Chemical Equilibrium **Assignment**

1. An example of reversible reaction is

(a) $AgNO_3(aq.) + HCl(aq.) \rightarrow AgCl(s) + HNO_3(aq.)$
(b) $NaOH + CH_3COOH \rightarrow CH_3COONa + H_2O$
(c) $2Na + 2H_2O \rightarrow 2NaOH + H_2$
(d) $Pb(NO_3)_2 + 2NaI \rightarrow PbI_2 + 2NaNO_3$

2. The given reaction, $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$ is irreversible because

(a) $NaCl$ is sparingly soluble in water
(b) $AgNO_3$ and $NaCl$ are completely ionised
(c) $AgCl$ is slightly soluble in water
(d) None of these

3. Which is incorrect for a reversible reaction

(a) The reaction is never completed
(b) The reactants are present in the initial stage but after that reactants and products are always present in the reaction mixture
(c) At equilibrium only products are present
(d) When the reaction is carried out in closed space it attains equilibrium state after suitable time.

4. What is the direction of a reversible reaction when one of the products of the reaction removed

(a) Forward direction (b) Backward direction (c) The reaction stops (d) All of these

5. The reaction which proceeds in the forward direction is

(a) $SnCl_4 + Hg_2Cl_2 \rightarrow SnCl_2 + 2HgCl_2$
(b) $NH_4Cl + NaOH \rightarrow H_2O + NH_3 + NaCl$
(c) $Mn^{2+} + 2H_2O + Cl_2 \rightarrow MnO_2 + 4H^+ + 2Cl^-$
(d) $S_4O_6^{--} + 2I^- \rightarrow 2S_2O_3^{2-} + I_2$

6. Which of the following conditions represents an equilibrium

(a) Freezing of ice in a open vessel, temperature of ice is constant
(b) Few drops of water is present along with air in a balloon, temperature of balloon is constant
(c) Water is boiling in a open vessel over stove, temperature of water is constant
(d) All the statements (a), (b) and (c) are correct for the equilibrium

7. Chemical equilibrium is dynamic in nature because

(a) Equilibrium is maintained rapidly
(b) The concentration of reactants and products become same at equilibrium
(c) The concentration of reactants and products are constant but different
(d) Both forward and backward reactions occur at all times with same speed as

8. One dm^3 of 2*M* ethanoic acid is mixed with one dm^3 of 3*M* ethanol to form an ester, $CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5 + H_2O$. The decrease in the initial rate if each solution is diluted with an equal volume of water would be

(a) 2 times (b) 4 times (c) 0.25 times (d) 0.5 times

9. 3.2 moles of hydrogen iodide were heated in a sealed bulb at 444°C till the equilibrium was reached. The degree of dissociation of *HI* at this temperature was found to be 22%. The number of moles of hydrogen iodide present at equilibrium are

(a) 1.87 (b) 2.496 (c) 4.00 (d) 2.00

10. For the reaction $2N_2O_4 \rightarrow 4NO_2$ given that $\frac{-d}{dt}(N_2O_4) = K$ and $\frac{d}{dt}(NO_2) = K'$, then

(a) $K' = 2K$ (b) $K' = K$ (c) $2K' = K$ (d) None of these

11. Which is false

(a) The greater the concentration of the substances involved in a reaction, the lower the speed of the reaction
(b) The point of dynamic equilibrium is reached when the reaction rate in one direction just balances the reaction rate in the opposite direction
(c) The dissociation of weak electrolyte is a reversible reaction
(d) The presence of free ions facilitates chemical changes

12. **Assertion** (*A*): The equilibrium constant is fixed and is the characteristic of any given chemical reaction at a specified temperature.

Reason (*R*): The composition of the final equilibrium mixture at a particular temperature depends upon the starting amount of reactants.

(a) Both *A* and *R* are true and *R* is a correct explanation of *A*
(b) Both *A* and *R* are true but *R* is not a correct explanation of *A*
(c) *A* is true but *R* is false

(d) Both *A* and *R* are false

(e) *A* is false but *R* is true

13. For a reaction of the type $aA + bB \rightleftharpoons$ Products, the $\frac{d[A]}{dt}$ is equal to….

(a) $-\frac{d[B]}{dt}$ (b) $-\frac{1}{b}\times\frac{d[B]}{dt}$ (c) $-\frac{a}{b}\times\frac{d[B]}{dt}$ (d) $-\frac{b}{a}\times\frac{d[B]}{dt}$

14. Which one of the following equation is correct for the reaction : $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

(a) $\frac{3d[H_2]}{dt} = \frac{2d[N_2]}{dt}$ (b) $\frac{2d[N_2]}{dt} = \frac{1}{3}\frac{d[H_2]}{dt}$ (c) $\frac{2d[NH_3]}{dt} = \frac{-3d[H_2]}{dt}$ (d) $\frac{3d[NH_3]}{dt} = \frac{-2d[H_2]}{dt}$

15. *HI* was heated in a closed tube at 440^oC till equilibrium is obtained. At this temperature 22% of *HI* was dissociated. The equilibrium constant for this dissociation will be

(a) 0.282 (b) 0.0796 (c) 0.0199 (d) 1.99

16. A reversible chemical reaction having two reactants in equilibrium. If the concentrations of the reactants are doubled, then the equilibrium constant will

(a) Also be doubled (b) Be halved (c) Become one fourth (d) Remain the same

17. The equilibrium constant *K*, for the given reaction 2*HI*(*g*) $\rightleftharpoons H_2(g) + I_2(g)$ at room temperature is 2.85 *K* and that at 698 *K* is 1.4×10^{-2} . Hence the reason that *HI* exists as a stable compound at room temperature is

(a) It decomposes so slowly that equilibrium is not readily achieved

(b) The bond *HI* has a large covalent contribution

(c) The standard free energy of the dissociation reaction at room temperature is – 0.62 *kcal*

(d) It is uncatalytic reaction

18. Partial pressures of *A*, *B*, *C* and *D* on the basis of gaseous system *A* + 2*B* $\rightleftharpoons$ *C* + 3*D* are *A* = 0.20; *B* = 0.10; *C* = 0.30 and *D* = 0.50 *atm*. the numerical value of equilibrium constant is

(a) 11.25 (b) 18.75 (c) 5 (d) 3.75

19. 4 moles of *A* are mixed with 4 moles of *B*. At equilibrium for the reaction *A* + *B* $\rightleftharpoons$ *C* + *D*, 2 moles of *C* and *D* are formed. The equilibrium constant for the reaction will be

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$ (c) 1 (d) 4

20. For which of the following reactions does the equilibrium constant depend on the units of concentration

(a) $NO_{(g)} \rightleftharpoons \frac{1}{2}N_{2(g)} + \frac{1}{2}O_{2(g)}$

(b) $Zn_{(s)} + Cu^{2+}_{(aq)} \rightleftharpoons Cu_{(s)} + Zn^{2+}_{(aq)}$

(c) $C_2H_5OH_{(l)} + CH_3COOH_{(l)} \rightleftharpoons CH_3COOC_2H_{5(l)} + H_2O_{(l)}$ (Reaction carried in an inert solvent)

(d) $COCl_{2(g)} \rightleftharpoons CO_{(g)} + Cl_{2(g)}$

21. The decomposition of N_2O_4 to NO_2 is carried out at 280*K* in chloroform. When equilibrium has been established, 0.2 mol of N_2O_4 and 2×10^{-3} mol of NO_2 are present in 2 *litre* solution. The equilibrium constant for reaction $N_2O_4 \rightleftharpoons 2NO_2$ is

(a) 1×10^{-2} (b) 2×10^{-3} (c) 1×10^{-5} (d) 2×10^{-5}

22. In a reaction *A* + *B* $\rightleftharpoons$ *C* + *D*, the concentrations of *A*, *B*, *C* and *D* (in *moles*/*litre*) are 0.5, 0.8, 0.4 and 1.0 respectively. The equilibrium constant is

(a) 0.1 (b) 1.0 (c) 10 (d) ∞

23. In a chemical equilibrium *A* + *B* $\rightleftharpoons$ *C* + *D*, when one mole each of the two reactants are mixed, 0.6 mole each of the products are formed. The equilibrium constant calculated is

(a) 1 (b) 0.36 (c) 2.25 (d) 4/9

24. The suitable expression for the equilibrium constant of the reaction $2NO_{(g)} + Cl_{2(g)} \rightleftharpoons 2NOCl_{(g)}$ is

(a) $K_c = \frac{[2NOCl]}{[2NO][Cl_2]}$ (b) $K_c = \frac{[NOCl]^2}{[NO]^2[Cl_2]}$ (c) $K_c = \frac{[NOCl]^2}{[NO][Cl_2]^2}$ (d) $K_c = \frac{[NOCl]^2}{[NO]^2[Cl_2]^2}$

25. $H_2 + I_2 \rightleftharpoons$ 2*HI*. In this equilibrium system if the concentration of the reactants at 25^oC is increased, the value of K_c will

(a) Increase (b) Decrease

(c) Remains the same (d) Depends on the nature of the reactants

26. At a given temperature, the equilibrium constant for reaction $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ is 2.4×10^{-3}. At the same temperature, the equilibrium constant for reaction $PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$ is

(a) 2.4×10^{-3} (b) -2.4×10^{-3} (c) 4.2×10^{2} (d) 4.8×10^{2}

27. For the reaction $C(s) + CO_2(g) \rightleftharpoons 2CO(g)$, the partial pressure of CO_2 and CO are 2.0 and 4.0 *atm* respectively at equilibrium. The K_p for the reaction is

(a) 0.5 (b) 4.0 (c) 8.0 (d) 32.0

28. An equilibrium mixture for the reaction $2H_2S(g) \rightleftharpoons 2H_2(g) + S_2(g)$ had 1 mole of H_2S, 0.2 mole of H_2 and 0.8 mole of S_2 in a 2 *litre* flask. The value of K_c in mole $litre^{-1}$ is

(a) 0.004 (b) 0.080 (c) 0.016 (d) 0.160

29. In a chemical equilibrium, the rate constant of the backward reaction is 7.5×10^{-4} and the equilibrium constant is 1.5. So the rate constant of the forward reaction is

(a) 5×10^{-4} (b) 2×10^{-3} (c) 1.125×10^{-3} (d) 9.0×10^{-4}

30. 28 *g* of N_2 and 6 *g* of H_2 were kept at 400^oC in 1 *litre* vessel, the equilibrium mixture contained 27.54 *g* of NH_3. The approximate value of K_c for the above reaction can be (in $mole^{-2}\, litre^2$)

(a) 75 (b) 50 (c) 25 (d) 100

31. The equilibrium concentration of *X*, *Y* and YX_2 are 4, 2 and 2 moles respectively for the equilibrium $2X + Y \rightleftharpoons YX_2$. The value of K_c is

(a) 0.625 (b) 0.0625 (c) 6.25 (d) 0.00625

32. At a certain temperature and a total pressure of 1 atmosphere dinitrogen tetraoxide (N_2O_4) 50% dissociated. The value of K_p at that temperature will be

(a) 0.75 atmosphere (b) 6.75 atmosphere (c) 2.00 atmosphere (d) 1.33 atmosphere

33. In the reaction $PCl_5 \rightleftharpoons PCl_3 + Cl_2$. 4 moles of PCl_5 are taken in a two litre flask. At equilibrium flask contain 0.4 moles of chlorine. Its equilibrium constant will be

(a) 0.011 (b) 0.022 (c) 0.044 (d) 0.001

34. The equilibrium constant (K_p) for the reaction $PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)$ is 16. If the volume of the container is reduced to one half its original volume, the value of K_p for the reaction at the same temperature will be

(a) 32 (b) 64 (c) 16 (d) 4

35. In the reaction $A + 2B \rightleftharpoons 2C$, if 2 moles of *A*, 3.0 moles of *B* and 2.0 moles of *C* are placed in a 2.0 *l* flask and the equilibrium concentration of *C* is 0.5 *mole*/*l*. The equilibrium constant (K_c) for the reaction is

(a) 0.073 (b) 0.147 (c) 0.33 (d) 0.026

36. $2SO_3 \rightleftharpoons 2SO_2 + O_2$. If $K_c = 100$, $\alpha = 1$, half of the reaction is completed, the concentration of SO_3 and SO_2 are equal, the concentration of O_2 is

(a) 0.001 *M* (b) $\frac{1}{2}$ of SO_2 (c) 2 times of SO_2 (d) Data incomplete

37. In a 500 *ml* capacity vessel *CO* and Cl_2 are mixed to form $COCl_2$. At equilibrium, it contains 0.2 moles of $COCl_2$ and 0.1 mole of each of *CO* and Cl_2. The equilibrium constant K_c for the reaction $CO + Cl_2 \rightleftharpoons COCl_2$ is

(a) 5 (b) 10 (c) 15 (d) 20

38. A reaction is $A + B \rightarrow C + D$. Initially we start with equal concentration of *A* and *B*. At equilibrium we find the moles of *C* is two times of *A*. What is the equilibrium constant of the reaction

(a) 4 (b) 2 (c) 1/4 (d) 1/2

39. If concentration of reactants is increased by '*x*' then *K* becomes

(a) In (*K*/*x*) (b) *K*/*x* (c) *K*+*x* (d) *K*

40. 4.5 moles each of hydrogen and iodine heated in a sealed ten litre vessel. At equilibrium, 3 moles of *HI* were found. The equilibrium constant for $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$ is

(a) 1 (b) 10 (c) 5 (d) 0.33

41. For a reversible reaction, if concentrations of the reactants are doubled, then equilibrium

(a) Is halved (b) Is doubled (c) Remains same (d) Becomes 1/4th

42. At a certain temperature $2HI \rightleftharpoons H_2 + I_2$ only 50% *HI* is dissociated at equilibrium. The equilibrium constant is

(a) 0.25 (b) 1.0 (c) 3.0 (d) 0.50

43. For the gaseous phase reaction $2NO \rightleftharpoons N_2 + O_2$ $\Delta H^0 = -43.5\ kcal\ mol^{-1}$. Which statement is correct

(a) *K* varies with addition of *NO*
(b) *K* decrease as temperature decreases
(c) *K* increases as temperature decreases
(d) *K* is independent of temperature

44. For the reversible reaction, $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ at 500^oC, the value of K_p is 1.44×10^{-5} when partial pressure is measured in atmospheres. The corresponding value of K_c with concentration in *mole* $litre^{-1}$, is

(a) $1.44 \times 10^{-5} /(0.082 \times 500)^{-2}$
(b) $1.44 \times 10^{-5} /(8.314 \times 773)^{-2}$
(c) $1.44 \times 10^{-5} /(0.082 \times 773)^{2}$
(d) $1.44 \times 10^{-5} /(0.082 \times 773)^{-2}$

45. A 1 *M* solution of glucose reaches dissociation equilibrium according to equation given below $6HCHO \rightleftharpoons C_6H_{12}O_6$. What is the concentration of *HCHO* at equilibrium if equilibrium constant is 6×10^{22}

(a) $1.6 \times 10^{-8}\ M$
(b) $3.2 \times 10^{-6}\ M$
(c) $3.2 \times 10^{-4}\ M$
(d) $1.6 \times 10^{-4}\ M$

46. Equilibrium concentration of *HI*, I_2 and H_2 is 0.7, 0.1 and 0.1 *M* respectively. The equilibrium constant for the reaction, $I_2 + H_2 \rightleftharpoons 2HI$ is

(a) 36
(b) 49
(c) 0.49
(d) 0.36

47. For the equilibrium $N_2 + 3H_2 \rightleftharpoons 2NH_3$, K_c at 1000*K* is 2.37×10^{-3}. If at equilibrium $[N_2] = 2M, [H_2] = 3M$, the concentration of NH_3 is

(a) 0.00358 *M*
(b) 0.0358 *M*
(c) 0.358 *M*
(d) 3.58 *M*

48. In the equilibrium $AB \rightleftharpoons A + B$; if the equilibrium concentration of *A* is doubled, the equilibrium concentration of *B* would become

(a) Twice
(b) Half
(c) 1/4th
(d) 1/8th

49. In the reaction $A+B \rightleftharpoons 2C$, at equilibrium, the concentration of *A* and *B* is 0.20 *mol* l^{-1} each and that of *C* was found to be $0.60\ mol\ l^{-1}$. The equilibrium constant of the reaction is

(a) 2.4
(b) 18
(c) 4.8
(d) 9

50. 5 moles of SO_2 and 5 moles of O_2 are allowed to react to form SO_3 in a closed vessel. At the equilibrium stage 60% of SO_2 is used up. The total number of moles of SO_2, O_2 and SO_3 in the vessel now is

(a) 10.0
(b) 8.5
(c) 10.5
(d) 3.9