Unit 8 Physical and chemical Equilibrium

Choose the best answer.

1. If K_b and K_f for a reversible reaction are 0.8×10^{-5} and 1.6×10^{-4} respectively, the value of the equilibrium constant is,

   a) 20 b) 0.2×10^{-1}

   c) 0.05 d) none of these

2. At a given temperature and pressure, the equilibrium constant values for the equilibria

   $3A_2 + B_2 + 2C \overset{K_1}{\rightleftharpoons} 2A_3BC$ and

   $A_3BC \overset{K_2}{\rightleftharpoons} \frac{3}{2} A_2 + \frac{1}{2} B_2 + C$

   The relation between K_1 and K_2 is

   a) $K_1 = \frac{1}{\sqrt{K_2}}$ b) $K_2 = K_1^{-1/2}$

   c) $K_1^2 = 2K_2$ d) $\frac{K_1}{2} = K_2$

3. The equilibrium constant for a reaction at room temperature is K_1 and that at 700 K is K_2. If $K_1 > K_2$, then

   a) The forward reaction is exothermic

   b) The forward reaction is endothermic

   c) The reaction does not attain equilibrium

   d) The reverse reaction is exothermic

4. The formation of ammonia from $N_2(g)$ and $H_2(g)$ is a reversible reaction

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) + \text{Heat}$$

What is the effect of increase of temperature on this equilibrium reaction

a) equilibrium is unaltered

b) formation of ammonia is favoured

c) equilibrium is shifted to the left

d) reaction rate does not change

5. Solubility of carbon dioxide gas in cold water can be increased by

a) increase in pressure

b) decrease in pressure

c) increase in volume

d) none of these

6 Which one of the following is incorrect statement ?

a) for a system at equilibrium, Q is always less than the equilibrium constant

b) equilibrium can be attained from either side of the reaction

c) presence of catalyst affects both the forward reaction and reverse reaction to the same extent

d) Equilibrium constant varied with temperature

7. K_1 and K_2 are the equilibrium constants for the reactions respectively.

$$N_2(g) + O_2(g) \overset{K_1}{\rightleftharpoons} 2NO(g)$$

$$2NO(g) + O_2(g) \overset{K_2}{\rightleftharpoons} 2NO_2(g)$$

What is the equilibrium constant for the reaction $NO_2(g) \rightleftharpoons \frac{1}{2}N_2(g) + O_2(g)$

a) $\frac{1}{\sqrt{K_1K_2}}$ b) $(K_1 = K_2)^{1/2}$

c) $\frac{1}{2K_1K_2}$ d) $\left(\frac{1}{K_1K_2}\right)^{3/2}$

8. In the equilibrium,

$$2A(g) \rightleftharpoons 2B(g) + C_2(g)$$

the equilibrium concentrations of A, B and C_2 at 400 K are 1×10^{-4} M, 2.0×10^{-3} M, 1.5×10^{-4} M respectively. The value of K_C for the equilibrium at 400 K is

a) 0.06 b) 0.09

c) 0.62 d) 3×10^{-2}

9. An equilibrium constant of 3.2×10^{-6} for a reaction means, the equilibrium is

a) largely towards forward direction

b) largely towards reverse direction

c) never established

d) none of these

10. $\frac{K_C}{K_P}$ for the reaction,

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ is

a) $\frac{1}{RT}$ b) $\sqrt{RT}$

c) RT d) $(RT)^2$

11. For the reaction AB (g) $\rightleftharpoons$ A(g) + B(g), at equilibrium, AB is 20% dissociated at a total pressure of P, The equilibrium

constant K_p is related to the total pressure by the expression

a) $P = 24\ K_p$ b) $P = 8\ K_p$

c) $24\ P = K_p$ d) none of these

12. In which of the following equilibrium, K_p and K_C are not equal?

a) $2\ NO(g) \rightleftharpoons N_2(g) + O_2(g)$

b) $SO_2(g) + NO_2 \rightleftharpoons SO_3(g) + NO(g)$

c) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

d) $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

13. If x is the fraction of PCl_5 dissociated at equilibrium in the reaction

$$PCl_5 \rightleftharpoons PCl_3 + Cl_2$$

then starting with 0.5 mole of PCl_5, the total number of moles of reactants and products at equilibrium is

a) $0.5 - x$ b) $x + 0.5$

c) $2x + 0.5$ d) $x + 1$

14. The values of K_{P_1} and K_{P_2} for the reactions

$$X \rightleftharpoons Y + Z$$

$A \rightleftharpoons 2B$ are in the ratio 9 : 1 if degree of dissociation and initial concentration of X and A be equal then total pressure at equilibrium P_1, and P_2 are in the ratio

a) 36 : 1 b) 1 : 1

c) 3 : 1 d) 1 : 9

15. In the reaction,

$Fe(OH)_3(s) \rightleftharpoons Fe^{3+}(aq) + 3OH^-(aq)$,

if the concentration of OH^- ions is decreased by ¼ times, then the

equilibrium concentration of Fe^{3+} will

a) not changed

b) also decreased by ¼ times

c) increase by 4 times

d) increase by 64 times

16. Consider the reaction where $K_p = 0.5$ at a particular temperature

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

if the three gases are mixed in a container so that the partial pressure of each gas is initially 1 atm, then which one of the following is true

a) more PCl_3 will be produced

b) more Cl_2 will be produced

c) more PCl_5 will be produced

d) none of these

17. Equimolar concentrations of H_2 and I_2 are heated to equilibrium in a 1 litre flask. What percentage of initial concentration of H_2 has reacted at equilibrium if rate constant for both forward and reverse reactions are equal

a) 33% b) 66%

c) $(33)^2$ % d) 16.5 %

18. In a chemical equilibrium, the rate constant for the forward reaction is 2.5×10^2 and the equilibrium constant is 50. The rate constant for the reverse reaction is,

a) 11.5 b) 5

c) 2×10^2 d) 2×10^{-3}

19. Which of the following is not a general

characteristic of equilibrium involving physical process

a) Equilibrium is possible only in a closed system at a given temperature

b) The opposing processes occur at the same rate and there is a dynamic but stable condition

c) All the physical processes stop at equilibrium

d) All measurable properties of the system remains constant

20. For the formation of Two moles of $SO_3(g)$ from SO_2 and O_2, the equilibrium constant is K_1. The equilibrium constant for the dissociation of one mole of SO_3 into SO_2 and O_2 is

a) $1/K_1$ b) K_1^2

c) $\left(\frac{1}{K_1}\right)^{1/2}$ d) $\frac{K_1}{2}$

21. Match the equilibria with the corresponding conditions,

i) Liquid $\rightleftharpoons$ Vapour

ii) Solid $\rightleftharpoons$ Liquid

iii) Solid $\rightleftharpoons$ Vapour

iv) Solute (s) $\rightleftharpoons$ Solute (Solution)

1) melting point

2) Saturated solution

3) Boiling point

4) Sublimation point

5) Unsaturated solution

	(i)	(ii)	(iii)	(iv)
(a)	1	2	3	4
(b)	3	1	4	2
(c)	2	1	3	4
(d)	3	2	4	5

22. Consider the following reversible reaction at equilibrium, A + B ⇌ C, If the concentration of the reactants A and B are doubled, then the equilibrium constant will

a) be doubled b) become one fourth

c) be halved d) remain the same

23. $[Co(H_2O)_6]^{2+}$ (aq) (pink) + $4Cl^-$ (aq) ⇌ $[CoCl_4]^{2-}$ (aq) (blue)+ 6 H_2O (*l*)

In the above reaction at equilibrium, the reaction mixture is blue in colour at room temperature. On cooling this mixture, it becomes pink in colour. On the basis of this information, which one of the following is true ?

a) $\Delta H > 0$ for the forward reaction

b) $\Delta H = 0$ for the reverse reaction

c) $\Delta H < 0$ for the forward reaction

d) Sign of the ΔH cannot be predicted based on this information.

24. The equilibrium constants of the following reactions are :

$N_2 + 3H_2 \rightleftharpoons 2NH_3$; K_1

$N_2 + O_2 \rightleftharpoons 2NO$; K_2

$H_2 + \frac{1}{2}O_2 \rightleftharpoons H_2O$; K_3

The equilibrium constant (K) for the reaction ;

$2NH_3 + \frac{5}{2}O_2 \overset{K}{\rightleftharpoons} 2NO + 3H_2O$, will be

a) $K_2^3 K_3 / K_1$ b) $K_1 K_3^3 / K_2$

c) $K_2 K_3^3 / K_1$ d) $K_2 K_3 / K_1$

25. A 20 litre container at 400 K contains CO_2 (g) at pressure 0.4 atm and an excess of SrO (neglect the volume of solid SrO). The volume of the container is now decreased by moving the movable piston fitted in the container. The maximum volume of the container, when pressure of CO_2 attains its maximum value will be :

Given that : $SrCO_3$ (S) $\rightleftharpoons$ SrO (S) + CO_2(g)

K_p = 1.6 atm (NEET 2017)

a) 2 litre b) 5 litre

c) 10 litre d) 4 litre