DPP-8 [Unit and Application of Equilibrium Constant]

Chapter: Chemical Equilibrium

"Bina assignment ke confidence toh hai... par wo fake wala hai. — Weird Chemist."

GROUP–A : Stability / Direction of Equilibrium

Q1. In which of the following reaction product is more stable :-

(1) $N_2 + 3H_2 \rightleftharpoons 2NH_3$; $K_1 = 2.3 \times 10^{-2}$
(2) $N_2 + O_2 \rightleftharpoons 2NO$; $K_2 = 2 \times 10^2$
(3) $H_2 + I_2 \rightleftharpoons 2HI$; $K_3 = 294$
(4) $XeO + \frac{1}{2}O_2 + F_2 \rightleftharpoons XeO_2F_2$; $K_4 = 1.4 \times 10^{-3}$

Q2. Which Oxide of Nitrogen is most stable :-

(1) $2NO_2(g) \rightleftharpoons N_2(g) + 2O_2(g)$; $K = 6.7 \times 10^{16}$
(2) $2NO(g) \rightleftharpoons N_2(g) + O_2(g)$; $K = 2.2 \times 10^{30}$
(3) $2N_2O_5(g) \rightleftharpoons 2N_2(g) + 5O_2(g)$; $K = 1.2 \times 10^{34}$
(4) $4N_2O(g) \rightleftharpoons 2N_2(g) + O_2(g)$; $K = 3.5 \times 10^{33}$

Q3. If the value of an equilibrium constant is 1.6×10^{12}, then at equilibrium the system will contain :-

(1) mostly reactants
(2) mostly products
(3) similar amounts of reactants and products
(4) all reactants

Q4. In a reaction, equilibrium proceeds towards reactants then K will be :-

(1) $K >> 1$
(2) $K << 1$
(3) $K = 0$
(4) $K = 1$

Q5. In which of the following does the reaction go almost to completion?

(1) $A + B \rightleftharpoons C$; $K = 10^4$
(2) $X + Y \rightleftharpoons Z$; $K = 10^{-3}$
(3) $P + Q \rightleftharpoons R$; $K = 1$
(4) $M + N \rightleftharpoons P$; $K = 10^{-1}$

Q6. Which of the following reactions goes almost all the way to completion, and which proceeds hardly at all?

(a) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$; $K_c = 2.7 \times 10^{-18}$
(b) $2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$; $K_c = 6.0 \times 10^{13}$

Q7. When $K_c >> 1$ for a chemical reaction,

(1) equilibrium would be achieved rapidly
(2) equilibrium would be achieved slowly
(3) product concentrations would be much greater than reactants at equilibrium
(4) reactant concentrations would be much greater than products at equilibrium

Q8. Benzene is made from acetylene... Would this reaction be most useful commercially if K were about 0.01, about 1, or about 10?

GROUP–B : Unit of K_c / K_p

Q9. **Using molar concentrations, what is the unit of K_c for $CH_3OH(g) \rightleftharpoons CO(g) + 2H_2(g)$:-**

(1) M^{-2}
(2) M^2
(3) M^{-1}
(4) M

Q10. **What is the unit of K_p for the reaction : $CS_2(g) + 4H_2(g) \rightleftharpoons CH_4(g) + 2H_2S(g)$**

(1) atm
(2) atm^{-2}
(3) atm^2
(4) atm^{-1}

Q11. **For the gaseous reaction, $C_2H_4 + H_2 \rightleftharpoons C_2H_6$, the equilibrium constant has units :**

(1) $mol^2\ dm^{-3}$
(2) $dm^3\ mol^{-1}$
(3) $dm^3\ mol^{-2}$
(4) $mol\ dm^{-3}$

Q12. **For $N_2 + 3H_2 \rightleftharpoons 2NH_3$, the units of K_c and K_p respectively are :**

(1) $mol^{-2}\ L^2$ and bar^{-2}
(2) $mol^{-2}\ L^2$ and bar^{-1}
(3) mol^{-1} L and bar^{-2}
(4) $mol^{-1}\ L^{-1}$ and bar^{-1}

Q13. **For hypothetical equilibrium, $4A(g) + 5B(g) \rightleftharpoons 4X(g) + 6Y(g)$, the unit of K_c will be :-**

(1) litre $mole^{-1}$
(2) mole $litre^{-1}$
(3) litre $mole^{-2}$
(4) $mole^2$ $litre^{-2}$

Q14. **What is the unit of K_p for the reaction ? $CS_2(g) + 4H_2(g) \rightleftharpoons CH_4(g) + 2H_2S(g)$**

(1) atm
(2) atm^{-2}
(3) atm^2
(4) atm^{-1}

GROUP–C : Comparing Equilibrium Constants (Tables)

Q15. **Equilibrium constant of some reactions are given as under :**

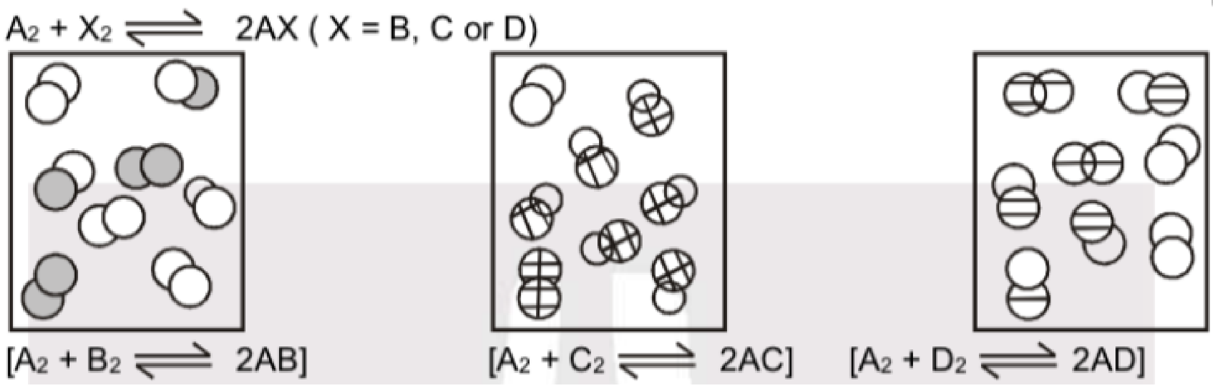
(a) $x \rightleftharpoons y$ — $K = 10^{-1}$
(b) $y \rightleftharpoons z$ — $K = 2 \times 10^{-2}$
(c) $P \rightleftharpoons Q$ — $K = 3 \times 10^{-4}$
(d) $R \rightleftharpoons S$ — $K = 2 \times 10^{-3}$

Initial concentration of reactants for each reaction was taken to be equal. Indicate in which reactions the reactants and products respectively were of highest concentration :-

(1) d, c
(2) c, a
(3) a, d
(4) b, c

Q16. Which reaction has the largest equilibrium constant?

[NSEC-2002]



(A) $A_2 + B_2 \rightleftharpoons 2AB$ (B) $A_2 + C_2 \rightleftharpoons 2AC$ (C) $A_2 + D_2 \rightleftharpoons 2AD$ (D) none of these

Group–D: Reaction Quotient (Q) vs Equilibrium Constant (K)

Q17. Assertion:– For a reaction, reaction quotient (Q) is equal to K when the reaction is in equilibrium.
Reason:– If a catalyst is added to the reaction at equilibrium, the value of Q remains no longer equal to K.

(1) A
(2) B
(3) C
(4) D

Q18. What will be the direction of reaction if concentration of H_2, I_2 and HI are 2 mol L^{-1}, 2 mol L^{-1} and 8 mol L^{-1} respectively. K_c for reaction $H_2 + I_2 \rightleftharpoons 2HI$ is 4.

(1) forward direction
(2) backward direction
(3) equilibrium condition
(4) reaction will be completed

Q19. A reaction mixture containing H_2, N_2 and NH_3 has partial pressures 2 atm, 1 atm and 3 atm respectively at 725K. If the value of K_p for the reaction,
$N_2 + 3H_2 \rightleftharpoons 2NH_3$ is 4.28×10^{-5} atm^{-2} at 725K, in which direction the net reaction will go?

(1) Forward
(2) Backward
(3) No net reaction
(4) Direction cannot be predicted

Q20. Which of the following is in favour of forward reaction?

(1) $Q = K_c$
(2) $Q > K_c$
(3) $Q < K_c$
(4) None

Q21. **Assertion:– The value of K increases when concentration of the reactants are increased.**
Reason:– With increase of concentration of reactants the equilibrium shifts in forward direction.
(1) A
(2) B
(3) C
(4) D

Q22. **Assertion:– For a reaction $A_{(g)} + B_{(g)} \rightleftharpoons AB_{(g)}$ if inert gas is added in a container at constant volume, the equilibrium shifts to left side.**
Reason:– Because partial pressure of A, B and AB decreases.
(1) A
(2) B
(3) C
(4) D

Q23. **At 445°C, K_c for the following reaction is 0.020.**
$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$
A mixture of H_2, I_2 and HI in a vessel at 445°C has the concentrations: [HI]= 2.0 M, $[H_2]$ = 0.50 M and $[I_2]$ = 0.10 M.
The statement true concerning reaction quotient Q_c is: [NSEC–2011]
(A) $Q_c = K_c$; the system is at equilibrium
(B) $Q_c < K_c$; more H_2 and I_2 will be produced
(C) Q_c is less than K_c ; more HI will be produced
(D) Q_c is greater than K_c ; more H_2 and I_2 will be produced

Q24. **The reaction quotient Q for $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ is given by**
$Q = \dfrac{[NH_3]^2}{[N_2][H_2]^3}$. The reaction will proceed in backward direction when:
(A) $Q = K_c$
(B) $Q < K_c$
(C) $Q > K_c$
(D) $A = 0$

Q25. **For the reaction, $2A + B \rightleftharpoons 3C$ at 298 K, $K_c = 49$. A 3L vessel contains 2, 1 and 3 moles of A, B and C respectively. The reaction at the same temperature:**
(A) must proceed in forward direction
(B) must proceed in backward direction
(C) must be equilibrium
(D) can not be predicted

Q26. **When two reactants, A and B are mixed to give products C and D, the reaction quotient Q, at the initial stages of the reaction:** [JEE–2000, 1/35]
(A) is zero
(B) decreases with time
(C) is independent of time
(D) increases with time

Q27. **The standard Gibbs energy change at 300 K for the reaction $2A \rightleftharpoons B + C$ is 2494.2 J. At a given time, composition of reaction mixture is: $[A] = \frac{1}{2}$, [B] = 2, $[C] = \frac{1}{2}$.**

The reaction proceeds in the: **[JEE(Main) 2015, 4/120]**

(1) forward direction because $Q > K_c$

(2) reverse direction because $Q > K_c$

(3) forward direction because $Q < K_c$

(4) reverse direction because $Q < K_c$

Q28. The equilibrium constant at 298 K for a reaction $A + B \rightleftharpoons C + D$ is 100. If initial concentration of all four species were 1 M each, then equilibrium concentration of D (in mol L^{-1}) will be: [JEE(Main) 2016, 4/120]

(1) 0.818

(2) 1.818

(3) 1.182

(4) 0.182