CHEMISTRY

NCERT - NCERT CHEMISTRY(TELUGU)

EQUILIBRIUM

Example

1. The following concentrations were obtained for the formation of NH_3 from N_2 and H_2 at equilibrium at $500K$. $[N_2] = 1.5 \times 10^{-2}M$. $[H_2] = 3.0 \times 10^{-2}$M and $[NH_3] = 1.2 \times 10^{-2}M$. Calculate equilibrium constant.

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2. At equilibrium , the concentrations of $N_2 = 3.0 \times 10^{-3} M$, $O_2 = 4.2 \times 10^{-3} M$ and $NO = 2.8 \times 10^{-3} M$ in a sealed vessel at $800K$. What will be K_c for the reaction

$N_2(g) + O_2(g) \Leftrightarrow 2NO(g)$

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3. PCl_5, PCl_3 and Cl_2 are at equilibrium at $500K$ and having concentration $1.59M$ PCl_3, $1.59MCl_2$ and $1.41MPCl_5$. Calcualte K_c for the reaction

$PCl_5 \Leftrightarrow PCl_3 + Cl_2$

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4. The value of $K_c = 4.24$ at $800K$ for the reaction,

$CO(g) + H_2O(g) \Leftrightarrow CO_2(g) + H_2(g)$

Calcualte equilibrium concentrations of CO_2, H_2, CO and H_2O at $800K$, if only CO and H_2O are present initially at concentrations of $0.1M$ each.

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5. For the equilibrium , $2NOCl(g) \Leftrightarrow 2NO(g) + Cl_2(g)$ the value of the equilibrium constant, K_c is 3.75×10^{-6} at $1069K$. Calculate the K_p for the reaction at this temperature ?

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6. The value of K_p for the reaction, $CO_2(g) + C(s) \Leftrightarrow 2CO(g)$ is 3.0 at $1000K$. If initially $P_{CO_2} = 0.48$ bar and $P_{CO} = 0$ bar and pure graphite is present, calculate the equilibrium partial pressures of CO and CO_2.

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7. The value of K_c for the reaction $2A \Leftrightarrow B + C$ is 2×10^{-3}. At a given time, the composition of reaction mixture is $[A] = [B] = [C] = 3 \times 10^{-4} M$. In which direction the reaction will proceed ?

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8. $13.8g$ of N_2O_4 was placed in a $1L$ reaction vessel at $400K$ and allowed to attain equilibrium

$N_2O_4(g) \Leftrightarrow 2NO_2(g)$

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

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9. 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 equlibrium $K_c = 1.80$

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10. The value of $\Delta G^{\oplus}$ for the phosphorylation of glucose in glucloysis is $13.8kJ/mol$. Find the value of K_c of $298K$

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11. Hydrolysis of sucrose gives, Sucrose $+H_2O \Leftrightarrow$ Glucose $+$ Fructose

Equlibrium constant K_c for the reaction is 2×10^{13} at $300K$. Calculate $\Delta G^{\oplus}$ at $300K$.

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12. What will be the conjugate bases of the following Bronsted acids: HF, H_2SO_4 and HCO_3^-?

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13. Write the conjugate acids for the following Bronsted bases: NH_2^-, NH_3 and $HCOO^-$:

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14. The species: H_2O, HCO_3^-, HSO_4^- and NH_3 can act both as Bronsted acids and bases. For each case give the corresponding conjugate acid and conjugate base.

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15. Explain Lewis acid base theory with suitable example. Classify the following species into Lewis acids and Lewis bases and show how these act as Lewis acid/base.

a. OH^- b. F^- c. H^+ d. BCl_3

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16. The concentration of hydrogen ion in a sample of soft drink is $3.8 \times 10^{-3} M$. What is its pH?

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17. Calculate pH of a 1.0×10^{-8} M solution of HCl.

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18. The ionization constant of HF is 3.2×10^{-4}. Calculate the degree of dissociation of HF in its $0.02M$ solution. Calculate the concentration of all species present (H_3O^+, F^- and HF) in the solution and its pH.

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19. The pH of $0.1M$ monobasic acid is 4.50. Calculate the concentration of species H^+.

A^- and HA at equilibrium . Also, determine the value of K_a and pK_a of the monobasic acid.

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20. Calculate the pH of $0.08M$ solution of hypochlorous acid, $HOCl$. The ionization constant of the acid is 2.5×10^{-5}. Determine the percent dissociation of $HOCl$.

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21. The pH of $0.004M$ hydrazine solution is 9.7. Calculate its ionization constant K_b and pK_b.

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22. Calculate the pH of the solution in which $0.2MNH_4Cl$ and $0.1MNH_3$ are present. The pK_b of ammonia solution is 4.75.

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23. Determine the degree of ionization and pH of $0.05M$ of ammonia solution. The ionization constant of ammonia can be taken from Table 7.7. Also, calculate the ionization constant of the conjugate acid of ammonia.

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24. Calculate the pH of $0.10M$ ammonia solution. Calcualte the pH after $50.0mL$ of this solution is treated with $25.0mL$ of $0.10MHCl$. The dissociation constant of ammonia, $K_b = 1.77 \times 10^{-5}$.

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25. The pK_a of acetic acid and pK_b of ammonium hydroxide are 4.76 and 4.75 respectively. Calculate the pH of ammonium acetate solution.

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26. Calculate the solubility of A_2X_2 in pure water, assuming that neither kind of ion reacts with water. The solubility product of $A_2X_3, K_{sp} = 1.1 \times 10^{-23}$.

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27. The values of K_{sp} of two sparingly soluble salts $Ni(OH)_2$ and $AgCN$ are 2.0×10^{-15} and 6×10^{-17} respectively. Which salt is more soluble ? Explain .

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28. Calculate the molar solubility of $Ni(OH)_2$ in $0.10MNaOH$. The ionic product of $Ni(OH)_2$ is 2.0×10^{-15}

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Exercise

1. A liquid is in equilibrium with its vapour in a sealed container at a fixed temperature. The volume of the container is suddenly increased.

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2. What is the initial effect of the change on vapour pressure ?

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3. How do rates of evaporation and condensation change on vapour pressure ?

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4. What happens when equilibrium is restored finally and what will be the final vapour pressure ?

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5. State law of chemical equilibrium? What is K_c for the following equilibrium when the equilibrium concentration of each substance is $[SO_2] = 0.60M$, $[O_2] = 0.82M$ and $[SO_3] = 1.90M$

$2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$

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6. At a certain temperature and total pressure of $10^5 Pa$, iodine vapour contains $40\,\%$ by volume of I atoms

$I_2(g) \Leftrightarrow 2I(g)$

Calculate K_p for the equilibrium

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7. Write expression for the equilibrium constant, K_c, for each of the following reactions:

(i) $2NOCl_{(g)} \leftrightarrow 2NO_{(g)} + Cl_{2(g)}$

(ii) $2Cu(NO_3)_{2(s)} \Leftrightarrow 2CuO_{(s)} + 4NO_{2(g)} + O_{2(g)}$

(iii)

$CH_3COOC_2H_{5(ag)} + H_2O(I) \Leftrightarrow CH_3COOH_{(aq)} + C_2H_5OH_{(aq)}$

(iv) $Fe^{+3}_{(aq)} + 3OH^{-}_{(aq)} \Leftrightarrow Fe(OH)_{3(S)}$

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8. Find out the value of K_c for each of the following equilibria from the value of K_p:

$(i) 2NOCl(g) \Leftrightarrow 2NO(g) + Cl_2(g), K_p = 1.8 \times 10^{-2}$ at $500K$

$(ii) CaCO_3(S) \Leftrightarrow CaO(s) + CO_2(g), K_p = 167$ at $1073K$

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9. For the following equilibrium, $K_c = 6.3 \times 10^{14}$ at $1000K$

$NO(g) + O_3(g) \Leftrightarrow NO_2(g) + O_2(g)$

Both the forward and reverse reaction in the equilibrium are elementary bimolecular reactions. What is K_c, for the reverse reaction?

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10. Explain why pure liquids and solids can ignored while writing the equilibrium constant expression?

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11. Reaction between N_2 and O_2 _ takes place as follows :

$2N_2(g) + O_2(g) \Leftrightarrow 2N_2O(g)$

If a mixture of 0.482 mol N_2 and 0.933 mol of O_2 is placed in a $10L$ reaction vessel and allowed to form N_2O at a temperature for which $K_c = 2.0 \times 10^{-37}$. determine the composition of equlibrium mixture.

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12. Nitric oxide reacts with Br_2 and gives nitrosyle bromide as per reaction given below :

$2NO(g) + Br_2(g) \Leftrightarrow 2NOBr(g)$

When 0.087 mol of NO and 0.0437 mol of Br_2 are mixed in a closed container at constant temperature, 0.0518 mol of $NOBr$ is obtained at equilibrium. Calculate equilibrium amount of NO and Br_2.

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13. At $450K$, $K_p = 2.0 \times 10^{10}$ /bar for the given reaction at equilibrium.

$2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$

What is K_c at this temperature ?

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14. A sample of $HI(g)$ is placed in flask at a pressure of 0.2atm. At equilibrium the partial pressure of $HI(g)$ is 0.04 atm. What is K_p for the given equilibrium ?

$2HI(g) \Leftrightarrow H_2(g) + I_2(g)$

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15. A mixture of 1.57 mol of N_2, 1.92 mol of H_2 and 8.13 mol of NH_3 is introduced into a $20L$ reaction vessel at $500K$. At this temperature, the equilibrium constant, K_c for the reaction $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$ is 1.7×10^2. Is the reaction mixture at equilibrium ? If not, what is the direction of the net reaction ?

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16. The equilibrium constant expression for a gas reaction is

$$K_c = \frac{[NH_3]^4[O_2]^5}{[NO]^4[H_2O]^6}$$

Write the balanced chemical equation corresponding to this expression.

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17. One mole of H_2O and one mole of CO are taken in $10L$ vessel and heated to $725K$. At equlibrium $40\,\%$ of water (by mass) reacts with CO according to the equation.

$$H_2O(g) + CO(g) \Leftrightarrow H_2(g) + CO_2(g)$$

Calculate the equilibrium constant for the reaction.

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18. At $700K$ equilibrium constant for the reaction :

$H_2(g) + I_2(g) \Leftrightarrow 2HI(g)$ is 54.8. If $0.5mol^{-1}$ of $HI(g)$ is present at equilibrium at $700K$. What are the concentration of $H_2(g)$ and $I_2(g)$ assuming that we initially started with $HI(g)$ and allowed it to reach equilibrium at $700K$?

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19. What is the equilibrium concentration of each of the substances in the equilirbrium when the initial concentration of ICl was $0.78M$?

$2ICl(g) \leftrightarrow I_2(g) + Cl_2(g), K_c = 0.14$

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20. $K_p = 0.04$ atm at $899K$ for the equilibrium shown below. What is the equilibrium concentration of C_2H_6 when it is placed in a flask at 4.0 atm pressure and allowed to come to equilibrium ?

$C_6H_6(g) \Leftrightarrow C_2H_4(g) + H_2(g)$

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21. Ethyl acetate is formed by the reaction between ethanol and acetic acid and the equilibrium is represented as :

$$CH_3COOH(I) + C_2H_5OH(I) \Leftrightarrow CH_3COOC_2H_5(I) + H_2O(I)$$

(i) Write the concentration ratio (reaction quotient). Q_c, for this reaction (note : water is not in excess and is not a solvent in this reaction)

(ii) At $293K$, if one starts with 1.00 mol of acetic acid and 0.18 mol of ethanol, there is 0.171 mol of ethyl acetate in the final equilibrium mixture. Calculate the equilibrium constant.

(iii) Starting with 0.5 mol of ethanol and 1.0 mol of acetic acid and maintaining it at $293K$, 0.214 mol of ethyl acetate is found after sometime. Has equilibrium been reached ?

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22. How much PCl_5 must be added to a one little vessel at $250^\circ C$ in order to obtain a concentration of 0.1 mole of Cl_2 at equilibrium. K_c for $PCl(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$ is $0.0414M$

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23. One of the reaction that takes place in producing steel from iron ore is the reduction of iron (II) oxide by carbon monoxide to give iron metal and CO_2.

$FeO(s) + CO(g) \Leftrightarrow Fe(s) + CO_2(g), \quad K_p = 0.265$ atm at $1050K$

What are the equilibrium partial pressures of CO and CO_2 at $1050K$ if the initial partial pressures are : $P_{CO} = 1.4$ atm and $= 0.8$ atm?

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24. Equilibrium constant, K_c for the reaction

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$at $500K$ is 0.061

At particular time, the analysis shows that composition of the reaction mixture is 3.0 mol $L^{-1}N_2$, 2.0 mol $L^{-1}H_2$ and 0.5 mol $L^{-1}NH_3$. Is the reaction at equilibrium ? If not in which direction does the reaction tend to proceed to reach equilibrium ?

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

$2BrCl(g) \Leftrightarrow Br_2(g) + Cl_2(g)$

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?

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

$C(s) + CO_2(g) \Leftrightarrow 2CO(g)$

Calculate K_c for this reaction at the above temperature.

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27. Calculate $a)\ \Delta G^\circ$ and $b)$ the equilibrium constant for the formation of NO_2 from NO and O_2 at $298K$

$NO(g) + 1/2O_2(g) \Leftrightarrow NO_2(g)$

where

$\Delta_f G^\oplus(NO_2) = 52.0kJ/mol$

$\Delta_f G^\oplus(NO) = 87.0kJ/mol$

$\Delta_f G^\oplus(O_2) = 0kJ/mol$

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28. Does the number of moles of reaction produces increase, decrease or remain same when each of the following equilibriumis subjected to a decrease in pressure by increasing the volume ?

$(a) PCl_5(g) \Leftrightarrow Pcl_5(g) + Cl_2(g)$

$(b) CaO(s) + CO_2(g) \Leftrightarrow CaCO_3(s)$

$(c) 3Fe(s) + 4H_2O(g) \Leftrightarrow Fe_3O_4(s) + 4H_2(g)$

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29. Which of the following reactions will get affected by increasing the pressure? Also, mention whether change will cause the reaction to go into forward or backward direction.

$(i) COCl_2(g) \Leftrightarrow CO(g) + Cl_2(g)$

$(ii) CH_4(g) + 2S_2(g) \Leftrightarrow CS_2(g) + 2H_2S(g)$

$(iii) CO_2(g) + C(s) \Leftrightarrow 2CO(g)$

$(iv) 2H_2(g) + CO(g) \Leftrightarrow CH_3OH(g)$

$(v) CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g)$

$(vi) 4NH_3(g) + 5O_2(g) \Leftrightarrow 4NO(g) + 6H_2O(g)$

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30. The equilibrium constant for the following reaction is 1.6×10^5 at $1024k$

$H_2(g) + Br_2(g) \Leftrightarrow 2HBr(g)$

Find the equilibrium pressure of all gases if 10.0 bar of HBr is introdued into a sealed container at $1024K$.

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31. Dihydrogen gas is obtained from natural gas by partial oxidation with stream as per the following endothermic reaction.

$CH_4(g) + H_2O(g) \Leftrightarrow CO(g) + 3H_2(g)$

a. Write an expression for K_p for the above reaction.

b. How will the values o K_p and composition of equilibrium mixture be affected by

(i) increasxing the pressure (ii) increasing the temperature (iii) using a catalyst?

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32. Describe the effect of:

a. addition of H_2

b. addition of CH_3OH

c. removal of CO

d. removal of CH_3OH on the equilibrium of the reaction.

$2H_2(g) + CO(g) \Leftrightarrow CH_3OH(g)$

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33. At 473K, equilibrium constant K_C for the decompositioni of phosphorus pentachloride, PCl_5 is 8.3×10^{-3}. If the decomposition is depicted as:

$PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g) \Delta H = 124.0 kJ \text{mol}^{-1}$

a. Write an expression of K_c for the reaction.

b. What is the value of K_c for the reverse reaction at the same temperature?

c. What would be effect on K_c if

(i) more PCl_5 is added (ii) pressure is increased (iii) the temperature in increased.

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34. Dihydrogen gas used in Haber's process is produced by reacting methane from natural gas with high temperature steam. The first stage of two stage reaction involves the formation of

CO and H_2. In second stage , CO formed in first stage is reacted with more steam in water gas shift reaction.

$CO(g) + H_2O \Leftrightarrow CO_2(g) + H_2(g)$

If a reaction vessel at $400^\circ C$ is charged with an equimolar mixtureof CO and steam such that $p_{CO} = p_{H_2P=4.0}$ bar, what will be the partial pressure of H_2 at equilibrium ? $K_p = 10.1$ at $400^\circ C$

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35. Predict which of the following reaction will have appreciable concentration of reactants and products :

$(a) Cl_2(g) \Leftrightarrow 2Cl(g) K_c = 5 \times 10^{-39}$

$(b) Cl_2(g) + 2NO(g) \Leftrightarrow 2NOCl(g) K_c = 3.7 \times 10^8$

$(c) Cl_2(g) + 2NO_2(g) \Leftrightarrow 2NO_2Cl(g) K_c = 1.8$

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36. The value of K_c for the reaction $3O_2(g) \Leftrightarrow 2O_3(g)$ is 2.0×10^{-50} at $25^\circ C$. If the equilibrium concentration of O_2 in air at $25^\circ C$ is 1.6×10^{-2}, what is the concentration of O_3 ?

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37. The reaction , $CO(g) + 3H_2(g) \Leftrightarrow CH_4(g) + H_2(g)$ is at equilibrium at $1300K$ in a $1L$ flask. It also contain 0.30 mol of CO, 0.10 mol of H_2 and 0.02 mol of H_2O and an unknown amount of CH_4 in the flask. Determine the concentration of CH_4 in the mixture. The equilibrium constant. K_c for the reaction at the given temperature is 3.90.

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38. What is meant by the conjugate acid-base pair ? Find the conjugate acid/base for the following species :

$HNO_2, CN^-, HClO_4, F^-, OH^-, CO_3^{2-}$, and S^{2-}.

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39. Which of the followings are Lewis acids? H_2O, BF_3, H^+, and NH_4^+

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40. What will be the conjugate bases of the following Bronsted acids: HF, H_2SO_4 and HCO_3^- ?

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41. Write the conjugate acids for the following Bronsted bases: NH_2^-, NH_3 and $HCOO^-$:

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42. The species: H_2O, HCO_3^-, HSO_4^- and NH_3 can act both as Bronsted acids and bases. For each case give the corresponding conjugate acid and conjugate base.

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43. Explain Lewis acid base theory with suitable example. Classify the following species into Lewis acids and Lewis bases and show how these act as Lewis acid/base.

a. OH^- b. F^- c. H^+ d. BCl_3

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44. The concentration of hydrogen ion in a sample of soft drink is $3.8 \times 10^{-3} M$. What is its pH?

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45. The pH of a sample of vinegar is 3.76. Calculate the concentration of hydrogen ion in it.

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46. The ionization constants of HF, $HCOOH$ and HCN at 298 K are $6.8x10^{-4}$, 1.8×10^{-4} and 4.7×10^{-9} respectively. Calculate the ionization constants of the corresponding conjugate base.

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47. The ionization constant of phenol is 1.0×10^{-10}. What is the concentration of phenolate ion in $0.05M$ solution of phenol? What will be its degree of ionization if the solution is also $0.01M$ in sodium phenolate ?

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48. The first ionization constant of H_2S is 9.1×10^{-8}. Calculate the concentration of HS^- ion in its $0.1M$ solution. How will this concentration be affected if the solution is $0.1M$ in HCl also ? If the second dissociation constant of H_2S is 1.2×10^{-13}, calculate the concentration of S^{2-} under both conditions.

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49. The ionization constant of acetic acid is 1.74×10^{-5}. Calculate the degree of dissociation of acetic acid in its $0.05M$ solution. Calculate the concentration of acetate ion in the solution and its pH.

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50. It has been found that the pH of a $0.01M$ soluiton of an organic acid is 4.15. Calculate the concentration of the anion, the ionization constant of the acid and its pK_a.

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51. Assuming complete dissociation, calculate the pH of the following solutions :

$(a) 0.003 M HCl$ $(b) 0.005 M NaOH$ $(c) 0.002 M HBr$

$(d) 0.002 M KOH$

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52. Calculate the pH of the following solution :

$(a) 2g$ of $TlOH$ dissolved in water to give 2 litre of solution.

(b) $0.3g$ of $Ca(OH)_2$ dissolved in water to give $500mL$ of solution.

(c) $0.3g$ of $NaOH$ dissolved in water to give $200mL$ of solution.

(d) $1mL$ of $13.6 M HCl$ is diluted with water to give 1 litre of solution.

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53. The degree of ionization of a $0.1M$ bromoacetic acid solution is 0.132. Calculate the pH of the solution and the pK_a of

bromoacetic acid.

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54. The pH of $0.005M$ codeine $(C_{18}H_{21}NO_3)$ solution is 9.95. Calculate its ionization constant and pK_b.

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55. What is the pH of $0.001M$ aniline solution ? The ionization constant of aniline can be taken from Table 7.7. Calculate the degree of ionization of aniline in the solution. Also calculate the ionization constant of the conjugate acid of aniline.

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56. Calcultae the degree of ionization of $0.05M$ acetic acid if its pK_a value is 4.74. How is the degree of dissociation affected when its solution also contains

$(a)0.01M$ $(b)0.1M$ in HCl ?

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57. The ionization constant of dimethylamine is 5.4×10^{-4}. Calculate its degree of ionization in its $0.02M$ solution. What percentgae of dimethylamine is ionized if the solution is also $0.1M$ in $NaOH$?

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58. Calculate the hydrogen ion concentration in the following biological fluids whose pH are given below :

(a) Human muscle-fluid, 6.83 (b) Human stomach fluid, 1.2

(C) Human blood 7.38 (d) Human saliva 6.4

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59. The pH of milk, black, coffee, tomato juice, lemon juice and egg white are 6.8, 5.0 , 4.2, 2.2 and 7.8 respectively. Calculate corresponding hydrogen ion concentration in each.

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60. If $0.561g$ of KOH is dissolved in water to give $200mL$ of solution at $298K$. Calculate the concentrations of potassium, hydrogen and hydroxyl ions. What is its pH ?

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61. The solubility of $Sr(OH)_2$ at $298K$ is $19.23g/L$ of solution. Calculate the concentrations of strontium and hydroxyl ions acid the pH of the solution.

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62. The ionization constant of propanoic acid is 1.32×10^{-5}. Calculate the degre of ionization of the acid in its $0.05M$ solution and also its pH. What will be its degree of ionization if the solution is $0.01M$ in HCl also ?

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63. The pH of $0.1M$ solution of cyantic acid $(HCNO)$ is 2.34 .Calulate the ionization constant of the acid and its degree of ionization in the solution.

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64. The ionization constant of nitrous acid is 4.5×10^{-4}. Calculate the pH of $0.04M$ sodium nitrite solution and also its degree of hydrolysis.

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65. A $0.02M$ solution of pyridinium hydrochloride has $pH = 3.44$. Calculate the inozation constant of pyridine.

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66. Predict if the solutions of the following salts are neutral , acidic or basic : $NaCl, Kbr, NaCN, NH_4NO_3, NaNO_2$ and KF

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67. The ionization constant of chloroacetic acid is 1.65×10^{-3}. What will be the pH of $0.1M$ acid and its $0.1M$ sodium salt solution ?

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68. Ionic product of water at $310K$ is 2.7×10^{-14} . What is the pH of neutral water at this temperature ?

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69. Calculate the pH of the resultant mixture :

$10mL$ of $0.2MCa(OH)_2 + 25mL$ of $0.1MHCl$

$(b) 10mL$ of $0.01MH_2SO_4 + 10mL$ of $0.01MCa(OH)_2$

$(c) 10mL$ of $0.1MH_2SO_4 + 10mL$ of $0.1MKOH$

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70. Determine the solubilities of silver chromate barium chromate, ferric hydroxide, lead chloride and mercurous iodide at $298K$ from their solubility product constants given in Table 7.9. Determine also the molarities of individual ions.

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71. The solubility product constant of Ag_2CrO_4 and $AgBr$ are 1.1×10^{-12} and 5.0×10^{-13} respectively. Calculate the ratio of the molarities of their saturated solutions.

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72. Equal volumes of $0.002M$ solutions of sodium iodate and cupric chlorate are mixed together. Will it lead to precipitation of copper iodate ? (For cupric iodate $K_{sp} = 7.4 \times 10^{-8}$).

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73. The ionization constant of benzoic acid is 6.46×10^{-5} and K_{sp} for silver benzoate is 2.5×10^{-13}. How many times is silver benzoate more soluble in a buffer of pH 3.19 compared to its solubility in pure water ?

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74. What is the maximum concentration of equimolar solutions of ferrous sulphate and sodium sulphide so that when mixed in

equal volumes, there is no precipition of iron sulphide ? (For iron sulphide , $K_{sp} = 6.3 \times 10^{-18}$).

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75. What is the minimum volume of water required to dissove $1g$ of calcium sulphate at $298K$? (For calcium sulphate, K_{sp} is 9.1×10^{-6}).

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76. The concentration of sulphide ion in $0.1MHCl$ solution saturated with hydrogen sulphide is $1.0 \times 10^{-19}M$. If $10mL$ of this is added to $5mL$ of $0.04M$ solution of the following : $FeSO_4$, $MnCl_2$, $ZnCl_2$ and $CdCl_2$.in which of these solutions precipitation will take place ?

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