CHEMISTRY

NCERT - NCERT CHEMISTRY(HINGLISH)

EQUILIBRIUM

Solved 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 the equilibrium constant.

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 $800 K$. What will be K_c for the reaction

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

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3. PCl_5, PCl_3 and Cl_2 are at equilibrium at $500K$ and having concentration $1.59 M PCl_3$, $1.59 M Cl_2$ and $1.41 M PCl_5$. Calculate 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 800 K for the reaction

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

Calculate equlibrium concentrations of CO_2H_2, CO and H_2O at 800 K, if only CO and H_2O are present initially at concentration of 0.10 M 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 $1069K$. Calcualate 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 bar at $1000K$. If initially $P_{CO_2} = 0.48$ bar, $P_{CO} = 0$ bar and pure graphite is present then determine equilibrium partial pressue of CO and CO_2 .

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7. The value of K_c for the reaction $2A \Leftrightarrow B + C$ is 2.0×10^{-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 pressuers at equilibrium was found to be 9.15 bar. Calculate 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 $3.80K$. Calculate composition of the mixture at equilibrium $K_c = 1.80$

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10. The value of $\Delta G^{\ominus}$ for the phosphorylation of glycose in glycolysis is $13.8 kJmol^{-1}$. Find the value of K_c at $298K$

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11. Hydrolysis of sucrose gives

$\text{Sucrose} + H_2O \Leftrightarrow \text{Glucose} + \text{Fructose}$

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

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12. Write the conjugate bases for the following Brddotonsted acids

(a) HF (b) H_2SO_4 (c) HCO_3^{Θ}

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13. Wirte the conjugate acids for the following Brdddotosted bases:

a. $\overset{\ominus}{N}H_2$ b. NH_3 c. $HCOO^{\ominus}$

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

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15. Classify the following species into Lewis acids and Lewis bases and show how these act as Lewis acid / base:

a. $\overset{\ominus}{O}H, b. F^{\ominus}, c. H^{\oplus}, d. BCl_3$

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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. The pH of $10^{-8} M$ solution of HCl in water is

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18. The ionization constant of HF is 3.2×10^{-4}. Calculate the degree of ionization of HF in its $0.02M$ solution. Calculate the concentration of all species present 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, $H^{\oplus}$, A^{Θ}, 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 0.08 solution of $HOCI$ (hydrochlorous acid). The ionisation constant of the acid is 2.5×10^{-5}. Determine the percent dissociation of $HOCI$.

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21. The pH of $0.004M$ hydrazine $(NH_2.NH_2)$ solution is 9.7. Calculate its ionisation constant K_b and pK_b.

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22. Calculate the pH of the solution in which $0.2 M NH_4Cl$ and $0.1 M NH_3$ are present. The pK_b of ammonia solution is 4.75.

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23. Determine the degree if ionization and pH of $0.05 M$ 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. 50.0 mL of 0.10 M ammonia solution is treated with 25.0 mL of $0.10 M HCI$. If $K_b(NH_3) = 1.77 \times 10^{-5}$, the pH of the resulting solution will be

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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. Calcualte the solubility of M_2X_3 in pure water, assuming that neither kind of ion reacts with H_2O. The solubility product of M_2X_3, $K_{sp} = 1.1 \times 10^{-23}$.

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27. The values of K_{sp} of two sparingly solubles salts, $Ni(OH)_2$ and $AgCN$ are 2.0×10^{-15} and 6×10^{-7} respectively, which salt is more soluble? Explain

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28. The solubility product of $Ni(OH)_2$ is 2.0×10^{-15}. The molar solubility of $Ni(OH)_2$ in $0.1 M NaOH$ solution is

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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.

a. what is the initial effect of the change on vapour pressure?

b. How do rates of evaporation and condensation change initially?

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

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2. What is K_c for the following 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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3. At a certain temperature and a total pressure of $10^5 Pa$, iodine vapour contains 40% by volume of $I \text{atoms}$, Calculate K_p for the equilibrium.

$I_{2(g)} \Leftrightarrow 2I_{(g)}$

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

a. $2NOCl(g) \Leftrightarrow 2NO(g) + Cl_2(g)$

b. $2Cu(NO_3)_2(s) \Leftrightarrow 2CuO(s) + 4NO_2(g) + O_2(g)$

c.

$CH_3COOC_2H_5(aq) + H_2O(1) \Leftrightarrow CH_3COOH(aq) + C_2H_5OH(aq)$

d. $Fe^{3+}(aq) + 3OH^{\ominus}(aq) \Leftrightarrow Fe(OH)_3(s)$

e. $I_2(s) + 5F_2 \Leftrightarrow 2IF_5$

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5. Find out the value of K_c for each of the following equilibrium from the value of K_p:

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

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

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

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

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

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

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8. Reaction between nitrogen and oxygen takes place as following:

$2N_{2(g)} + O_2 \Leftrightarrow 2N_2O_{(g)}$

If a mixture of $0.482 \text{mole} N_2$ and $0.933 \text{mole of } O_2$ is placed in a reaction vessel of volume $10 litre$ and allowed to form N_2O at a temperature for which $K_c = 2.0 \times 10^{-37} litre mol^{-1}$. Determine the composition of equilibrium mixture.

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9. Nitric oxide reacts with bromine and gives nitrosyl-bromide as per reaction given below:

$2NO_{(g)} + Br_{2(g)} \Leftrightarrow 2NOBr_{(g)}$.

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

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

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

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12. A mixture of $1.57mol$ of $N_2, 1.92mol$ of H_2 and $8.13mol$ 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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13. 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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14. One mole of H_2O and one mole of CO are taken in a $10 litre$ vessel and heated to $725K$. At equilibrium, $40 percent$ of water (by mass) reacts with carbon monoxide 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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15. At $700K$ equilibrium constant for the reaction,

$H_{2(g)} + I_{2(g)} \Leftrightarrow 2HI_{(g)}$

is 54.8. If $0.5 mol litre^{-1}$ of $HI_{(g)}$ is present at equilibrium at $700K$, what are the concentrations 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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16. What is the equilibrium concentration of each of the substance in the equilibrium 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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17. $K_p = 0.04 atm$ 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?

$C_2H_6(g) \Leftrightarrow C_2H_4(g) + H_2(g)$

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18. The ester , ethyl acetate is formed by the reaction of ethanol and acetic acid and the equilibrium is represented as :

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

(i) Write the concentration ratio (concentration quotient) Q for this reaction. Note that water is not in excess and is not a solvent in this reaction.

(ii) At 293 K, if one starts with 1.000 mol of acetic acid 0.180 mol of ethanol, there is 0.171 mol of ethyl acetate in the final equilibrium mixture . Calculate the equilibrium constant.

(iii) Starting with 0.50 mol of ethanol and 1.000 mol of acetic acid and maintaining it at 293 K, 0.214 mol of ethyl acetate is found after some time. Has equilibrium been reached?

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19. A sample of pure PCl_5 was introduced into an evacuated vessel at $473K$. After equilibrium was attained,concentration of PCl_5 was found to be $0.5 \times 10^{-1} mollitre^{-1}$. If value of K_c is $8.3 \times 10^{-3} mollitre^{-1}$. What are the concentrations of PCl_3 and Cl_2 at equilibrium ?

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

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

What are the equilibrium partial pressure of CO and CO_2 at $1050K$ if the partical pressure are: $p_{CO} = 1.4atm$ and $p_{CO_2} = 0.80atm$?

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21. Equilibrium constant, K_c for the reaction,

$N_{2(g)} + 3H_{2(g)} \Leftrightarrow 2NH_{3(g)}$,

at $500K$ is $0.061 litre^2 \text{mole}^{-2}$. At a particular time, the analysis shows that composition of the reaction mixture is $3.00 mol litre^{-1} N_2$, $2.00 mol litre^{-1} H_2$, and $0.500 mol litre^{-1} NH_3$.

Is the reaction at equilibrium? If not, in which direction does the reaction tend to proceed to reach equilibrium?

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22. 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 $3.30 \times 10^{-3} mollitre^{-1}$, what is its molar concentration in the mixture at equilibrium?

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

$C_{(s)} + CO_{2(g)} \Leftrightarrow 2CO_{(g)}$

Calculate K_c for the reaction at the above temperature.

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24. Calculate (a) ΔG^{Θ} and (b) the equilibrium constant for the formation of NO and O_2 at $298K$

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

where

$\Delta_f G^{\Theta}(NO_2) = 52.0 kJmol^{-1}$

$\Delta_f G^{\Theta}(NO) = 87.0 kJmol^{-1}$

$\Delta_f G^{\Theta}(O_2) = 0 kJmol^{-1}$

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25. Does the number of moles of reaction products increase, decrease, or remain same when each of the following equilibrium is subjected to a decrease in pressure by increasing the volume?

a. $PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$

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

a. $COCl_2(g) \Leftrightarrow CO(g) + Cl_2(g)$

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

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

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

e. $CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g)$

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

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27. 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 introduced into a sealed container at $1024K$.

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28. Dihydrogen gas is obtained from natural gas by partial oxidation with steam as per 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 value of K_(p) and composition of equilibrium mixture be affected by

i. Increasing the pressure

ii. Increasing the temperature

iii. Using a catalyst?

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29. Decribe 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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30. At $473K$, equilibrium constant K_c for decomposition of phosphorus pentachloride, PCl_5 is 8.3×10^{-3}. If decomposition is depicted as,

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

a. Write an expression for 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 the effect on K_c if

i. More PCl_5 is added

ii. Pressure is increased

iii. The temperature is increased?

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31. Dihydrogen gas used in Haber's process is produced by reacting methane from natural gas with high temperature steam. The first stage of the two 2 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,

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

If a reaction vessel at $400^\circ C$ is charged with an equimolar mixture of CO and steam such that $p_{CO} = p_{H_2O} = 4.0$ bar, what will be the partial pressure of H_2 at equilibrium? $K_p = 0.1$ at $400^\circ C$.

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32. Predict which of the following reactions will have appreciable concentration of rectants 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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33. 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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34. The reaction, $CO(g) + 3H_2(g) \Leftrightarrow CH_4(g) + H_2O(g)$ is at equilibrium at $1300K$ in a $1L$ flask. It also contains $0.30 mol$ 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 us 3.90.

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

$HNO_2, CN^{\Theta}, HClO_4, F^{\Theta}, \overset{\Theta}{O}H, CO_3^{2-}$, and S^{2-}

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36. Which of the followings are Lewis acids: $H_2O, BF_3, H^{\oplus}$ and NH_4?

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37. Write the conjugate bases for the following Brddotonsted acids

(a) HF (b) H_2SO_4 (c) HCO_3^{Θ}

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38. Wirte the conjugate acids for the following Brdddotosted bases:

a. $\overset{\Theta}{N}H_2$ b. NH_3 c. $HCOO^{\Theta}$

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39. The species: H_2O, $HCO_3^{\ominus}$, $HSO_4^{\ominus}$ and NH_3 can act both as Bronsted acids and bases. For each case give the corresponding conjugate acid and base.

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40. Classify the following species into Lewis acids and Lewis bases and show how these act as Lewis acid / base:

a. $\overset{\ominus}{O}H$, $b.\ F^{\ominus}$, $c.\ H^{\oplus}$, $d.\ BCl_3$

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

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43. The ionization constant of HF, $HCOOH$ and HCN at $298K$ are 6.8×10^{-4}, 1.8×10^{-4} and 4.8×10^{-9} respectively. Calculate the ionization constant of the corresponding conjugate base.

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44. 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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45. The first ionization constant of H_2S is 9.1×10^{-8}. Calculate the concentration of HS^{Θ} 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 if H_2S is 1.2×10^{-13}, calculate the concentration of S^{2-} under both conditions.

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46. The ionization constant of acetic acid 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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47. It has been found that the pH of a $0.01M$ solution 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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48. Assuming complete dissociation, calculate the pH of the following solutions,

a. $0.003MHCl, b. 0.005MNaOH$,

c. $0.002MHBr, d. 0.002MKOH$

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49. Calculate the pH of the following solutions:

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 $13.6MHCl$ is duluted with water to give 1 litre of solution.

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50. 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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51. The pH of $0.005M$ codenine $(C_{18}H_{21}NO_3)$ solution is 9.95. Calculate its ionisation constant and pK_b.

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52. What is the pH of $0.001M$ aniline solution? The ionization constant of aniline 4.27×10^{-10}. 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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53. Calculate the degree of ionisation 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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54. The ionisation constant of dimethylamine is 5.4×10^{-4}. Calculate its degree of ionization in its $0.02M$ solution. What percentage of dimethylamine is ionized if the solution is also $0.1M$ in $NaOH$?

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55. 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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56. 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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57. If $0.561g$ of (KOH) is dissolved in water to give. $200mL$ of solution at $298K$. Calculate the concentration of potassium, hydrogen and hydroxyl ions. What is its pH?

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58. The solubility of $Sr(OH)_2$ at $298K$ is $19.23gL^{-1}$ of solution. Calculate the concentrations cf strontium and hydroxyl ions and the pH of the solution.

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

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60. The pH of $0.1M$ solution of cyanic acid $(HCNO)$ is 2.34. Calculate the ionization constant of the acid and its degree of ionisation in the solution.

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61. 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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62. A $0.02M$ solution of pyridinium hydrochloride has $pH = 3.44$. Calculate the ionization constant of pyridine.

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63. 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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64. The ionization constant of chloroacetic acid is 1.35×10^{-3}. What will be the pH of $0.1M$ acid and its $0.1M$ sodium salt solution?

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

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66. Calculate the pH of the resultant mixture:

a. $10mL$ 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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67. 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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68. 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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69. Equal volumes of 0.002 M solution of sodium iodate and cupric chlorate are mixed togather. Will it lead to precipitation of copper iodate?

$(\text{for cupric iodate} K = 7.4 \times 10^{-8})$.

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70. The ionisation constant of benzoic acid $(PhCOOH)$ is 6.46×10^{-5} and K_{sp} for silver benzoate is 2.5×10^{-3}. How many times is silver benzoate more soluble in a buffer of $pH 3.19$ compared to its solubility is pure water?

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71. What is the maximum concentration of equimolar solutions of ferrous sulphate and sodium sulphide so that when mixed in equal volumes, there is no precipitation of iron sulphide? (For iron sulphide, $K_{sp} = 6.3 \times 10^{-18}$).

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72. What is the minimum volume of water required to dissolve $1.0 g$ of calcium sulphate at $298 K$?

(For calcium sulphate , $K_{sp} is 9.1 \times 10^{-6}$).

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

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