



CHEMISTRY

JEE (MAIN AND ADVANCED) CHEMISTRY

CHEMICAL EQUILIBRIUM

Problem

1. The reaction between ethanoic acid and ethanol is reversible even in an open vessel. Why?

[Watch Video Solution](#)

2. How is the establishment of water and water vapour equilibrium detected?

[Watch Video Solution](#)

3. Solubility of iodine of water is $1.1 \times 10^{-3} \text{ mol L}^{-1}$ at 290K. When 0.1g of iodine is stirred in 200ml water till the equilibrium is reached at 290K, calculate the mass of undissolved iodine.



Watch Video Solution

4. Chemical equilibrium is dynamic. Why?



Watch Video Solution

5. 4.25 grams of ammonia are dissolved to form 4L aqueous solution. Calculate the active mass.



Watch Video Solution

6. What is the active mass of one litre of oxygen gas at NTP?



Watch Video Solution

7. PCl_5 was taken at 2 atm in a closed vessel at $154^\circ C$ Keeping the temperature constant $PCl_5 \leftrightarrow PCl_3 + Cl_2$ equilibrium is established when 50% of PCl_5 decomposes. Calculate the K_p for the equilibrium.



Watch Video Solution

8. Equilibrium constant K_c for the reaction $H_2(g) + I_2(g) \leftrightarrow HI(g)$ is 50. What is the value of K_c for the reaction $\frac{1}{2}H_2(g) + \frac{1}{2}I_2(g) \leftrightarrow HI$ and $2HI(g) \leftrightarrow H_2(g) + I_2(g)$?



Watch Video Solution

9. K_c values respectively for the reactions, $H_2SO_3 \leftrightarrow H^+ + HSO_3^-$ and $HSO_3^- \leftrightarrow H^+ + SO_3^{2-}$ and 2×10^{-2} and Calculate the K_c for the reaction $H_2SO_3 \leftrightarrow 2H^+ + SO_3^{2-}$



Watch Video Solution

10. The reaction was started with 0.1M each of CO and H_2O at 800K. K_c for the chemical reaction , $CO(g) + H_2O(g) \leftrightarrow CO_2(g) + H_2(g)$ at 800K is 4.24. Calculate the equilibrium concentration of the lightest gas.



Watch Video Solution

11. K_p for the reaction $NH_4HS(s) \leftrightarrow NH_3(g) + H_2S(g)$ at certain temperature is 9 atm^2 Calculate the equilibrium pressure.



Watch Video Solution

12. For the cyclic teimerisation of acetylene to give one mole of benzene $K_c = 4L^2mol^{-2}$ IF the equilibrium concentration of benzene is $0.5molL^{-1}$ calculate the equilibrium concentration of acetylene.



Watch Video Solution

13. At 500K, $K_p = 1.8 \times 10^{-2}$ atm for the reaction $2NOCl(g) \leftrightarrow 2NO(g) + Cl_2(g)$ calculate the K_C at the same temperature.



Watch Video Solution

14. For the equilibrium $2SO_3(g) \leftrightarrow 2SO_2(g) + O_2(g)$ the partial pressure SO_3 , SO_2 and O_2 gases, at 650 K are respectively 0.3 bar, 0.6 bar and 0.4 bar. If the moles of both the oxides of sulphur are so adjusted as equal, what will be the partial pressure of O_2 .



Watch Video Solution

15. The equilibrium constant for the reaction $2X + Y \leftrightarrow X_2Y$ is $10L^2mol^{-2}$. The rate constant for the backward reaction is $28s^{-1}$. What is the rate constant of the forward reaction.



Watch Video Solution

16. K_C for the reaction $2X \leftrightarrow Y + Z$ is 2×10^{-3} at a given time the composition of reaction mixture $[X] = [Y] = [Z] = 2.8 \times 10^{-4}M$. IN what direction, the reaction will proceed?



Watch Video Solution

17. $N_2O_4(g) + 57KJ \leftrightarrow 2NO_2(g)$. Predict favourable Le chaterlier conditions.



Watch Video Solution

18. Solubility of NH_4Cl increases, while that of $CaCl_2$ decreases upon heating why?



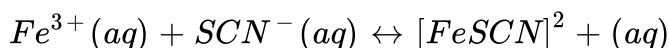
Watch Video Solution

19. Formation of NH_4 is preferred at low temperature, whereas formation of NO requires high temperature. Why?



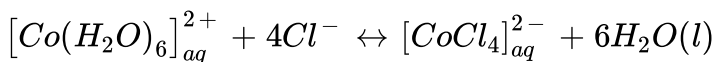
Watch Video Solution

20. What is the effect of added sodium thiocyanate on the following equilibrium?



Watch Video Solution

21. At room temperature the following equilibrium mixture is blue but when cooled in a freezing mixture, the colour of mixture turns pink. What is the nature of reaction.

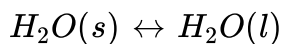


Pink Blue



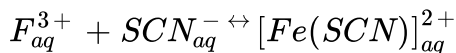
Watch Video Solution

22. What is the effect of increase of pressure on the following physical equilibrium?



Watch Video Solution

23. What is the effect of addition of oxalic acid and $HgCl_2$ to the following equilibrium



Yellow Colourless Deepred



Watch Video Solution

Exercise 1 1

1. What are irreversible reactions. Give examples.



Watch Video Solution

2. Give examples of reversible reactions.



Watch Video Solution

3. Describe the equilibrium state and its attainment.



Watch Video Solution

4. Write the important characteristics of equilibrium.



Watch Video Solution

5. What are homogenous and heterogenous equilibria? Give two example of each .



Watch Video Solution

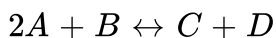
Exercise 1 2

1. State and explain law of mass action.



Watch Video Solution

2. Write the expression for the equilibrium constant for the reaction



Watch Video Solution

3. With suitable examples, discuss the relationship between K_c and K_p .



Watch Video Solution

4. Write the characteristics of equilibrium constant.



Watch Video Solution

5. At equilibrium $AB_5(g) \leftrightarrow AB_3(g) + B_2(g)$ the concentrations of AB_5 and AB_3 are 0.2 and 0.1 mol L^{-1} respectively. If $K_c = 0.5 \text{ mol L}^{-1}$ calculate the equilibrium concentration of B_2 .



Watch Video Solution

6. $PCl_5(g) \leftrightarrow PCl_3(g) + Cl_2(g)$ At $300K$, K_C is 0.204 mol L^{-1} . What is the value of K_p ?



Watch Video Solution

7. $13.8g$ of N_2O_4 was placed in a $1L$ reaction vessel at $400K$ and allowed to attain equilibrium



The total pressure at equilibrium was found to be 9.15 bar . Calculate K_c , K_p and partial pressure at equilibrium.



Watch Video Solution

8. 3.00 mol of PCl_5 kept in 1L closed reaction vessel was allowed to attain equilibrium at 380K. Calculate composition of the mixture at equilibrium $K_c = 1.80$



Watch Video Solution

9. K_p for the reaction $2SO_3(g) + O_2(g) \leftrightarrow 2SO_2(g)$ is $2.5 \times 10^{20} atm^{-1}$ at 500K. Calculate the K_p for the reaction $SO_3(g) \leftrightarrow SO_2(g) + \frac{1}{2}O_2(g)$.



Watch Video Solution

10. At 1300K, 0.3 mol of CO, 0.1 mol H_2 , 0.02 mol of H_2O and an unknown amount of CH_4 are present at equilibrium in a vessel. K_c for the reaction $CO(g) + H_2(g) \leftrightarrow CH_4(g) + H_2O(g)$ is 3.9. What is the equilibrium concentration CH_4



Watch Video Solution

11. 0.482 mol N_2 and 0.933 mol O_2 are placed in a 10 L vessel and allowed to form N_2O at constant temperature. Numerical value of K_c for the reaction $2N_2(g) + O_2(g) \leftrightarrow 2N_2O(g)$ is $2 \times 10^{-37} Kmol^{-1}$. Calculate the equilibrium concentration of nitrous oxide.



Watch Video Solution

12. The degree of dissociation of phosphorous pentachloride at certain temperature at 1atm is 0.2. calculate the pressure at which phosphorous pentachloride will be half dissociated at the same temperature.



Watch Video Solution

13. K_c for the reaction $H_2 + I_2 \leftrightarrow 2HI$ at $500^\circ C$ is 45.9. calculate the equilibrium concentration of HI.



Watch Video Solution

Exercise 1 3

1. Explain Le Chatelier's principle.



Watch Video Solution

2. What are the Le chatelier predictions on the influence of change of pressure, temperature and concentration on equilibria?



Watch Video Solution

3. What is the effect of addition of $NaNO_2$ to the decomposition of $NaNO_3$.



Watch Video Solution

Questions For Descriptive Answers

1. The characteristic of equilibrium and equilibrium constant are different.

Explain.



Watch Video Solution

2. Is evaporation of water a reversible process?



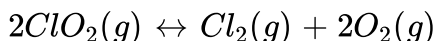
Watch Video Solution

3. A dynamic equilibrium means a balance between the tendency towards minimum and maximum enthalpies. Explain.



Watch Video Solution

4. Write the expression for the equilibrium constant of the reversible reaction.



Watch Video Solution

5. Starting from one mole each of anol and acetic acid, at equilibrium $\frac{2}{3}$ mole of ester is formed . Calculate the equilibrium constant.



Watch Video Solution

6. At $8.2^{\circ}C$, 0.778mol dm^{-3} of N_2O_4 and $2.84 \times 10^{-3}\text{mol dm}^{-3}$ of NO_2 were observed in certain experiment in a chloroform solution. Calculate the value of equilibrium constant for the reaction, $2NO_2(g) \leftrightarrow N_2O_4(g)$.



Watch Video Solution

7. At an equilibrium pressure of 2atm, the K_p for the reaction $PCl_5(g) \leftrightarrow PCl_3(g) + Cl_2(g)$ is 1.286 atm. What is the extent of dissociation of PCl_5 .



Watch Video Solution

8. At 125°C the K_p for the reaction $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \leftrightarrow 2\text{NH}_3(\text{g})$ is $2.15 \times 10^{-6} \text{atm}^{-2}$. Calculate K_c for the equilibrium at same temperature.



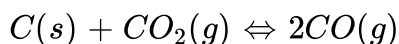
Watch Video Solution

9. For the reaction $\text{H}_2(\text{g}) + \text{Br}_2(\text{g}) \leftrightarrow 2\text{HBr}(\text{g})$ at 1024K , K_p is 1.6×10^5 . IF 10 bar of hydrogen bromide is introduced into the vessel at 1024K to establish equilibrium, what is the equilibrium pressure of hydrogen bromide?



Watch Video Solution

10. At 1127K and 1 atm pressure, a gaseous mixture of CO and CO_2 in equilibrium with solid carbon has 90.55 % CO by mass



Calculate K_c for this reaction at the above temperature.



Watch Video Solution

11. Some solid NH_4HS is placed in a flask containing 0.5 atm NH_3 . What is the equilibrium presence of NH_3 if $K_p = 0.11 atm^2$ for the reaction $NH_4HS(s) \leftrightarrow NH_3(s) + H_2S(g)$.



Watch Video Solution

12. K_c is 6.3×10^{14} for the reaction $NO + O_3 \leftrightarrow NO_2 + O_2$ at 1000K, calculate K_c for the reverse reaction.



Watch Video Solution

13. The equilibrium constant K_c for the $SO_{2(g)} + NO_{2(g)} \rightleftharpoons SO_{3(g)} + NO_{(g)}$ reaction is 16. if 1 mole of each of all the four gases is taken in ldm^3 vessel, the equilibrium concentration of NO would be



Watch Video Solution

14. An equilibrium mixture $N_2O_4 \leftrightarrow 2NO_2$ at 300K contains N_2O_4 and NO_2 at 0.28 and 1.1 atm, respectively. IF the volume of the container is doubled. Calculate the equilibrium pressure of nitrogen dioxide.



Watch Video Solution

15. K_c for the reaction $H_2 + I_2 \leftrightarrow 2HI$ at $500^\circ C$ is 45.9. calculate the equilibrium concentration of HI.



Watch Video Solution

16. The equilibrium constant for the polymerisation of formaldehyde to glucose in aqueous solution is 6×10^{22} . IF 1M glucose is at equilibrium $6HCHO \leftrightarrow C_6H_{12}O_6$ what is the concentration of formaldehyde at equilibrium?



Watch Video Solution

17. K_C for the reaction $N_2 + O_2 \leftrightarrow 2NO$ in air at 2500K is 2.1×10^{-3} . At equilibrium mole percentage of nitric oxide is 1.8. What is the mole fraction of N_2 in the air.



Watch Video Solution

18. The degree of dissociation is 0.4 at 400 K and a 1 atm for the gaseous reaction: $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$: assuming ideal behaviour of gases, calculate the density of equilibrium mixture at 400K and 1atm



Watch Video Solution

19. Bromine monochloride, $BrCl$ decomposes into bromine and chlorine and reaches the equilibrium :



for which $K_c = 32$ at 500K. If initially pure $BrCl$ is present at a concentration of $3.3 \times 10^{-3} mol L^{-1}$, what is its molar concentration in the mixture at equilibrium?

[Watch Video Solution](#)

20. Calculate the extent of dissociation of PCl_5 if the equilibrium pressure is numerically 3 times of its K_p .

[Watch Video Solution](#)

21. K_p for the reaction $N_2O_4(g) \leftrightarrow 2NO_2(g)$ at 750K is 640torr. Calculate the percentage of dissociation of N_2O_4 at equilibrium pressure of 160torr.

[Watch Video Solution](#)

22. At 1065°C the heat of dissociation of H_2S is 42.4K cal and the K_p for the decomposition reaction $2H_2S \leftrightarrow 2H_2 + S_2$ is 0.0118 atm. Find the K_p at 1132°C

[Watch Video Solution](#)

23. K_c for the reaction $Ag(CN)_2^- \leftrightarrow Ag^+ + 2CN^-$ at 298K is $4 \times 10^{-19} M^2$. Starting with 0.1M KCN and 0.03 $AgNO_3$. Calculate the equilibrium concentration of Ag^+



Watch Video Solution

24. $2SO_2(g) + O_2(g) \leftrightarrow 2SO_3(g)$ IF the volume of reaction vessel is increased, what happens to K_c . Explain.



Watch Video Solution

25. Ice melts slowly at high altitudes. Explain Why?



Watch Video Solution

26. Water boils at high temperature, taken in a pressure cooker. Explain?



Watch Video Solution

27. K_C for the reaction $2X \leftrightarrow Y + Z$ is 2×10^{-3} at a given time the composition of reaction mixture $[X] = [Y] = [Z] = 2.8 \times 10^{-4} M$. IN what direction, the reaction will proceed?

[Watch Video Solution](#)

28. On a red hot coke carbondioxide is reduced to carbon monoxide. Write the equation and predict the favourable conditions for the reactions.

[Watch Video Solution](#)

29. The specific heat capacity of a gas at constant pressure is greater than that at constant volume because

[Watch Video Solution](#)

30. $N_2(g) + O_2(g) + 181kJ \leftrightarrow 2NO(g)$ Write the Le Chatelier's conditions for shifting the equilibrium towards the formation of nitric acid.



Watch Video Solution