Equilibrium

Assertion Reason Questions

In the following question no. (9-11) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choice.

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

1. Assertion (A): Increasing the concentration of H_2 will increase the magnitude of equilibrium constant of the reaction.

$H_2 + I_2 \rightleftharpoons 2HI$

Reason (R): Value of K depends upon the concentration of reactants and products taken.

Ans. (d) (A) is false but (R) is true.
Explanation: The value of equilibrium constant does not depend upon the initial concentration of reactant.

2. Assertion (A): For any chemical reaction at a particular temperature, the equilibrium constant is fixed and is a characteristic property. is
Reason (R): Equilibrium constant independent of temperature.

Ans. (c) (A) is true but (R) is false.
Explanation: The equilibrium constant has a definite value for every chemical reaction at a given temperature.

3. Assertion (A): Chemical equilibrium represents a state of a reversible reaction in which properties of the system (pressure, concentration, etc.) become constant under the given set of conditions.
Reason (R): The chemical equilibrium is a state of rest in which opposite reactions stop.

Ans. (c) (A) is true but (R) is false.
Explanation: At equilibrium, all the macroscopic properties such as pressure and

concentration become constant but at equilibrium, both forward and backward reaction work in opposite direction.

4. Assertion (A): For any chemical reaction at a particular temperature, the equilibrium constant is fixed and is a characteristic property.
Reason (R): Equilibrium constant is independent of temperature.

Ans. (c) (A) is true but (R) is false.
Explanation: The equilibrium constant is dependent on the temperature. It has one unique value for the particular reaction at the given temperature. Hence, the assertion is true and the reason is false.

5. Assertion(A): IfQ,<K reaction moves in the direction of the reactant.
Reason(R): Reaction quotient is defined in the same way as equilibrium constant at any stage of the reaction.

Ans. (d) (A) is false but (R) is true.
Explanation: $aX + bY \rightleftarrows cU + dW$

$$Q_p = \frac{[U]^c[W]^d}{[X]^a[Y]^b}$$

The reaction quotient is defined in the same way as the equilibrium constant. The given assertion is wrong according to the conditions, because for the $Q_p<K_p$ reaction proceeds in the direction of the product and the reason is correct.

6. Assertion (A): The Gibbs free energy for reaction is minimum at constant temperature and pressure for the reaction at equilibrium.
Reason (R): The Gibbs free energy of both the reactants and products increase and are equal at equilibrium.

Ans. (c) (A) is true but (R) is false.
Explanation: The Gibbs free energy is given as:
$\Delta G = \Delta G^\circ + RT\ln Q$
At equilibrium, $\Delta G^\circ = 0$ thus the value of ΔG° is minimum at this condition. The Gibbs free energy of both the reactants and the products becomes equal at the equilibrium. They may increase or decrease also at certain conditions.

7. Assertion (A): The equilibrium constant for the given reaction is $CaCO_{3(s)} \xrightarrow{\Delta} CaO_{(s)} + CO_{2(g)}$ is

$$K_c = \frac{[CaCO_3]}{[CaO][CO_2]}.$$

Reason (R): Equilibrium constant is the ratio of the product of molar concentration of the substances produced to the product of the molar concentrations of reactants with each concentration term raised to the power equal to the respective stoichiometric constant.

Ans. (d) (A) is false but (R) is true.
Explanation: The assertion is wrong because for the given reaction $CaCO_3$, and CaO are given as solid because the molar concentration of solids is taken as unity. Meanwhile, the given reason defines the equilibrium constant correctly.

$K_c = [CO_2]$

8. Assertion (A): In the dissociation of PCI, at constant pressure and temperature, addition of helium at equilibrium increases the dissociation of PCL,.
Reason (R): Helium reacts with Cl, and hence shifts the equilibrium in forward direction.

Ans. (c) (A) is true but (R) is false.
Explanation: Helium is an inert gas and hence does not react with Cl_2. However, to keep the pressure constant on addition of helium, volume of the system will increase which will favour forward reaction.

9. Assertion (A): Weak acids have very strong conjugate bases while strong acids have weak conjugate bases.
Reason (R): Conjugate acid-base pairs differ only by one proton.

Ans. (b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
Explanation: Strong acids such as perchloric acid and hydrochloric acid give conjugate base ions CLO_4 Cl- which are much weaker bases than H_2O. On the other hand, a weak acid like acetic acid is only partially dissociated in an aqueous medium and thus the solution mainly contains undissociated acetic acid which proves that CH_3COO is a stronger base than H_2O.

10. Assertion (A): The ionisation constants of weak diprotic acid are in the order of $K_{a1} > K_{a2}$
Reason (R): Removal of H from anion is difficult as compared to neutral atoms.

Ans. (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
Explanation: The ionisation constants of weak diprotic acid are in order of $K_{a1} > K_{a2}$. due to more stability of conjugate base and removal of H+ from anion is difficult as compared to neutral atom

11. Assertion (A): The ionisation of hydrogen sulphide in water is low in the presence of hydrochloric acid.
Reason (R): Hydrogen sulphide is a weak acid.

Ans. (b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
Explanation: Ionisation of HS gets suppressed in water due to common H+ ions produced by HCL

12. Assertion (A): A solution containing a mixture of acetic acid and sodium acetate maintains a constant value of pH on the addition of small amounts of acid or alkali.
Reason (R): A solution containing a mixture of acetic acid and sodium acetate acts as a buffer solution around pH of 4.75.

Ans. (b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
Explanation: The addition of a minimal volume of acid or alkali or dilution in the solution will withstand the change in pH.

13. Assertion (A): Neutral solutions always have pH equal to 7.
Reason (R): pH of a solution does not depend on temperature.

Ans. (d) (A) is false but (R) is true.
Explanation: At 298 K, the pH of neutral solution is 7, as the temperature increase, there will be an increase in the dissociation, thus increases [H+]. Thus, pH of the solution depends upon temperature.

14. Assertion (A): Aqueous solution of ammonium carbonate is basic.
Reason (R): Acidic/basic nature of a salt solution of a salt of a weak acid and weak base depends on Ka and Kb value of the acid and the base forming it.

Ans. (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
Explanation: Both sssertion and reason are true and reason is correct explanation of assertion because K_a and K_b values are responsible for acidic and basic characters of the substances.