CAREER ENDEAVOUR
ACADEMY PRIVATE LIMITED
Best Institute for NET-JRF, GATE & IIT-JAM Exams

CHEMICAL SCIENCES (NET-JRF/GATE)

Unit Test: Chemical Kinetics

Time : 00: 50 Hour

Date : 06-02-2014
M.M. : 60

Instructions:

1. Question Paper contains two parts: Part-A and Part-B. Part-A contains 10 objective type questions, each question carry 2 marks. Part-B contains 10 objective type questions, each question carry 4 marks.

2. There is nagative marking, 0.5 mark will be deducted for each wrong answer in Part-A and 1 marks for Part-B.

3. Attempt all the questions, use of calculator is not allowed.

PART-A

1. The concentration of R in the reaction $R \rightarrow P$ was measured as a function of time and the following data is obtained

[R] (molar)	1.0	0.75	0.40	0.10
t (min)	0.0	0.05	0.12	0.18

   The order of reaction is:

   (a) Zero (b) One (c) Two (d) Three

2. For the reaction $aA \longrightarrow$ Products the plot of $\dfrac{1}{[A]^2}$ versus time gives a straight line. The order of the reaction is:

   (a) 0 (b) 1 (c) 2 (d) 3

3. For a reaction with rate equation

   $$-\frac{dC}{dt} = kC^2$$

   C_0 and C are the concentration at time $t = 0$ and 't' respectively. If 10 min were required for C_0 to become $C_0/2$, the time required for C_0 to become $C_0/4$ is:

   (a) 10 min (b) 20 min (c) 30 min (d) 40 min

4. The molar extinction coefficient of a complex is $12000\,L\,mol^{-1}cm^{-1}$ and the minimum detectable absorbance is 0.01. Calculate the minimum concentration of the complex that can be detected in a Lambert-Beer law cell of path length 1.00 cm.

   (a) $8.33 \times 10^{-7}\,M$ (b) $1.20 \times 10^{-5}\,M$ (c) $1.20 \times 10^{-4}\,M$ (d) $1.20 \times 10^{-3}\,M$

5. For a reaction $2A \rightarrow$ Product the initial concentration of A is 0.1 M and the rate constant is $2 \times 10^{-3}\,dm^3 mol^{-1}s^{-1}$. The half life period of the reaction is:

   (a) 5 sec (b) 50 sec (c) 500 sec (d) 5000 sec

6. The decomposition of ethane follows the rate law $-\dfrac{d}{dt}[CH_3CH_3] = k[CH_3CH_3]$ with $k = \left(\dfrac{k_1 k_3 k_4}{k_5}\right)^{1/2}$.

   Where k_1, k_3, k_4 and k_5 are the rate constants of various elementary steps.

   The values of E_as of elemantary reactions were found to be

   $$E_{a_1} = 350 \text{ kJ mole}^{-1}$$

   $$E_{a_3} = 160 \text{ kJ mole}^{-1}$$

   $$E_{a_4} = 30 \text{ kJ mole}^{-1}$$

   and $\qquad E_{a_5} = 10 \text{ kJ mole}^{-1}$

   The activation energy of the overall reaction is
   (a) 165 kJ mole^{-1} (b) 265 kJ mole^{-1} (c) 275 kJ mole^{-1} (d) 375 kJ mole^{-1}

7. Consider the elementary reaction $\qquad A + A + A \longrightarrow Product$

   $$\begin{array}{ccccc} t=0 & a & a & a & 0 \end{array}$$

   Then three quarter life expression will be

   (a) $\dfrac{15}{2a^2 k}$ (b) $\dfrac{15}{6a^2 k}$ (c) $\dfrac{13}{6a^2 k}$ (d) $\dfrac{7}{18a^2 k}$

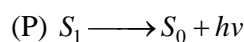8. The reaction $2H_2 + 2NO \rightarrow N_2 + 2H_2O$ is assumed to proceed by the following mechanism:

   $$2NO \rightleftharpoons N_2O_2 \qquad\qquad \text{fast}$$

   $$N_2O_2 + H_2 \rightleftharpoons N_2O + H_2O \quad \text{slow}$$

   $$N_2O + H_2 \rightleftharpoons N_2 + H_2O \qquad \text{fast}$$

   which is the rate law for this reaction?

   (a) $\text{Rate} = K[NO][H_2]$ (b) $\text{Rate} = K[NO]^2[H_2]$ (c) $\text{Rate} = K[NO][H_2]^2$ (d) $\text{Rate} = K[NO]^2[H_2]^2$

9. **Column-I**   **Column-II**

   (i) Collisional quenching   (P) $S_1 \longrightarrow S_0 + h\nu$

   (ii) Fluorescence   (Q) $T_1 \longrightarrow S_0 + h\nu'$
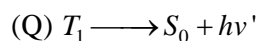
   (iii) Photosensitization   (R) $S^* + M \longrightarrow S + M + \text{heat}$
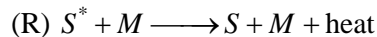
   (iv) Phosphorescence   (S) $S^* + A_2(g) \longrightarrow S + 2A(g)$
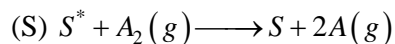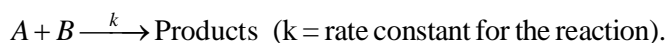
   Correct match for (P), (Q), (R), (S) in column (I) is:

	(P)	(Q)	(R)	(S)
(a)	(ii)	(iv)	(i)	(iii)
(b)	(ii)	(iv)	(iii)	(i)
(c)	(iv)	(ii)	(i)	(iii)
(d)	(iv)	(ii)	(iii)	(i)

10. Select the rate law that confirms to the following data for the reaction:

$A + B \xrightarrow{\;k\;}$ Products (k = rate constant for the reaction).

Exp. NO.	[A] (mol L^{-1})	[B] (mol L^{-1})	Initial rate (mol L^{-1} s^{-1})
1.	0.024	0.035	1×10^{-3}.
2.	0.012	0.070	8×10^{-3}.
3.	0.024	0.070	8×10^{-3}.

(a) $-\dfrac{d[A]}{dt} = k[A][B]^2$

(b) $-\dfrac{d[A]}{dt} = k[A]^2[B]$

(c) $-\dfrac{d[A]}{dt} = k[A][B]^3$

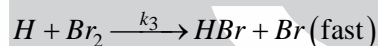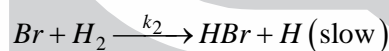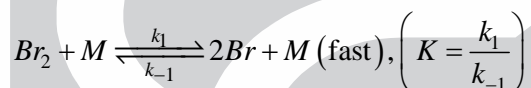(d) $-\dfrac{d[A]}{dt} = k[B]^3$

Part-B

11. The rate constant of decomposition of a compound is represented by

$$\ell nK = 5.0 - \frac{12000}{T}$$

The value of E_A (in Kcal mol^{-1}) for this compound at 300 K is:

(a) 24   (b) 12   (c) 240   (d) 120

12. H_2 and Br_2 react to give HBr by the following steps.:

$$Br_2 + M \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} 2Br + M \;(\text{fast}), \left(K = \frac{k_1}{k_{-1}} \right)$$

$$Br + H_2 \xrightarrow{\;k_2\;} HBr + H \;(\text{slow})$$

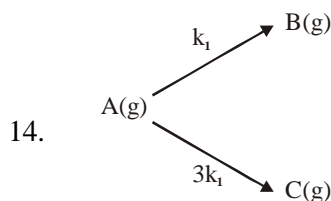$$H + Br_2 \xrightarrow{\;k_3\;} HBr + Br \;(\text{fast})$$

(a) Rate $= k_2 (K)^{1/2} [H_2][Br_2]^{1/2}$

(b) Rate $= k_2 [H_2][Br_2]$

(c) Rate $= k_2 k_1^{1/2} [H_2][Br_2]^{1/2}$

(d) Rate $= k_2 [H_2][Br_2]^{1/2}$

13. For the reaction $2A + B \rightleftharpoons X^{\#} \longrightarrow P$, $E_a = 25.0\; kJ\; mol^{-1}$ at 300 K. The enthalpy change for the formation of activated complex from the reaction in kJ/ol is:

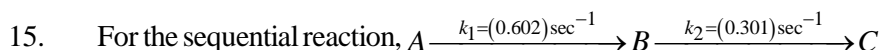(a) 20 kJ/mole   (b) 17.5 kJ/mole   (c) 27.5 kJ/mole   (d) 15.0 kJ/mole

14.

At t = 0, pressure due to A only = 8 atm.

Partial pressure due to B(g), C(g), C(g) and total pressure at the end of reaction is:

(a) $P_B = 2$ atm, $P_C = 6$ atm, $P_{total} = 8$ atm   (b) $P_B = 6$ atm, $P_C = 2$ atm, $P_{total} = 8$ atm

(c) $P_B = 2$ atm, $P_C = 6$ atm, $P_{total} = 32$ atm   (d) $P_B = \dfrac{8}{3}$ atm, $P_C = 2$ atm, $P_{total} = \dfrac{14}{3}$ atm

15. For the sequential reaction, $A \xrightarrow{k_1=(0.602)\sec^{-1}} B \xrightarrow{k_2=(0.301)\sec^{-1}} C$

    Time when concentration of 'B' will reach maximum is:

    (a) 2.303 sec   (b) 1 sec   (c) 4.606 sec   (d) 2 sec

16. When light is incident on any chemical substance then 20% of light is absorbed and rest is transmitted.

    So, transmittance and absorbance values are respectively:

    (a) $80\%, \log \frac{8}{10}$ (b) $80\%, \log \frac{10}{8}$ (c) $20\%, \log 5$ (d) $20\%, \log 2$.

17. Consider the following reactions:

    (i) $A(g) \longrightarrow$ Products,   (Unimolecular reaction following Lindemann mechanism)

    (ii) $A(g) \xrightarrow{M(s)}$ Products   (Unimolecular hetrogeneous catalysis reation)

    Choose the correct statements.

Low Pressure	High Pressure
(a) Reaction (i) – Ist order	Reaction (i) – 2nd order
Reaction (ii) – 2nd order	Reaction (ii) – Ist order
(b) Reaction (i) – 2nd order	Reaction (i) – 1st order
Reaction (ii) – 1st order	Reaction (ii) – 2nd order
(c) Both reaction (i) and (ii) – 2nd order	Both reaction (i) and (ii) – 1st order
(d) Reaction (i) – 2nd order	Reaction (i) – 1st order
Reaction (ii) – 1st order	Reaction (ii) – zeroth order

18. For the reaction $A \rightarrow B$, the rate constant $k_1 = A_1 e^{-E_{a_1}/RT}$ and for the reaction $k_2 = A_2 e^{-E_{a_2}/RT}$. If $A_1 = 10^8, A_2 = 10^{10}$, $E_{a_1} = 600 \, cal/mol$, $E_{a_2} = 1800 \, cal/m$, then the temperature 'a' which $k_1 = k_2$ (R = 2 cal/k mol)

    (a) 1200 K   (b) 1200×4.606   (c) $\frac{1200}{4.606}$ K   (d) $\frac{600}{4.606}$ K

19. The following mechanism has been suggested for thermal decomposition of NO_2.

    Overall reaction: $2NO_2 = 2NO + O_2$

    Mechanism: $NO_2 + NO_2 \xrightarrow{k_1} NO + NO + O_2$; $NO_2 + NO_2 \xrightarrow{k_2} NO_3 + NO$

    $NO_3 + NO \xrightarrow{k_3} 2NO_2$; $NO_3 + NO_2 \xrightarrow{k_4} NO + O_2 + NO_2$

    The above mechanism leads to the following rate law: $-\dfrac{d[NO_2]}{dt} = 2k_d[NO_2]^2$. The value of $k_d = ?$

    (a) $k_1 + \dfrac{k_2 k_4 [NO]}{k_3[NO] + k_4[NO_2]}$ (b) $k_1 + \dfrac{k_2 k_4 [NO_2]}{k_3[NO] + k_4[NO_2]}$

    (c) $1 + \dfrac{k_2 k_4 [NO_2]}{k_3[NO] + k_4[NO_2]}$ (d) None of these
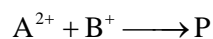
20.	The incorrect statement is/are

(I) For KCl $a = \sqrt{(\gamma \pm m)^4}$

(II) Ionic strength of 0.25 molal K_2SO_4 solution is 0.50.

(III) Salt effect is +ve, for the reaction

$$A^{2+} + B^+ \longrightarrow P$$

(IV) For $2A^+ + B^- + C^{--} \longrightarrow P$

$$\log\left(\frac{k}{k_0}\right) = +6A\sqrt{I}$$

(a) II, III   (b) IV only   (c) III and IV   (d) None of these

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[ANSWERS]

PART-A

1. (a)	2. (d)	3. (c)	4. (a)	5. (d)	6. (b)	7. (d)
8. (b)	9. (a)	10. (d)				

PART-B

11. (a)	12. (a)	13. (b)	14. (a)	15. (a)	16. (b)	17. (d)
18. (d)	19. (b)	20. (d)				