produce 0.675 mole of B?

1) 0.5hour 2) 0.25hour 3) 2 hour **4) 1 hour**

**Ans: 4**

**The value a/a-x**

**In first case 0.8/(0.8-0.6) =0.8/0.2 =4**

**In second case 0.9/(0.9-0.675) =0.9/0.225 = 4**

**Thus time taken is 1 hour only.**

1. The rate constant for the reaction; 2N2O5 → 4NO2 + O2is 3.0 × 10-5 sec-1. If the rate is 2.40×105mol L-1sec-1, then the concentration of N2O5 (in mol L-1) is,

1) 1.4 2) 1.2 3) 0.02 **4) 0.8**

**Hint; rate = k[N2O5] or [N2O5] = = = 0.8**

1. Consider the chemical reaction; N2(g) + 3H2(g) → 2NH3(g). The rate of this reaction can be expressed in terms of time derivatives of concentration of N2(g), H2(g) or NH3(g).Identify the correct relationship amongst the rate expressions,
   * 1. **Rate = -d[N2]/dt = -1/3d[H2]/dt = ½d[NH3]dt**
     2. Rate = -d[N2]/dt = -3d[H2]/dt = 2d[NH3]/dt
     3. Rate = d[N2]/dt = 1/3d[H2]/dt = 1/2d[NH3]/dt
     4. Rate = -d[N2]/dt = -d[H2]/dt = d[NH3]/dt.
2. In a first order reaction, the concentration of the reactant decreases from 0.8 M to 0.4 M in 15 minutes. The time taken for the concentration to change from 0.1 M to 0.025M is

1) 7.5 mins 2) 15 mins **3) 30 mins** 4) 60 mins

**Ans: 3 t1/2 is 15 mins. Therefore concentration reduces from 0.1M to 0.025 M i.e., 0.1 0.05 0.025 therefore time= 2t1/2 i.e 30 mins.**

1. The rate of a chemical reaction doubles for every 100C rise of temperature. If the temperature is raised by 500C, the rate of this reaction increases by about

1) 24 times. **2) 32 times.** 3) 64 times. 4) 10 times.

**Ans : (2) The rate of this reaction increases by = 25 = 32 times.**

1. If 60% of a first order reaction was completed in 60 minutes. 50% of the same reaction would be completed in approximately :

1) 40 minutes. 2) 50 minutes. **3) 45 minutes**. 4) 60 minutes.

**Ans : (3)**

**K=2.303/60 log (100/100-60) = 2.303/60 log5/2 (log5-log2=0.7-0.3=0.4)**

**=2.303/60 x 0.4**

**t1/2= 0.693/k = (0.693x60) /(2.303x0.4) = 45**

1. For a chemical reaction, the rate of the reaction is ,when the initial concentration is 0.05mol/dm3. The rate of the same reaction is  when the initial concentration is 0.1 mol/dm3. The order of the reaction is

1) 0 **2) 3** 3) 1 4) 2

**Ans: 2**

**let Rate = k [A]n**

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1. 75% of a first order reaction is completed in 32 minutes. 50% of the reaction would have been completed

1) 24 minutes **2) 16 minutes**  3) 18 minutes 4) 23 minutes

**Ans: 2**

**Since t75% = 2 t 50% , 32 min= 2 x t50% thus t50% = 32/2 = 16 min**

1. In the first order reaction A → B, if k is rate constant and initial concentration of the reactant A is 0.5 M, then the half life is :

**1) ln 2 / k** 2) 0.693 / 0.5 k 3) log 2 / k 4) log 2 / k

**Ans : (1) t1/2 = 0.693/K obtained from derivation as t1/2 = 2.303xlog2 /K =ln2/K**

1. The rate constant (K1) of one reaction is double of the rate constant ( K11) of another reaction. Then the relationship between the corresponding activation energies of the two reaction (Ea1 and Ea11) will be

1) Ea1> Ea11 2) Ea1=Ea11 **3) Ea1< Ea11**  4) Ea1= 4 Ea11

**Ans: 3 greater the rate constant lesser is the activation energy.**

**K1> K11 thus Ea1< Ea11**

1. Half lives of a first order and zero order reactions are same. Then the ratio of the initial rates of the first order reaction to that of zero order reaction is

1)1/ 0.693 **2) 2x 0.693** 3)0.693 4)2/0.693

**Ans: 2 for 1st order t1/2 =0.693/k**

**For 0 order t1/2 =[R0]/ 2k1**

**Initial rate of 1st order reaxn r1 = k [R0]**

**Initial rate of 0 order reaxn r0 = k1**

**Thus r1/r0 = k [R0] /k1 -------------------(1)**

**Given 0.693/k =[R0]/ 2k1**

**i.e., k [R0] /k1 = 2x 0.693 (rearranging)**

**substituting in (1) we get r1/r0 =2x 0.693**

1. During the decomposition of H2O2 to give oxygen, 48g O2 is formed per minute at a certain point of time. The rate of formation of water at this point is

1)0.75 mol min-1 2)1.5mol min-1 3)2.25mol min-1 **4) 3 mol min-1**

**Ans:4 Rate of formation of O2 is 48 g min-1 =48/32 =3/2 mol min-1**

**2 H2O2 2H20 + O2**

**½ d[H2O2]/dt = d[O2]/dt**

**d[H2O2]/dt = 2x (3/2) =3mol/min**

1. A catalyst lowers the activation energy of the forward reaction by 10kJ/mol. What effect does it have on activation energy of the backward reaction?

1) Increases by 10kJ/mol **2) decreases by 10kJ/mol**

3) remains unaffected 4) cannot be predicted

1. For a chemical reaction, X Y, the rate of reaction increases by a factor of 1.837 when the concentration of X is increased to 1.5times, the order of the reaction with respect to X is

1)1 **2)1.5**  3) 2 4) 2.5

**Ans: 2 r= k[X]n**

**1.837r = k[1.5X]n**

**1.837= [1.5]n therefore n = 1.5**

1. Given t1/2 =3 hours, how many grams of a substance will remain after 18hours from 300gram of a substance?

**1)4.6gram** 2)5.6gram 3)9.2gram 4)6.4gram

**Ans: 1 number of half lives= 18/3 = 6**

**Amount left after n half lives = [Ro]/ 2n = 300/26 = 4.6g**

1. For an endothermic reaction, where ΔH represents the enthalpy of the reaction in kJ/mol, the minimum value for the energy of activation will be

1)Less than ΔH 2)zero **3)more than ΔH** 4) equal to ΔH

1. A chemical reaction was carried out at 300K and 280K. The rate constants were found to be k1 and k2 respectively. Then

1)k2= 4 k1 2) k2 = 2k1 **3) k2=0.25k1** 4)k2=0.5k1

**Ans: 3 k1 = 4 k2 therefore k2=0.25k1**

1. At 500K, the half life period of a gaseous reaction at an initial pressure of 80 kPa is 350s. When the pressure is 40kPa, the half life period is 175 s. The order of the reaction is

**1)Zero**  2)one 3) three 4)two

**Ans:1**

**p1 = 80 t1/2= 350s**

**p2= 40 t1/2 = 175s**

**We know t1/2 α 1/ [R0]n-1**

**Thus (t1/2)1/ (t1/2)2 = ( p2/ p1)n-1**

**350/175 = (40/80)n-1**

**2=(1/2)n-1 i.e., 2= 21-n**

**1=1-n therefore n=0**

1. In a first order reaction the concentration of the reactant decreases from 800mol/dm3 to 50mol/dm3 in 2 x 104 seconds. The rate constant in sec-1 is (log16=1.2)

**1) 1.386 x 10-4**  2) 3.45 x 10-5 3) 2x104 4) 2x10-4

**Ans:1**



1. The rate constant of a reaction is 175litre2mol-2 s-1. What is the order of reaction?

1) first 2)second  **3)third**  4)zero

1. For a first order reaction, the rate of reaction at [A] = 0.2 M is 1.0x10-2 molL-1min-1. The half-life period for the reaction is

**1) 832 s** 2) 440 s 3) 416 s 4) 14 s

**Ans:1 r = k[A], k = 10-2/0.2 = 5 x 10-2, t1/2 = 0.693/k = 0.693/5x10-2 = 13.86 min = 882 s**

1. The temperature dependence of rate constant (k) of a chemical reaction is written in terms of Arrhenius equation k= Ae-Ea/RT. Activation energy of the reaction can be calculated by plotting

1) log k vs T **2) log k vs 1/T** 3) k vs T 4) k vs 1/logT

**Ans: 2**

1. Which represents the time to complete 90% of first order reaction is

1) k/2.303 x log4/3 2)2.303/k x log3/4 **3)2.303/k** 4)2.303/k x log3

1. The rate of the reaction, 2NO+Cl2 → 2NOCl is given by the rate equation, rate =k[NO]2[Cl2].The value of rate constant can be increased by the

1**) Increasing temperature** 2) Increasing the concentration of NO

3) Increasing the concentration of the Cl2  4) all the above

**Ans:1. Rate constant is independent of the initial concentration of the reactants. It has a constant value at fixed temperature. Hence the value of rate constant can be increased by increasing the temperature.**

1. Under the same reaction conditions, initial concentration 1.386 mol dm-3 of a substance becomes half in 40 s and 20 s through first order and zero order kinetics respectively. Ratio of the rate constants for first order (k1) and zero order (k0) of the reaction is

1) 0.5 moldm-3 2) 1.0 moldm-3 3) 1.5 moldm-3 4) 2.0 moldm-3

**Ans: (1)**

**t1/2= = 40 s .......(1) and t1/2= = 20 s .........(2)**

**Eq. (2)/(1) × = ½**

**= = 0.5**

1. Under the same reaction conditions, initial concentration 1.386moldm-3 of a substance becomes half in 40 s and 20 s through first order and zero order kinetics respectively. Ratio of the rate constants for first order (k1) and zero order (k0) of the reaction is

1) 0.5 moldm-3 2) 1.0 moldm-3 3) 1.5 moldm-3 4) 2.0 moldm-3

**Ans: (1)**

**t1/2= = 40 s .......(1) and t1/2= = 20 s .........(2)**

**Eq. (2)/(1) × = ½**

**= = 0.5**

1. If the rate of a gaseous reaction is independent of pressure. The order of reaction is

**1) 0** 2) 1 3) 2 4) 3

**Ans: (1) rate α [Preactant]0**

**i.e., rate = k**

**So, the order of reaction will be zero.**

1. In the presence of a catalyst, the heat evolved or absorbed during the reaction

1)increases 2) decreases

**3) remains unchanged**  4)may increase or decrease