Equilibrium

1. **Assertion (A):** For the reaction, $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$, $K_p = K_c$

   Reason (R): K_p of all gases reactions is equal to K_c.

   (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

   (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

   (3) (A) is true but (R) is false

   (4) Both (A) and (R) are false

2. **Assertion (A):** A net reaction can occur only if a system is not at equilibrium.

   Reason (R): All reversible reactions occur to reach a state of equilibrium.

   (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

   (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

   (3) (A) is true but (R) is false

   (4) Both (A) and (R) are false

3. **Assertion (A):** For the reaction, $N_2 + O_2 \rightleftharpoons 2NO$, increase in pressure at equilibrium has no effect on the reaction.

   Reason (R): Σ moles of gaseous product $- \Sigma$ moles of gaseous reactant = 0.

   (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

   (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

   (3) (A) is true but (R) is false

   (4) Both (A) and (R) are false

4. **Assertion (A):** The reaction quotient, Q has the same form as the equilibrium constant K_{eq}, and is evaluated using any given concentrations of the species involved in the reaction, and not necessarily equilibrium concentrations.

   Reason (R): If the numerical value of Q is not the same as the value of equilibrium constant, a reaction will occur.

   (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

   (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

   (3) (A) is true but (R) is false

   (4) Both (A) and (R) are false

5. **Assertion (A):** If the equation for a reaction is reversed, the equilibrium constant is inverted and if the equation is multiplied by 2, the equilibrium constant is squared.

   Reason (R): The numerical value of an equilibrium constant depends on the way the equation for the reaction is written.

   (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

   (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

   (3) (A) is true but (R) is false

   (4) Both (A) and (R) are false

6. **Assertion (A):** $K_p = K_c$ for all reactions.

   Reason (R): At constant temperature, the pressure of the gas is not proportional to the concentration.

   (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

   (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

   (3) (A) is true but (R) is false

   (4) Both (A) and (R) are false

7. **Assertion (A):** A catalyst does not influences the values of equilibrium constant.

Reason (R): Catalysts influence the rate of both forward and backward reactions equally.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

8. **Assertion (A):** For

$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$. If more Cl_2 is added the equilibrium will shift in backward direction hence equilibrium constant will decrease.

Reason (R): Addition of inert gas to the equilibrium mixture at constant volume, alter the equilibrium.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

9. **Assertion (A):** For a reaction at equilibrium, the Gibb's free energy of reaction is minimum at constant temp. and pressure.

Reason (R): The Gibb's free energy of both reactants and products increases and become equal at equilibrium.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

10. **Assertion (A):** If $Q_P < K_P$ reaction moves in direction of products.

Reason (R): Reaction quotient is defined in the same way as equilibrium constant at any stage of the reaction.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

11. **Assertion (A):** Among HCl, H_2SO_4 and $HClO_4$, $HClO_4$ is the strongest acid.

Reason (R): $HClO_4$ ionizes to maximum extent when dissolved in glacial acetic acid.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

12. **Assertion (A):** pH of x M HCl is less than pH of x M CH_3COOH.

Reason (R): The degree of ionization of HCl and CH_3COOH are equal at infinite dilution.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

13. **Assertion (A):** The degree of dissociation of a weak base increases on dilution.

Reason (R): The value of K_b increases on dilution

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

14. **Assertion (A):** The conjugate acid base pair differ by a proton.

Reason (R): NH_2^- and NH_4^+ are conjugate acid base pair.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

15. **Assertion (A):** Phenolphthalein is used as an indicator in the titration of weak acid with NaOH.

Reason (R): Near the end point, the pH of the solution is alkaline due to hydrolysis of anion.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

16. **Assertion (A):** The degree of dissociation of CH_3COOH is more in a solution which is basic than in water.

Reason (R): K_a of CH_3COOH increases in basic solution.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

17. **Assertion (A):** Addition of HCl (aq.) to HCOOH (aq.) decrease to ionization of HCOOH (aq.).

Reason (R): Due to common ion effect of H^+, ionization of HCOOH decrease.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

18. **Assertion (A):** pH of 10^{-7} M HCl is less than 7 at 25°C.

Reason (R): At very low concentration of HCl, contribution of H^+ from water is considerable.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

19. **Assertion (A):** Solubility of sparingly soluble salt decreases due to common ion effect.

Reason (R): Solubility product constant does not depend on common ion effect.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

20. **Assertion (A):** Solubility od AgCl in NH_3(aq.) is greater than in pure water.

Reason (R): When AgCl dissolve in NH_3(aq.), complex ion formation $Ag(NH_3)_2^+$ takes place and solubility equilibria of AgCl shifted in forward direction.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

21. **Assertion (A):** H_3PO_3 is a dibasic acid and it's salt Na_3PO_3 does not exist.

Reason (R): Being dibasic nature, only two H are replaceable.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

22. **Assertion (A):** The aqueous solution of $CF_3COO^-Na^+$ is more basic than the aqueous solution of $CH_3COO^-Na^+$ for same concentration of salt.

Reason (R): The salt derived from weak acid and strong base hydrolyses to generate acidic solution.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

23. **Assertion (A):** According to principle of common ion effect, the solubility of HgI_2 is expected to be less in an aqueous solution of KI than in water. But HgI_2 dissolves in an aqueous solution of KI to form a clear solution.

Reason (R): Iodide ion, I^- is highly polarizable.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

24. **Assertion (A):** pH of HCl solution is less than that of acetic acid solution of the same concentration.

Reason (R): In equimolar solutions, the number of titrable protons present in HCl acid is less than that present in acetic acid.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

25. **Assertion (A):** On increasing temperature pH of H_2O decreases.

Reason (R): At high temperature water become acidic.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

26. **ASSERTION (A):** The dissociation constant of polyprotic acid are in the order $K_1 > K_2 > K_3$.

REASON (R): The $\left[H^+\right]$ furnished in 1st step of dissociation exerts common ion effect to reduce 2nd dissociation and so on.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

27. **Assertion (A):** A catalyst (positive) decreases energy of activation of the reaction without changing the position of equilibrium.

Reason **(R):** By changing the concentration of any of the reactant or product species, the position of equilibrium may change but equilibrium constant will remain the same provided temperature remains constant.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

28. **Assertion (A):** The equilibrium (given below) attained in a closed vessel remains unaltered by the addition of $CaCO_{3(s)}$

$CaCO_{3(s)} \rightleftharpoons CaO_{(s)} + CO_2 \uparrow$

Reason (R): The active mass of a solid is a constant and independent of its mass and is always taken to be unity.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

29. **Assertion (A):** Addition of inert gas to an equilibrium mixture at constant pressure does not effect the equilibrium.

Reason (R): Addition of inert gas at constant pressure decreases the volume of equilibrium mixture.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

30. **Assertion (A):** At an equilibrium $A(g) + 2B(g) \rightleftharpoons C(g)$ if substantial amount of water is added to the mixture and stated that only A(g) gets dissolved to a certain extent in water then equilibrium shifts towards forward direction.

Reason (R): On decreasing the volume of reaction mixture and keeping rest of things same the equilibrium shifts to a direction having more number of gaseous molecules.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

ANSWER KEY																			
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Ans.	3	1	1	2	1	4	1	4	3	2	1	2	3	3	1	3	1	1	2	1
Que.	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**										
Ans.	1	4	2	3	3	1	2	1	4	4										