CHEMISTRY

BOOKS - S DINESH & CO CHEMISTRY (HINGLISH)

EQUILIBRIUM

Example

1. A vessel has two compartments connected at the top. In one compartment (B), radioactive methyl ioddide $\left(\overset{*}{C}H_3I\right)$ is placed while in other compartment (A). Normal methly iodide (CH_3I) is placed. Will the vapours over (A) and (B) become radioactive ? Will the radioactivity spread to the liquid in compartment A? Discuss in terms of dynamic nature of the equilibrium between the vapours and the liquid.

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2. During bottling a carbonated beverage was made by saturating flavoured water at $0^\circ C$ with CO_2 at a pressure of 4.0 atm. Later ,the bottle was opened and the soft drink allowed to come to equilibrium at $25^\circ C$ with air containing CO_2 at a pressure of 4.3×10^{-4} atm. Find the concentration of CO_2 in the freshly bottled soda and in the soda after it had stood open and come to the equilibrium. The Henry's law constants for aqueous solutions fo CO_2 are : at $0^\circ C, K = 7.7 \times 10^{-2}$ mol L^{-1} atm $^{-1}$ and at $25^\circ C, k = 3.2 \times 10$

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3. Give the mathematical expression for the equilibrium constant $(K_c$ and $K_p)$ for the reactions.

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

$(ii) N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$

$(iii) PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$

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4. 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.

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5. At $700K$, the equilibrium constant K_p for the reaction

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

is $1.80 \times 10^{-3}kPa$. What is the numerical value of K_c in moles per litre for this reaction at the same temperature?

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6. At $500^\circ C$ the equilibrium constant for the reaction

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g) is 6.02 \times 10^{-2} litre^{-2} mol^{-2}$

What is the value of K_p at the same temperature?

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7. The equilibrium constant for the reaction :

$Fe^3 + (aq) + SCN^-(aq) \Leftrightarrow FeSCN^{2+}(aq)$

at 298 K is 138. What is the value of the equilibrium for the reaction?

$2Fe^{3+}(aq) + 2SCN^-(aq) \Leftrightarrow 2FeSCN^{2+}(aq)$

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8. The equilibrium constant for the reaction

$H_2(g) + S(s) \Leftrightarrow H_2S(g)$

is 18.5 at $925K$ and 9.25 at $1000K$, respectively. Calculate the enthalpy of the reaction.

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9. Write the equilibrium constant expressions for the following reactions.

$(i) BaCO_3(s) \Leftrightarrow BaO(s) + CO_2(g)$

$(ii) AgBr(s) \Leftrightarrow Ag^{+}(aq) + Br^{-}(aq)$

$(iii) CH_3COCH_3(l) \Leftrightarrow CH_3COCH_3(g)$

$(iv) Al(s) + 3H^{+}(aq) \Leftrightarrow Al^{3+}(aq) + \frac{3}{2}H_2(g)$

$(v) HPO_4^{2-}(aq) + H_2O(l) \Leftrightarrow H_3O^{+}(aq) + PO_4^{3-}(aq)$

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10. At 800 K in a sealed vessel for the equilibrium $N_2(g) + O_2(g) \Leftrightarrow 2NO(g)$, the equilibrium concentrations of $N_2(g), O_2(g)$ and $NO(g)$ are respectively $0.36 \times 10^{-3}M, 4.41 \times 10^{-3}M$ and $1.4 \times 10^{-3}M$. Calculate the value of K_c for the reaction $NO(g) \Leftrightarrow 1/2N_2(g) + 1/2O_2(g) at 800K is$:

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11. The equilibrium constant at $278K$ for $Cu(s) + 2Ag^{\oplus}(aq) \Leftrightarrow Cu^{2+}(aq) + 2Ag(s)$ is 2.0×10^{15}. In a solution in which copper has displaced, some silver ions from the solution, the concentration of Cu^{2+} ions from the solution, the concentration of

Cu^{2+} ions is $1.8 \times 10^{-2} molL^{-1}$ and the concentration of $Ag^{\oplus}$ ions is $3.0 \times 10^{-9} molL^{-1}$. Is the system at equilibrium?

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12. The equilibrium constant for the reaction

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

is 0.35 at 298 K. In the following mixture at 298 K, has equilibrium been reached ? If not state on which side of the equilibrium the system is :

$(i) P_{H_2} = 0.10$ atm and $P_{HI} = 0.80$ atm and there is solid I_2 in the container.

$(ii) P_{H_2} = 0.55$atm and $P_{HI} = 0.44$ atm and there is solid i_2 in the container.

$(III) P_{H_2} = 2.5$ atm and $P_{Hi} = 0.15$ atm and there is solid I_2 in the container.

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

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14. The standard Gibbs energy change at $300 K$ for the reaction $2A \Leftrightarrow B + C$ is $2494.2 J$. At a given time, the composition of the reaction mixture is $[A] = \frac{1}{2}, [B] = 2$ and $[C] = \frac{1}{2}$. The reaction proceeds in which direction?

$(R = 8.314 JK/\text{mole} = 2.718)$

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15. Given the equilibrium , $N_2O_4(g) \Leftrightarrow 2NO_2(g)$ with $k_p = 0.15$ atm at $298 K$.

(a) What is K_p using pressure in torr?

(b) What is K_c using units of moles per litre ?

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16. For which of the following reactions does the equilibrium constant depend upon the units of concentration?

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

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

$(C) NO(g) \Leftrightarrow 1/2N_2(g) + 1/2O_2(g)$

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17. The equilibrium constant for the reactions have been measured at 823 K.

$CoO(s) + H_2(g) \Leftrightarrow Co(s) + H_2O(g), K = 67$

$CoO(s) + CO(g) \Leftrightarrow Co(s) + CO_2(g), K = 490.$

From the data, calculate the equilibrium constant for the reaction.

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

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18. 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.

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19. 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

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

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20. For the reaction , $H_2(g) + I_2(g) \Leftrightarrow 2HI(g)$, $K = 55.3$ at $699K$. In a mixture consisting of 0.70 atm of HI and 0.02 atm each of H_2 and I_2 at 699 K, will there be any net reaction ? If so will HI be consumed or formed ?

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21. following equilibrium is studied by taking 1 mole of N_2 and 3 moles of H_2 in a 1L flask at a given temperature?

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$

$NH_3(g)$ formed at equilibrium is neutralised by 200 mL of 1M HCl. Calculate equilibrium constant.

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22. AB_2 dissociates as

$AB_2(g) \Leftrightarrow AB(g) + B(g)$. If the initial pressure is 500 mm of Hg and the total pressure at equilibrium is 700 mm of Hg. Calculate K_p for the reaction.

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23. Determine the concentration of CO_2 which will be in equilibrium with 2.5×10^{-2} mol $L^{-1} of CO at 100^\circ C$ for the reaction

$FeO(s) + CO(g) \Leftrightarrow Fe(s) + CO_2, K_c = 5.0$

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24. PCl_3, PCl_3 and Cl_2 are at eqilibrium at 500 K and above have concentration 1.59 M for $PCl_3, 1.59M$ for Cl_2 and 1.41 M for PCl_5. Calculate K_c for the reaction :

$PCl_5 \Leftrightarrow PCl_3 + Cl_2$

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25. A vessel at $1000K$ contains carbon dioxide with a pressure of $0.5atm$. Some of the carbon dioxide is converted to carbon monoxide on addition of graphite. Calculate the value of K_p if total pressure at equilibrium is $0.8atm$.

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26. For the reaction : $CO(g) + H_2O(g) \Leftrightarrow CO_2(g) + H_2(g)$

the value of $K_c = 4.24 at 600K$. Calculate the equilibrium concentration of CO_2, H_2, CO and H_2O at 800 K, if only CO and H_2 are present initially at a concentration of 0.10 M each.

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27. At some temperature and under a pressure of 4 atm, PCl_5 is $10\,\%$ dissociated. Calculated the pressure at which PCl_5 will be $20\,\%$ dissociated temperature remaining same.

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28. 3.00 mol of PCl_5 kept in 1 L closed reaction vessel was allowed to attain equilibrium at 380K. Calculate the composition of the mixture at equilibrium. $K_c = 1.80$.

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29. 13.8 g of N_2O_4 was placed in 1 L 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. Calculate K_c, K_p and partial pressure at equilibrium .

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30. The values of K_{p1} and K_{p2} for the two equilibrium reactions

$X \Leftrightarrow +Z$ and $A \Leftrightarrow 2B$

are in the ratio 9, 1,. If degree of dissociation of X and A be equal , calculate the ratio of the total pressure of the equilibrium mixture in the two cases.

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31. For the reaction

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

$K_p = 1.16$ atm at $800^\circ C$. If 20.0g of $CaCO_3$ was put into a 10.0 L flask and heated to $800^\circ C$, what percentage of $CaCO_3$ would remain unreacted at equilibrium ?

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32. 3.2 moles of HI were heated in a sealed bulb at $444^\circ C$ till the equilibrium was reached. Its degree of dissociation was found to be 20% . Calculate the number of moles of hydrogen iodide, hydrogen and iodine present at the equilibrium point and determine the value of equilibrium constant.

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33. The equilibrium constant for the reaction

$A_2(g) + B_2 \Leftrightarrow 2AB(g)$

at 373 K is 50. If one litre flask containing one mole of A_2 is connected to a two flask containing two moles of B_2, how many moles of AB will be formed at 373 K?

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34. Two moles of PCl_5 were heated to $327^\circ C$ in a closed two-litre vessel, and when equilibrium was achieved, PCl_5 was found to be 40% dissociated into PCl_3 and Cl_2. Calculate the equilibrium constant K_p and K_c for this reaction.

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35. The equilibrium constant for the reaction :

$$CH_3COOH + C_2H_5OH \Leftrightarrow CH_3COOC_2H_5 + H_2O$$

is 4.0 at $25^\circ C$. Calculate the weight of ethyl acetate that will be obtained when 120 g of acetic acid are reacted with 92 g of ethyl alcohol.

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36. Prove that the pressure necessary to obtain 50% dissociation of PCl_5 at 500 K is numerically three times the value of K_p.

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37. The dissociation of phosgene gas $(COCl_2)$ is represented as :

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

When the mixture of these three gases is compressed at constanat temperature , what happens to (i) the amount of CO in the mixture (ii) the partial pressure of $COCl_2$ (iii) the equilibrium constant for the reaction ?

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38. Equilibrium constant K_c is expreseed as the concentration of products divided by reactants , each term raised to the stoichiometric coefficient for reaction $aA + bB \Leftrightarrow cC + dD$

$K_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ (unit of concentration are mol/L)

Answer the following on the basis of above paragrah

(i) Write the equilibrium constnat for the reaction

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$

(ii) Write the units of equilibrium constant for the reaction

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

(iii) What will be the effect of catalyst on the euilibrium constant :

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39. for the exothermic formation of sulphur trioxide from sulphur dioxide.

And oxygen in the gas phase:

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

$K_p = 40.5atm^{-1} at 900K$ and $\Delta H = -198kJ$

(i) Write the expression for the equilibrium constant for the reaction.

(ii) At room temperature ($\approx 300K$) will K_p be greater than less than or equal to K_p at 900 K .

(iii) How will the equilibrium be affected if the volume of the vessel contaning the three gases is reduced, keeping the termperature constant

? What happens ?

(iv) What is the effect of adding 1 mole of He (g) to a flask containing SO_2, O_2 and SO_3 at equilibrium at constant temperatrue ?

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40. A weak monobasic acid is found to be 4% ionided at 0.1 M concentration. Calculate the value of the ionisation constant.

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41. When 0.1 mole of NH_3 is dissolved in water to make 1.0 L of solution , the $\left[OH^-\right]$ of solution is 1.34×10^{-3}M. Calculate K_b for NH_3.

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42. Calculate the degree of ionisation and $\left[H_3O^+\right]$ of 0.01 M acetic acid solution . K_a for acetic at 298 K is 1.8×10^{-5}

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43. Calculate the concentration of hydroxyl ions in 0.2 M solution of ammonium hydroxide having $K_b = 1.8 \times 10^{-5}$.

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44. At 300 K, the degree of dissociation of 0.066 M solution of an acid HA is 0.0145. What would be its degree of dissociation of 0.02 M solution of the acid at the same temperature?

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45. (i) State the formula and name the conjugate base of each of the following species :

$(a) H_3O^+ (b) HSO_4^- (C) NH_4^+ (d) HF (e) CH_3COOH (f) CH_3NH_3^+ (g) H_3P$

(ii) State the formula and name the conjugate acid of each of the

following species :

$(a) OH^{-} (b) HPO_4^{2-} (C) H_2PO_4^{-} (d) CH_3NH_2 (e) CO_3^{2-} (f) NH_3 (g) CH_3CO$

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46. The species $H_2O, HCO_3^{-}, HSO_4^{-}$ and NH_3 and act both as Bronsted acid and base. For each case, give the correponding conjugate acid and base.

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47. Calculate the hydrogen ion and hydroxyl ion concentration of 0.01 M solution of $NaOH$ at 298 K.

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48. A solution has been prepared by dissolving 0.063 g of HNO_3 in 1000 mL of It . Calculate the $\left[H^{+}\right]$ and $\left[OH^{-}\right]$ of the solution.

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49. Find the pH of a solution of 0.01 M acetic acid which is only 20% ionised.

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50. Calculate pH values of (i) 0.2 M H_2SO_4 solution (ii) 0.2M $Ca(OH)_2$ solution.

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51. A solution has been prepared by dissolving 0.63 g of nitric acid in 100 mL. What is its pH value ? Assume that the acid is completely dissociated.

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52. Caculate the pH value of 0.20M solution of methyl amine (CH_3NH_2) at 298 K, given that its ionisation constant (K_b) is 4.4×10^{-5}.

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53. At 298 K, the pH of a lemon juice is 2.32. Calculate its $[H_3O^+]$ and $[OH^-]$.

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54. Find the pH of the following soluitons:

(i) 3.2 g of hydrogen chloride dissolved in 1.0 L of water

(ii) 0.28 g of potassium hydroxide dissolved in 1.0 L of water .

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55. 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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56. Calculate the pH of 10^{-8} M acid solution.

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57. Calculate the pH of 10^{-10} M NaOH solution.

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58. An acid solution of $pH = 6$ is diluted 100 times. The pH of solution becomes

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59. Equal volumes of three acid solutions of $pH3$, 4 and 5 are mixed in a vessel. What will be the H^+ ion concentration in the mixture?

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60. Calculate the pH value of a solution obtained by mixing 50 mL of 0.2 N HCl solution with 50 mL of 0.1 N NaOH solution.

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61. $1cm^3$ of 0.01 N HCl solution is added to one litre of sodium chloride solution . Calculate the pH of the resulting solution.

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62. What will be the resultant pH, when 200 mL of an aqueous solution of $HCI(pH = 2.0)$ is mixed with 300 mL of an aqueous solution of

$NaOH(pH = 12.0)$?

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63. Determine the degree of ionisation and pH of a 0.05 M ammonia solution. Also calculate ionisation constant of the conjugate acid ammonia. Given that K_b for NH_3 is 1.77×10^{-5}.

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64. Calculate the degree of hydrolysis of 0.1 M solution of sodium acetate at $298K: K_a = 1.8 \times 10^{-5}$.

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65. Calculate the percentage hydrolysis of decinormal solution of ammonium acetate given that

$k_a = 1.75 \times 10^{-5}, K_b = 1.80 \times 10^{-5}$ and $K_w = 1.0 \times 10^{-14}$

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66. Calculate the degree of hydrolysis and pH of a 0.1 M sodium acetate solution. Hydrolysis constant for sodium acetate is 5.6×10^{-10}.

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67. K_a for butyric acid is 2.0×10^{-5}. Calculate pH and hydroxyl ion concentration in $0.2M$ aqueous solution of sodium butyate.

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68. Calculate the pH of a buffer solution containing 0.1 mole of acetic acid and 0.15 mole of sodium acetate. K_c for acetic acid is 1.75×10^{-5}.

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69. A buffer solution with pH 9 is to be prepared by mixing NH_4OH solution . $K_b = 1.8 \times 10^{-5}$.

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70. What is the pH of the solution when 0.2 mole of hydrochloric acid is added to one litre of a solution containing 1 M acetic acid and acetate ion ? Assume that the total volume is one litre .K_a for $CH_3COOH = 1.8 \times 10^{-5}$.

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71. The solubility of AgCl in water at 298 K is 1.06×10^{-5} mole per litre. Calculate its solubility product at this temperature.

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72. The solubility of CaF_2 in water at $298Kis1.7 \times 10^{-3}$ grams per 100 mL of the solution. Calculate solubility product of CaF_2.

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73. pH of saturated solution of $Ba(OH)_2$ is 12. The value of solubility product (K_{sp}) of $Ba(OH)_2$ is

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74. The solubility of silver bromide is $7.7 \times 10^{-13} mol^2 L^{-2}$. Calculate the solubility of the salt.

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75. 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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76. What is the solubility of Ag_2CrO_4 in water if the value of the solubility product $(K_{sp}) = 1.3 \times 10^{-11}(mol/L)^3$?

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

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

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78. What is the minimum pH of a solution of 0.1 M in Mg^{2+} from which $Mg(OH)_2$ will not precipitate $K_{sp} = 1.2 \times 10^{-11}M^3$.

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79. If $25.0cm^3$ of 0.05 M $Ba(NO_3)_2$ solution is mixed with 25.0 cm^3 of 0.02 M NaF solution. Will any BaF_2 precipitated ? $\left(K_{sp} \text{ for } BaF_2 = 1.7 \times 10^{-6}\right)$

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80. $20mL$ of $1.5 \times 10^{-5}M$ barium chloride solution is mixed with 40 mL of 0.9×10^{-5} sodium sulphate. Will a precipitate get formed ? $\left(K_{sp} \text{ for } BaSO_4 = 1 \times 10^{-10}\right)$

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Short Answer Type Question

1. The ionisation of hydrochloric in water is given below:

$HCI(aq) + H_2O(l) \Leftrightarrow H_3O^+CI^-(aq)$

Label two conjugate acid- base pairs in this ionisation.

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2. The aqueous solution of sugart does not conduct electricity. However when sodium chloride is added to water, it conducts electricity. How will you explain this statement on the basis of ionisation and how is it affected by concentration of sodium chloride ?

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3. BF_3 does not have proton but still acts as an acid and reacts with NH_3. Why is it so? What type of bond is formed between the two ?

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4. Ionisation constant of a weak base MOH, is given by the expression

$$K_b = \frac{[M^+][OH^-]}{[MOH]}$$

Values of ionisation constant of some weak bases at a particular

temperature are given below :

$Base$	Dimethylamine	$H_2O(l)$	Pyridine	Ammonia
K_b	5.4×10^{-4}	1.3×10	1.77×10^{-9}	1.77×10^{-5}

Arrange the bases in decreasing order of the extent of their ionisation at equilibrium. Which of the above base is the strongest?

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5. Conjugate acid of a weak base is always stronger. What will be the decrinsing order of basic strength of the following conjugate bases?

$OH^-, RO^-, CH_3COO^-, CI^-$

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6. Arrange the following in increasing order of ph:

$KNO_3(aq), CH_3COONa(aq), NH_4CI(aq), C_6H_5COONH_4(aq)$

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7. The value of K_c for the reaction $2HI(g) \Leftrightarrow H_2 + I_2(g)$ is 1×10^{-4}. At a given time, t he composition of reaction mixture is $[HI] = 2 \times 10^{-5} mol, [H_2] = 1 \times 10^{-5}$ mol and $[l_2] = 1 \times 10^{-5}$ mol In which direction will the reaction proceed ?

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8. On the basis of the equation $ph = -\log\left[H^+\right]$,the ph of 10^{-8} mol dm^{-3} solution of HCI should be 8. However, it is observed to be less than 7.0. Explain the reason.

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9. ph of a solution of a strong acid is 5.0.What will be the ph of the solution obtained after dilluting the given solution to 100 times ?

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10. A sparingly soluble salt gets precipitated only when the prudct of concentration of its ions in th e solution (Q_{sp}) becomes greater than its solubility product. If solubility of $BaSO_4$ in water is 8×10^{-4} mol dm^{-3}. Calculater its solubility in 0.01 mol dm^{-3} of H_2SO_4.

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11. Calculate the ph of a solution formed by mixing equal volumes of two solutions A and B of a strong acids having $ph = 6$ and $ph = 4$ respectively.

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12. The solubility product of $AI(OH)_3$ is 2.7×10^{-11}. Calculate its solubility in mgL^{-1}. (Atomic mass of $AI = 27u$).

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13. Calculate the volume of water required to dissolve$0.1g$ lead (II) chloride to get a saturaed solution $(K_{sp}$ of $PbCI_2 = 3.2 \times 10^{-8}$, atomic mass of $Pb = 207u)$. Multiply your answer with 10 to get answer.

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14. A reaction between ammonia and boron triflurdie is given below :

$: NH_3 + BF_3 \rightarrow H_3N : BF_3$

Identify the acid and base in this reaction. Which theory explanis it ? What is the hybridsation of B and N in the additon compound ?

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15. Following data is given for the reaction :

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

$\Delta_f H^{\Theta}[CaO(s)] = -635.1kJmol^{-1}$

$\Delta_f H^{\Theta}[Ca_2(s)] = -393.5kJmol^{-1}$

$\Delta_f H^{\Theta}[CaCO_3(s)] = -1206.9kJmol^{-1}$

Predict the effect of temperature on the equilibrium of the above reaction.

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16. How can you prdict the following stages of a reaction by comparing the value of $K_c$and Q_c` ?

(i) Net reaction proceeds in the toward direction.

(ii) Net recation proceeds in the backward dirction.

(iii) No net rection occurs.

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17. On the basis of Le Chatelier principle explain how temperature and pressure can be adjusted to increase the yield of ammonia int he following reaction.

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g), \Delta H = -92.38KJMol^{-1}$

What will be the effect of addition of argon to the avove mixture at cosntant volume ?

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18. A sparingly soluble slat having gereral formula, A_xB_y and molar solubility S is in equilibrium with its saturated solution. Write the relationship between the solubility and solubility product for such salt.

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19. Write a relation between ΔG and Q and deifine the meaning of each term and answer the following :

Why a reaction proceeds forward when $Q < K$ and no net reaction occure when $Q = K$.

Explain the effect of increase in presure in terms of reaction quotient Q for the reaction : $CO(g) + 3H_2(g) \Leftrightarrow CH_4(g) + H_2O(g)$

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Concept Based Questions

1. A crystal of common slat of given mass is by kept in aqueous solution. After 12 hours, its mass ramanins the same, Is the crystal in equilibrium with the solution?

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2. Why is there a fizz when a soda water bottle is opend?

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3. Can equilibrium be achieved between water and its vapours in an open vessel ? Explain yours answer and say what happens eventuallly.

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4. From the values of the equilibrium constants, indicate in which case, does not reaction go farthest to completion :

$K_1 = 10^{-10}, K_2 = 10^{10}, K_3 = 10^5$.

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5. The value of the equilibrium constant is less than zero. What does it indicate ?

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6. Would you expect equilibrium constant for the reaction $l_2(g) \Leftrightarrow 2l(g)$ to increase or decrease as temperature increases. Assign reson.

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7. Following equilibrium is set up when SCN^- ion is added to Fe^{3+} in aqueous solution :

$$\underset{\text{Pale yellow}}{Fe^{3+}} + \underset{\text{Colour less}}{SCN^-} \Leftrightarrow \underset{\text{Deep red}}{[Fe(SCN)]^{2+}}$$

When silver nitrate is added to the solution, AgSCN gets precipitate. What will happen to the equilibrium?

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8. Following reaction occurs in a Blast Furnace :

$Fe_2O_3(s) + 3CO(g) \Leftrightarrow 2Fe(l) + 3CO_2(g)$

Use Le Chetelier's principle to predict the direction of reaction when equilibrium mixture is disturbed by (a) adding Fe_2O_3 (b) removing CO_2 (c) removing CO.

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9. Acetic acid is highly soluble in water but still a weak electrolyte. Why?

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10. Discuss the role of NH_4OH in group III of basic redicals.

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11. How will you account for the following :

(a) Clothes dry quicker on a windy day

We sweat more on a humid day?

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12. the solubility of CO_2 in water decreases with increases in temperature . Explain.

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13. Will ionic product of water increase or decrease if temperature is increased ?

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14. In a chemical reaction under equilibrium , there is no change in moler conertration of products and reactants. Does the reaction stop?

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15. Out of water and silver nitrate solution, in which case silver choride will dissolve more?

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16. Magnesium is not precipitated from a solution of its salt by NH_4OH in the presence of NH_4CI. Explain.

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17. SO_3 is an acidic oxide while Na_2O is basic in nature. Support the same with the halp of exaples .

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18. $Zn(OH)_2$ is not precipitated when NH_4OH is added to a zinc salt solution containing some ammonium chloride. Explain.

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19. Will the pH of water be same at $4^\circ C$ and $25^\circ C$? Explain.

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H.O.T.S Conceptual Questions

1. Reaction between ethyl acetate and water attains a state of equilibrium in an open vessel but not the decomposition of $CaCO_3$. Explain.

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2. For a reaction , $Br_2 \Leftrightarrow 2Br,$ the equilibrium constant at 600K and 800 K are respectively 6.1×10^{-12} and 1.0×10^{-7}. What is the nature of the reaction?

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3. Barium sulphate is washed with water containing a little amount of dilute H_2SO_4 in gravimetric analysis. Justify.

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4. CO_2 gas is much more soluble in aqueous NaOH solution than in water. Justify.

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5. Why do teeth undergo decay by eating sweets regularly?

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6. What is the effect of decreasing the volume of the container in the reaction.

$2C(s) + O_2(g) < \Rightarrow 2CO(g)$

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Additional Important Questions

1. Which of the following reactions involve homogenous and which involve hetrogenous equilibria?

a) $2N_2O(g) < \Rightarrow 2N_2(g) + O_2(g)$

b) $2NH_3(g) < \Rightarrow N_2(g) + 3H_2(g)$

c) $2Cu(NO_3)_2(s) < \Rightarrow 2CuO(s) + 4NO_2(g) + O_2(g)$

d)

$CH_3COOC_2H_5(aq) + H_2O(l) < \Rightarrow CH_3COOH(aq) + C_2H_5OH(aq)$

e) $Fe^{3+}(aq) + 3OH^-(aq) < \Rightarrow Fe(OH)_3(s).$

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2. Write the expressioin for the equilibrium constant for each of the following reactions?

(i) $2NOCl(g) < \Rightarrow 2NO(g) + Cl_2(g)$

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

(iii) $I_2(s) + 5F_2(g) \Leftrightarrow 2IF_5(g)$

(iv) $FeO(s) + CO(g) \Leftrightarrow Fe(s) + CO_2(g)$

(v) $Na_2CO_3(s) + SO_2(g) + 1/2O_2(g) \Leftrightarrow Na_2SO_4(s) + CO_2(g).$

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3. What quantiative information can you obtain from the value of the equilibrium constant?

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4. Which of the following can behave both as Bronsted acids as well as Bronsted bases?

$H_2O, HCO^-, H_2SO_4, H_3PO_4, HS^-, NH_3.$

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5. Classify the following into acids and bases according to Lewis Concept:

$S^{2-}, H^+, OH^-, BF_3, Ni^{2+}, AICI_3, NF_3, SnCI_4, NH_3$

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6. An aqueous solution of $CuSO_4$ is acidic while that of Na_2SO_4 is neutral. Explain.

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7. An aqueous solution of ferric chloride gives a brown precipitate upon standing . Justify.

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8. How does water help in the dissociation of acids and base?

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9. Water is rather neutral but becomes a strong base when HCI is dissolved in water . Explain.

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10. (a) Arrange the following Bronsted acids in decreasing acidic strength:

$HCI, HBr, HI, CH_3COOH, HCO_3^- H_2O.$

(b) Arrange the following Bronsted bases in increasing basic strength:

$CO_3^{2-}, NH_3 SO_4^{2-}, CI^-, Br^-, NO_3^-$.

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11. How will you account for the acidic character of nitrous acid (HNO_2) according to both Arrhenius theory and Bronsted-Lowry theory?

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12. With the help of Lowry-Bronsted concept show that $HCIO_4$ is a stronger acid than $HCIO_3$ when dissolved is water.

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13. How does Lewis theory explain the acidic character of CO_2?

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14. Do you agree with the statement that Lewis base is a Bronsted base? Justify your answer.

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15. Out of the following :

$H_2PO_4^-, SO_3^{2-}, ClO^-, Fe^{3+}, BCl_3, NH_4^+,$ select

(a) Bronsted and Lowry and (b) Bronsted and Lowry base (C) Lewis acid (d) Lewis base.

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16. Out of the following pairs point out the stronger Lewis acid and assigh reason.

$(a) BF_3 \text{ or } BH_3$ $(b) Sn^{2+} \text{ or } Sn^{4+}$

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17. HCl is a stronger acid then CH_3COOH but both have almost same acidic strength when dissolved in liquid ammonia. Explain.

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18. Arrange the following in order of increasing acid strength:

$(a) NH_3, CH_4, HF, H_2O$ $(b) HCOOH, C_6H_5COOH. CH_3COOH$

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19. Find the value of equilibrium constant if the rate constante for the forward and backward reactions are , 2.38×10^{-4} and 8.15×10^{-4} respetively.

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20. The nature of a solution whether neutral , acidic or basic depends upon its pH value. The pH of a solution changes when an acid or base

added to it . Howerver the pH of the solution is maintained by the addition of a suitable buffer whether acidic or basic.

(a) Define a buffer solution (b) Give one example each of acidic and basic buffers. (c) Define pH of a solution .

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21. Match the column-I with column-II

Column_I	Column-II
(i)Equilibrium	$(a)\Delta G = +ve$
(ii)Spontaneous reaction	$(b)\Delta G = 0$
(iii)Non-spontaneous reaction	$(c)\Delta G = -ve$

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22. Arrhenius Concept

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23. What is the conjugate acid of NH_3?

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24. Derive the relation between pK_a and pK_w

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25. Calculate pH of 0.01 M HCI solution.

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26. (a) Derive a relationship between K_p and K_c

(b) What is a buffer solution?

(C) Define acid according to Lewis concept.

(d) Calculate pH value of 0.01 m HCI.

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Problem

1. Prove $\alpha = \sqrt{\left(\frac{K_p}{P + K_p}\right)}$ for

$PCl_5 \Leftrightarrow PCl_3 + Cl_2$

where α is the degree of dissociation at temperature when equilibrium constant is K_p.

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2. A vessel at $1000K$ contains carbon dioxide with a pressure of $0.5atm$. Some of the carbon dioxide is converted to carbon monoxide on addition of graphite. Calculate the value of K_p if total pressure at equilibrium is $0.8atm$.

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3. $20\,\%$ N_2O_4 molecules are dissociated in a sample of gas at $27^\circ C$ and 760 torr. Calculate the density of the equilibrium mixture.

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4. The degree of dissociation is 0.4 at $400K$ and 1.0 atm for the gaseous reaction

$PCl_5 \Leftrightarrow PCl_3 + Cl_2$

assuming ideal behaviour of all gases, calculate the density of equilibrium mixture at $400K$ and 1.0 atm (relative atomic mass of P is 31.0 and of Cl is 35.5).

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5. $0.16gN_2H_4$ is dissoolved in H_2O and total volume is made upto $500mL$. Calculate the percentage of N_2H_4 that has reacted with H_2O in this solution. K_b for $N_2H_4 = 4.0 \times 10^{-6}M$.

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6. A sample of AgCI was treated with $5.00mL$ of $1.5M\ Na_2CO_3$ solubility to give Ag_2CO_3 . The remaining solution contained $0.0026gofCI^-$ per litre. Calculate the solubility product of AgCI. $\left(K_{SP}f\ \text{or}\ Ag_2CO_3 = 8.2 \times 10^{-12}\right)$

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7. What is the value of k_c for the reaction at 1473 K

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

when one mode of iodic gas is introduced into an evacuated one litre flask so that only 5% of it gets dissociated ?

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8. Calculate pH at which $Mg(OH)_2$ begins to precipitate from a solution containing $0.10MMg^{2+}$ ions. $\left(K_{SP}ofMg(OH)_2 = 1 \times 10^{-11}\right)$

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9. The pH of $0.05M$ aqueous solution of diethy1 amine is 12.0 . Caluclate K_b.

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10. The solubility product of AgCI in water is1.5×10^{-10}. Calculate its solubility in $0.01MNaCI$.

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11. What will be the resultant pH, when 200 mL of an aqueous solution of $HCI(pH = 2.0)$ is mixed with 300 mL of an aqueous solution of $NaOH(pH = 12.0)$?

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12. (a) Prove that in the aqueous solution of NH_4CI concentration of H_3O^+ ions is $\sqrt{K_h \times c}$.

(b) Find out the ration of $\frac{[HCO_3^-]}{[H_2CO_3]}$ in the aqueous solution of carbonic acid whose pH is 7.4. $\left(K_a = 4.5 \times 10^{-7}\right)$

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value Based questions

1. The nature of a solution whether neutral , acidic or basic depends upon its pH value. The pH of a solution changes when an acid or base added to it . Howerver the pH of the solution is maintained by the addition of a suitable buffer whether acidic or basic.

(i) Define a buffer solution

(ii) Give one example each of acidic and basic buffers.

(iii) What is the value associated with the use of buffer solution in human beings ?

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2. When a certain system is in a state of equilibrium both the forward and the backward processes proceed at the same speed i.e. it is of dynamic nature. Le Chatelier's principle helps in controlling the conditions of temperature, pressure and concentration which govern the system.

(i) State the principle.

(ii) The manufacture of ammonia is based on which industrial process.

(iii) What is the condition of temperature for the process ?

(iv) What is the value associated with the optimum temperature for the process ?

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3. The concept of cmmon ion effect applies to the dissociation of weak electrolytes. Their dissociation gets further suppressed in the presence of common ions furnished by a suitable electrolyte. Similarly the solubility of sparingly soluble salts in water gets suppresessed by the presence of a common ions. You are provided with an aqueous solution containing

Cu^{2+} and Zn^{2+} ions.

(i) How are these ions precipitated from the solution

(ii) What is the colour of the precipiate formed ?

(iii) How does dilute HCI help in checking the precipitation of Zn^{2+} ions in group II?

(iv) How does NH_4OH help in promoting the precipitation of Zn^{2+} ions in group IV?`

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Problems for Practice

1. Which of the following systems are at equilibrium ?

(i) Mercury and mercury vapours in a thermometre at room temperature

(ii) Water boiling in an open container

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2. What kind of equilibrium is described by Henry's laq ?

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3. Can equilibrium be attained in a reaction between acetic acid and ethyl alcohol carried in open container ?

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4. What is the effect of catalyst on the equilibrium state in a chemical reaction ?

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5. under what conditions can equilibrium be achieved between a solid and its liquid state ?

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6. A process $X \Leftrightarrow Y$ attains equilibrium at T. Can we increase the amount of the product on adding catalyst?

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7. Write the relation between K_p and K_c for the following reactions :

(i) $PCI_5(g) \Leftrightarrow PCI_3(g) + CI_2(g)$

(ii) $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$

(iii) $2H_2O(g) \Leftrightarrow 2H_2(g) + O_2(g)$

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

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8. Write the equilibrium constant (K_c) expression for the following reaction :

$(i) Cu^{2+}(aq) + 2A(s) \Leftrightarrow Cu(s) + 2A^{+}(aq)$

$(ii) 4HCI(g) + O_2(g) \Leftrightarrow 2CI_2(g) + 2H_2O(g)$

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9. The value of the equilibrium constant for the reaction :

H_(2) (g) +I_(2) (g) hArr 2HI (g) $at 720 K is 48. \hat{W} is the value of the equilibrium constant of the reaction:$

1//2 H_(2)(g) + 1//2I_(2)(g) hArr HI (g)`

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10. For an equilibrium reaction, the rate constants for the forward and the backward reaction are 2.38×10^{-4} and 8.15×10^{-5}, respectively. Calculate the equilibrium constant for the reaction.

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11. Two moles of HI were heated in a sealed tube at $440^{\circ} C$ till the equilibrium was reached. HI was found to be 22% decomposed.The equilibrium constant for disssociation is :

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12. The initial molar concentration of the reactants A and B were 0.1 M and 0.2 M respectively in the following reaction

$A + B \Leftrightarrow 2C$

When equilibrium was attained the concentration of A in the reaction mixture was found to be 0.06M . Calculate the equilibrium constant.

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13. the degree of dissociation of PCI_5 at a certain temperature and under one atmosphere pressure is 0.2. Calculate the pressure at which it is half dissociated at the same temperature.

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14. In an experiment starting with 1 mol C_2H_5OH, 1 mol CH_3COOH, and 1 mol of water, the equilibrium mixture mixture of analysis showa

that $54.3\ \%$ of the acid is eaterified. Calculate K_c.

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15. Under what pressure must an equimolar mixture of PCl_3 and Cl_2 be placed at $250^\circ C$ in order to obtain PCl_5 at 1 atm? $(K_p \text{for dissociation of} PCl_5 = 1.78)$.

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16. For the reaction,

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$

the partial pressure of N_2 and H_2 are 0.80 and 0.40 atmosphere, respectively, at equilibrium. The total pressure of the system is 2.80 atm. What is K_p for the above reaction?

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17. In the reaction $A + B \Leftrightarrow C + D$, What will happen to the equilibrium if concentration of A is increased ?

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18. The equilibrium constant for a reaction is 2×10^{-23} at $25^{\circ}C$ and 2×10^{-2} at $50^{\circ}C$. Is the reaction endothermic or exothermic ?

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19. What will be the effect of increased pressure in the following equilibrium reactions ?

(i) H_(2)(g) +I_(2) (g) hArr 2HI(g)$(ii) N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$

(Iii) N_(2)O_(4)(g) hArr 2NO_(2)(g)`

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20. Mention atleast three ways by which the concentration of $SO_2(g)$ be increased in the following reaction in a state of equilibrium :

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

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21. What happens to the solubility to CO_2 in water if temperature is increased ?

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22. In a gaseous system $A(g) + B(g) \Leftrightarrow C(g)$ contained in a one litre flask, 1mole of an inert gas in pumped. Will there be any effect on the equilibria ?

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23. The dissociation constant for an acid HA is 1.6×10^{-5}. Calculate its H_3O^+ in concentration in 0.01 M solution .

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24. At 298 K, 0.1 M solution of acetic acid is $1.34\,\%$ ionised . What is the ionisation constant (K_a) for the acid ?

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25. Calculate the degree of dissociation and concentration of H_3O^+ ions in 0.01 M solution of formic acid $\left(K_c = 2.1 \times 10^{-4} \text{ at } 298K\right)$

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26. K_a for an acid HA is 4.9×10^{-8}. Calculate percentage dissocitation H^+ ion concentration for its 0.1 M aqueous solution.

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27. Calculate the degree of ionisation and concentration of H_3O^+ ions in a solution of 0.01 M formic acid $\left(K_a = 2.1 \times 10^{-4}\right)$

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28. The values of ionisation constants for some pairs of acids and bases are given which of them is stronger ?

(a) Acetic acid $\left(K_a = 1.8 \times 10^5\right)$, boric acid $\left(K_a = 5, 8 \times 10^{-10}\right)$

(b) Hydrofluoric acid $\left(K_a = 6.7 \times 10^{-4}\right), benzoicacid$(K_(a) =6.3 xx 10^(-5))$(c) Ammoniumhydr \otimes ide$(K_(b) =1.8 xx 10^(-5))

$Ma \geq nsiumhydr \otimes ide$(K_(b) =8.1 xx 10^(-3))`

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29. Give the conjugate bases of (i) $H_2O (ii) NHO_3 (iii) NH_4^+ (Iv) HCO_3^{2-}$.

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30. Which is the stronger base in the following : CI^-, NO_3^-, CH_3COO^- SO_3^{2-} ions?

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31. Which concept can explain the acitic character of CO_2 ?

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32. $AlCI_3$ is the an acid according to which concept ?

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33. Name a species which can act both as conjugate acid and conjugate base.

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34. Give the formulae of the conjugate acids of the following : ,

$(i) NH_3 (ii) HS^- (iii) HSO_4^- (iv) H_2O$

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35. The hydronium ion concentration of a solution is $1.3 \times 10^{-5} M$. Find out its pH value. Predict the nature of the solution.

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36. Caculate the pH of 0.001 N H_2SO_4 solution.

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37. 4.0 g of NaOH are dissolved per litre of the solution at 298 K . Calculate the pH of the solution.

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38. How much KOH must be dissolved in one litre of solution to get a pH of 12 at $25^{\circ} C$?

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39. The pH of 0.1 M solution of an organic acid is 4.0. Calculate its dissociation constant.

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40. The value of k_w is 9.55×10^{-14} at a certain temperature . Calculate the pH of water at this temperature .

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41. The pH of $0.05M$ aqueous solution of diethy1 amine is 12.0 . Caluclate K_b.

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42. What is the hydrogen ion concentration of a solution with pH value 5.6 ?

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43. How many moles of $Ca(OH)_2$ must be dissolved to produce 250 mL of an aqueous solution of pH 10.65, assuming completer dissociation ?

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44. The pH of 0.01 M hydrocyanic acid (HCH) is 5.2 .What is the dissociation constant for the acid ?

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45. Calculate the pH value of 0.0001 M HNO_3

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46. Calculate the degree of hydrolysis of 0.01 M solution of ammonium chloride if its pH is 5.28.

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47. Determine the hydrolysis constantand degree of hydrolysis of 0.01 M solution of ammonium acetate , given that $K_a = 1.752 \times 10^{-5}, K_b = 1.74 \times 10^{-5}$

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48. Calculate the degree of hydrolysis of 0.04 M solution of NH_4CI of $pH = 5.28$

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49. Calculate the degree of hydrolysis and hydrolysis constant of 0.01 M solution of NH_4CI. Given $K_w = 1 \times 10^{-14}$, $K_b = 1.75 \times 10^{-5}$

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50. The solubilty of barium sulphate at 298 K is $1.1 \times 10^{-5} \text{mol } L^{-1}$. Calculate the solubilty product of barium sulphate at the same temerature.

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51. The solubility of $Mg(OH)_2$ is $8.352 \times 10^{-3} gL^{-1}$ at 298 K. Calculate the K_{sp} of $Mg(OH)_2$ at this temerature.

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52. How many moles of $AgBr\left(K_w = 5 \times 10^{-13}\right)$ will dissolve in a 0.01 M NaBr solution ? (NaBr is completely ionised in solution)

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53. Calculate the concentration of Mg^{2+} ions and OH^- ions in a saturated soluton of $Mg(OH)_2$.The solubility product of $Mg(OH)_2$ is 9.0×10^{-12}

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54. Calculate the solubility of $PbCI_2$ in grams $/$lite if the solubility product of

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55. Predict whether a precipitate will be formed or not on mixing 20 mL of 0.001 M NaCl with 80 mL of 0.01 M $AgNO_3$ solution $\left(K_{sp} \text{ for } AgCI = 1.5 \times 10^{-10}\right)$

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56. Equal volumes of 0.02 M Na_2SO_4 solution and 0.02 M $BaCI_2$ solution are mixed together . Predict whether a precipitate will get formed or not. K_{sp} value of $BaSO_4$ is 1.5×10^{-9}

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57. 50 mL of 0.01 M solution of $Ca(NO_3)_2$ is added to 150 mL of 0.08 M solution of $(NH_4)_2SO_4$. Predict Whether $CaSO_4$ will be precipitated or not. K_{sp} of $CaSO_4 = 4 \times 10^{-5}$

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NCERT

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

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, $K_c = 6.3 \times 10^{14} at 1000K$

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

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 0.933mole of O_2 is placed in a reaction vessel of volume $10litre$ and allowed to form N_2O at a temperature for which $K_c = 2.0 \times 10^{-37} litremol^{-1}$. 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. $K_p = 0.04atm$ at $899K$ for the equilibrium shown below. What is the equilibrium concentration of C_2H_6 when it is placed in a flask at $4.0atm$ 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 evacuted 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 $3.00 mollitre^{-1} N_2$, $2.00 mollitre^{-1} H_2$, and $0.500 mollitre^{-1} NH_3$. 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 $(a)\Delta G^{\Theta}$ and (b) the equilibrium constant for the formation of NO_2 from NO and O_2 at 298 K

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

$\Delta_f G^{\Theta}(NO_2) = 52.0kJ/mol, \Delta_f G^{\Theta}(NO) = 87.0kJ/mol, \Delta_f G^{\Theta}(O_2) =$

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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 increase in pressure ? Also mention whether the change will cause the reaction to go the right or left direction.

(i) $CH_4(g) + 2S)_2(g) \Leftrightarrow CS_2(g) + 2H_2S(g)$

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

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

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

(v) $COCI_2(g) \Leftrightarrow CO(g) + CI_2(g)$

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

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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 $0.30mol$ of CO, $0.10mol$ 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. What will be the conjugate bases for the Bronsted acids ? HF, H_2SO_4 and H_2CO_3?

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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: $H_2O, HCO_3^{\Theta}, HSO_4^{\Theta}$ 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 acid and Lewis base and show how these act as such.

a. $\overset{\Theta}{O}H$ b. F^{Θ} c. $H^{\oplus}$ d. BCI_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 $6.8 \times 10^{-4}, 1.8 \times 10^{-4}$ 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 ionisation of a $0.1M$ bromoacetic acid solution is 0.13. 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 solution of the following salts are neutral, acidic or basic:

$NaCI, KBr, NaCN, NH_4NO_3, NaNO_2$ 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 298 K form their solubility product constants given below. Determine also the molarities of individual ions.

$K_{SP\,(Ag_2CrO_4)} = 1.1 \times 10^{-12}$,

$K_{SP\,(BaCrO_4)} = 1.2 \times 10^{-10}$,

$K_{SP\,[Fe(OH)_3]} = 1.0 \times 10^{-38}$,

$K_{SP\,(PbCI_2)} = 1.6 \times 10^{-5}$,

$K_{SP\,(Hg_2I_2)} = 4.5 \times 10^{-29}$.

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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?

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

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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 $1.0g$ of calcium sulphate at $298K$?

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

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73. The concentration of suphide 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: $FeSO_4$, $MnCl_2$, $ZnCl_z$ and $CdCl_2$. In which of these solutions precipitation will take place?

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74. We know that the relationship between K_c and K_p is

$K_p = K_c(RT)^{\Delta ng}$

What would be the value of Δ^{ng} for the reaction

$NH_4CI_{(s)} \Leftrightarrow NH_3(g) + HCI(g)$

A. 1

B. 0.5

C. 1.5

D. 2

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75. For the reaction $H_2(g) + I_2(g) \Leftrightarrow 2HI(g)$, the standard free energy is $\Delta G^{\Theta} > 0$. the equilibrium constant (k) would be.

A. $K = 0$

B. $K > 1$

C. $k = 1$

D. $k < 1$

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76. Which of the following is not a general characteristic of equilibrium involving physical processes ?

A. Equilibrium is possible only in a closed system at a given temperature.

B. All measurable properties of the system remain constant.

C. All the physical processes stop at equilibrium .

D. The opposing processes occur at the same rate and there is dynamic but stable condition.

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77. PCI_5, PCI_3 and CI_2 are in equilibrium at 500 K in a closed container and their concentration are $0.8 > 10^{-3}\ \text{mol}L^{-1}$ and $1.2 \times 10^{-3}\text{mol}L^{-1}$ and $1.2 \times 10^{-3}\text{mol}L^{-1}$ respectively. The value of K_c for the reaction $PCI_5(g) \Leftrightarrow PCI_3(g) + CI_2(g)$ will be

A. $1.8 \times 10^3 molL^{-1}$

B. 1.8×10^{-3}

C. $1.8 \times 10^{-3} molL^{-1}$

D. 0.55×10^4

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78. Which of the following statements is incorrect?

A. In equilibrium mixture of ice and water kept in perfectly insulated flask mass of ice and water do not change with time.

B. the intensity of red colur increases when oxalic acid is added to a solution containing iron (III) nitrate and potassium thiocyanate.

C. On addition of catalyst. The equilibrium constant value is not affected.

D. equilibrim constant for a reaction with negative ΔH value dcreases as the temperature increases.

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79. When hydrochloric aicd is addded to cobalt and nitrate solution at room temperautre, the following reaction takes place and the reaction mixture becomes blue. On cooling the mixture it becomes pink. On the basis of this information mark the corect ansewer.

$$\underset{\text{pink}}{\left[Co(H_2O)_6\right]^{3+}}(aq) + 4CI^- \Leftrightarrow \underset{\text{blue}}{CoCI_4^{2-}}(aq) + 6H_2O(l)$$

A. $\Delta H > 0$ for the reaction

B. $\Delta H < 0$ for the reaction

C. $\Delta H = 0$ for the reaction

D. The sign of ΔH cannot be predicted on the basis of this information

Answer: A

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80. The Ph OF NEUTRAL WATER AT $25^{\circ}C$ is 7.0. As the temperature increases, ionisation of water increases, however the concentration of H^{+} ions nad OH^{-} ions equal. What will be the ph of puire water at $60^{\circ}C$?

A. Equal to 7.0

B. Greater than 7.0

C. Less than 7.0

D. Equal to zero

Answer: C

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81. The ionisation cosntabnt of an acid, K_a is the meaure of strength of an acid. The K_a values of acetic acid, hypochlorous acid and formic acid are 1.74×10^{-5}, 3.0×10^{-8} and 1.8×10^{-4} respectively. Which of the

following orders of ph of 0.1 mol dm^{-3} solutions of these acids is correct ?

A. acetic acid gt hypochlorous acid gt formic acid

B. hypochlorous acid gt acetic acid gt formic acid

C. formic gt hypochlorous acid gt acetic acid

D. formic acid gt acetic acid gt hypochlorous acid

Answer: B

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82. K_{a1},$K_{a2}$and K_{a3} are the respective ionisation constants for the following reactions.

$H_2S \Leftrightarrow H^+ + HS^-$,$HS^- \Leftrightarrow H^+S^{-2}$

$H_2S \Leftrightarrow 2H^+ + S^{2-}$

The correct relationship between K_{a1},$K_{a2}$and K_{a3} is

A. $K_{a3} = K_{a1} \times K_{a2}$

B. $K_{a3} = K_{a1} + K_{a2}$

C. $K_{a3} = K_{a1} - K_{a2}$

D. $K_{a3} = K_{a1} / K_{a2}$

Answer: A

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83. Acidity of BF_3 can be explained on ths basis of which of the follwoing concepts?

A. Arrhenius concept

B. Bronsted Lowry concept

C. Lewis concept

D. Bronsted Lowry as well as Lewis concept.

Answer: C

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84. Which of the following will produce a buffer sollution when mixed in equal volumes ?

A. $0.1 \text{ mol dm}^{-3} NH_4OH$ and $0.1 \text{ mol dm}^{-3} HCI$

B. $0.05 \text{ mol dm}^{-3} NH_4OH$ and $0.1 \text{ mol dm}^{-3} HCI$

C. $0.1 \text{ mol dm}^{-3} NH_4OH$ and $0.05 \text{ mol dm}^{-3} HCI$

D. $0.1 \text{ mol dm}^{-3} CH_3COONA$ and $0.1 \text{ mol dm}^{-3} CH_3COOH$

.

Answer: D

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85. In which of the following solvents silver chloride easily soluble ?

A. $0.1 moldm^{-3} AgNO_3$ solution

B. $0.1 moldm^{-3} HCI$ solution

C. H_2O

D. Aqueous ammonia

Answer: D

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86. What will be the volume of pH of 0.01 moldm^{-3}

$CH_3COOH\left(K_a = 1.74 \times 10^{-5}\right)$

A. 3.4

B. 3.6

C. 3.9

D. 3.0

Answer: A

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87. K_a for CH_3COOH is 1.8×10^{-5} and K_b for NH_4OH is 1.8×10^{-5}

The pH of ammonium acetate will be :

A. 7.005

B. 4.75

C. 7

D. Between 6 and 7

Answer: C

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88. Which of the following options will be correct for the stage of half competiton of the reaction $A \rightarrow B$?

A. $\Delta G^{\Theta} = 0$

B. $\Delta G^{\Theta} > 0$

C. $\Delta G^{\Theta} < 0$

D. $\Delta G^{\Theta} = -RTIn2$`

Answer: A

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89. On increasing the pressure, in which dirction will the gas phase reaction proceed to re-establish equilibrium, is predicated by applying the Le Chatelier's principle. Consider the reaction.

$N_2(g) + 3H_2 \Leftrightarrow 2NH_3(g)$

Which of the following is correct, if the total pressure at which the equlibrium is established, is increased without changing the temperature ?

A. K will remain same

B. K will decrease

C. K will increase

D. K will increase initially and decreases when pressure is very high

Answer: A

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90. What will be the correct order of vapour pressure of water, acetone and ether at $30^{\circ}C$. Given that among these compounds, water bus maximum boiling point ?

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91. At 500 K, equlibrium constant, K_c for the following reaction is 5.

$1/2H_2(g) + 1/2(g) \Leftrightarrow HI(g)$

What would be the equilibrium constant K_c for the reaction $2hi(g) \Leftrightarrow H_2(g) + l_2(g)$

A. 0.04

B. 0.4

C. 25

D. 2.5

Answer: A

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92. In which of the following reactions, the equilibrium reamins unaffected on addition of small amount of argon at constant volume?

A. $H_2(g) + l_2(g) \Leftrightarrow 2HI(g)$

B. $PCI_5(g) \Leftrightarrow PCI_3(g) + CI_2(g)$

C. $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$

D. The equilibrium will remain unaffected in all the three cases.

Answer: D

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Multiple choice Qestions

1. For the reaction $N_2O_4(g) \Leftrightarrow 2NO_2(g)$, the value of K is 50 at 400 K and 1700 at 500 K. Which of the following options is correct?

A. The reaction is endothermic

B. The reaction is exothermic

C. If $NO_2(g)$ and $N_2O_4(g)$ are mixed at $400K$ at partial pressures 20 bar and 2 bar respectively, more $N_2O_4(g)$ will be formed.

D. The entropy of the system increases.

Answer: A::C::D

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2. At a particular temperature and atmospheric pressure, the solid and liquid phases of a pure substance can exist i equilibrium. Which of the following term defines this temperature ?

A. Noraml melting point

B. Equilibrium temperature

C. Boiling point

D. Freezing point

Answer: A::D

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3. Le Chatelier's principle is applicable to:

A. only homogeneous chemical reversible reactions

B. only heterogeneous chemical reversible reactions

C. only physical equilibria.

D. all systems, chemical or physical in equilibrium .

Answer: D

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4. In the melting of ice, which one of the conditions will be more favourable?

A. High temperature and high pressure

B. Low temperature and low pressure.

C. Low temperature and high pressure

D. High temperature and low pressure.

Answer: A

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5. Solubility of a gas in liquid increases on:

A. addition of a catalyst

B. decreasing of pressure

C. increasing of pressure

D. increasing of temperature

Answer: C

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6. When KOH is dissolved in water, heat is evolved. If the temperature is raised, the solunility of KOH

A. increases

B. decreases

C. remains the same

D. cannot be predicted

Answer: B

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7. The yield of product in the reaction,

$A_2(g) + 2B(g) \Leftrightarrow C(g) + QKJ$

would be higher at:

A. low temperature and high pressure

B. high temperature and high pressure

C. low temperature and low pressure

D. high temperature and low pressure.

Answer: A

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8. Manufacture of ammonia from the elements is represented by

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g) + 22.4kcal$

The maximum yield of ammonia will be obtained when the process is made to take place

A. at low pressure and high temperature

B. at low pressure and low temperature

C. at high pressure and high temperature

D. at high pressure and low temperature

Answer: D

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9. The degree of dissociation in a weak electrolyte increase

A. on increasing pressure

B. on decreasing dilution

C. on increasing dilution

D. on increasing concentration.

Answer: C

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10. Which of the following is the weakest base?

A. $NaOH$

B. $Ca(OH)_2$

C. NH_4OH

D. KOH

Answer: C

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11. Acetic Acid is a weak electrolyte because:

A. its molecular mass is high

B. it is a covalent compound

C. it is highly unstable

D. it does not dissociate much or its ionisation is very small.

Answer: D

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12. when NH_4CI is added to NH_4OH solution the dissociation of ammonium hydroxide is reduced. It is due to

A. common ion effect

B. hydrolysis

C. oxidation

D. reducation

Answer: A

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13. The addition of HCl will not supress the ionisation of

A. acetic acid

B. sulphuric acid

C. H_2S

D. benzoic acid

Answer: B

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14. H_2S in the presence of HCl precipitates II group but not IV group because :

A. HCI activates H_2S

B. HCI decreases concentration of sulphide ions

C. HCI increases concentration of sulphide ions

D. sulphides of IV group are unstable in HCI.

Answer: B

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15. Which of the following is a Lawis base ?

A. $AICI_3$

B. Ag

C. $Al(OH)_3$

D. NH_3

Answer: D

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16. which is correct about the following reaction ?

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

A. $K_p = pCO_2$

B. $K_p = (pCO_2)^2$

C. $k_P = pCaO$

D. $K_p = pCaCO_3$

Answer: A

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Matching Type Questions

1. 

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2. For the reaction : $N_2(g) + 3H_2(g) = 2NH_3(g)$

Equilibrium constant $K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$

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3.

$(A)\Delta G^{\Theta} > 0$	$(i)K > 1$
$(B)\Delta G^{\Theta} < 0$	$(ii)K = 1$
$(C)\Delta G^{\Theta} > 0$	$(iii)K = 0$
	$(iv)K < 1$

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4.

$(A)NH_3$	$(i)CO_3^{2-}$
$(B)HCO_3^-$	$(ii)NH_4^+$
$(C)H_2O$	$(iii)H_3O^+$
$(D)HSO_4^-$	$(iv)H_2SO_4$
$(E)H_2CO_3$	

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5. 

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6. 

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Assertion & Reason

1. Asseration (A) : Increasing order of acidity of hydrogen halides is $HF < HCI < HBr < HI$

Reason (R): While comparing acids formed by the elements belonging to the same group of periodic table, H-A bond strength is a more important factor in determining acidity of an acid than the polar nature of the bond.

A. Both A and B are true and R is the correct explanation of A.

B. Both A and R are ture but R is not the correct explanation of A.

C. A is the ture R is false.

D. Both A and R are false.

Answer: A

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2. Asseration : A solution containing a mixture of acetic acid and sodium acetate maintains a constant value of ph on addition of small amounts of acid or alkali.

Reason : A solution containing a mixture of acetic acid and sodium acetate acts as a buffer solution around ph 4.75.

A. Both A and R are ture and R is correct explanation of A.

B. Both A and R are ture but R is not the correct explanation of A.

C. A is true but R is false.

D. Both A and R are false.

Answer: A

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3. Asseration : The ionisation of hydrogen sulphide in water is low in the presence of hydrochloric acid.

Reason : Hydrogen sulphide is a weak acid.

A. Both A and R are ture and R is correct explanation of A.

B. Both A and R are true but R is not correct explanation of A.

C. A is true but R is false.

D. Both A and R are false.

Answer: B

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4. Asseration : For any chemical reaction at particular temperautre, the equilibrium constant is fixed and is a characteristic property.

Equilibrium constant is independent of temperature.

A. Both A and R are true and R is correct explanation of A.

B. Both A and R are true but R is not correct explanation of A.

C. A is true but R is false.

D. Both A and R are false.

Answer: C

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5. Asseration : A queous solution of ammonium carbonate is basic.

Reason : Acidic/basic nature of a salt of weak acid base depends on K_a and K_b value of the acid and the base forming it.

A. Both A and R are ture and R is correct explanation of A.

B. Both A and R are true but R is not correct explanation of A.

C. A is the false but R is true.

D. Both A and R are false.

Answer: A

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6. Asseration : An aqeous solution of ammonium acetate can act as buffer.

Reason: Acetic acid is a weak acid and NH_4OH is a weak base.

A. Both A and R are true and R is correct explanation of A.

B. Both A and R are true but R is not correct explanation of A.

C. A is false but R is true.

D. Both A and R are false.

Answer: C

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7. Asseration : In the dissociation of PCI_5 at constant pressure and temperature addition of helium at equilibrium increases the dissociation of PCI_5.

Reason : Helium removes CI_2 from the field of action.

A. Both A and R are true and R is correct explanation of A.

B. Both A and R are ture but R is not correct explanation of A.

C. A is true but R is false.

D. Both A and are false.

Answer: C

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very short answer questions

1. Define equilibrium state. In which type of reactions is equilibrium attained ?

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2. What is the nature of chemical equilibrium ?

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3. What happes if the temperature of saturated solution be increased ?

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4. Can a catalyst disturb the state of equilibrium?

Watch Video Solution

5. What happes to the solubility of a gas in water if temperature is increased ?

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6. State Henry's law.

Watch Video Solution

7. What is the nature of physical equilibrium ?

Watch Video Solution

8. Under what conditions , ice $\Leftrightarrow$ water system is in equilibrium ?

(a) at 273 K (b) below 273 K (C) above 273 K ?

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9. What is the equilibrium constant expression for the following reaction ?

$AI(s) + 3H^{+}(aq) \Leftrightarrow AI^{3+}(aq) + 3/2H_2(g)$

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10. How are K_p and K_c related to each other in the reaction

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

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11. can equilibrium be obtained in reaction between acetic acid and ethyl alcohol in an open container?

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12. under what conditions can equilibrium be achieved between a solid and its liquid state ?

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13. In a reaction $Q_c = K,$ What does it indicate?

Watch Video Solution

14. Write the relation between K_p and K_c for the reaction:

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$

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15. State law of mass action.

Watch Video Solution

16. Name the factors which can disturb the state of equilibrium in a reversible reaction.

Watch Video Solution

17. State Le Chatelier's principle.

Watch Video Solution

18. Mention atleast three ways by which the concentration of $SO_2(g)$ be increased in the following reaction in a state of equilibrium :

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

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19. What is the effect of increase in temperature on the solubility of a gas in water ?

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20. Under what conditions does pressure not influence the equilibrium state?

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21. What will happen to the equilibrium state if an inert gas is added at constant volume ?

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22. The formation of $NH_3(g)$ is exothermic in nature. What will happen if the temperature of the reaction mixture is increased ?

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23. What happens to the solubility of KCI in water if the temperature is increased ?

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Short Answer Question

1. Define equilibrium state. In which type of reactions is equilibrium attained ?

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2. Discuss how equilibrium is indicated in copper sulphate crystals when dissolved in water.

Watch Video Solution

3. What is the nature of physical equilibrium ?

Watch Video Solution

4. Give three example representing physical equilibrium.

Watch Video Solution

5. The measurable properties of the system donot change When equilibrium is achieved. Explain.

Watch Video Solution

6. VAPOUR PRESSURE AND EFFECT OF TEMPERATURE

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7. The value of equilibrium constant for the reaction

$H_2(g) + I_2(g) \Leftrightarrow 2HI(g)$ is 48 at 720 K

What is the value of the equilibrium constant for the reaction

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

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8. The equilibrium state can be attained from both sides of the chemical reaction.

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9. How does the value of equilibrium constant predict the extent of the reaction.

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10. Does a chemical reaction become static when equilibrium is reached ? Comment and explain.

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11. The expression for the equilibrium constant for a reaction in the gaseous phase is :

$$K_c = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$$

Write the balanced chemical equation corresponding to this expression.

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12. The increase in concentration of the reactants shifts the equilibrium towards the products side. Explain.

Watch Video Solution

13. What is the effect of increase in the pressure on the following reaction ?

$PCI_5(g) \Leftrightarrow PCI_3(g) + CI_2(g)$

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14. In a gaseous reaction , the reactant moles are more than the product moles. Discuss the effect of increase in pressure on the equilibrium state

?

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15. An inert gas does not alter the state of chemical equilibrium when added at constant volume. Discuss.

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16. What is an electrolyte ? How are electrolytes classified ?

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17. OSTWALD'S DILUTION LAW

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18. All Arrhenius acids are Bronsted acids but all Arrhenius bases are not Bronsted bases. Discuss.

Watch Video Solution

19. Discuss two limitations of Arrhenius theory .

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20. Relative strangths of weak acids and weak bases are compared in terms of the square roots of their dissociation constants. Explain.

Watch Video Solution

21. What are conjugate acid base pairs. Give two examples.

Watch Video Solution

22. Select the conjugate pairs in the following reactions:

$HCI + HCO_3^- \Leftrightarrow H_2CO_3 + CI^-$

$H_2SO_4 + H_2O \Leftrightarrow HSO_4^- + H_3O^+$

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23. Even ions can act as acids and bases. State the concept which accounts for it.

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24. Predict whether the following substance will give , acidic, basic or neutral solutions

(i) K_2CO_3 (ii) KCI (iii) $FeCI_3$ (iv) NH_3CI (v) $CuSO_4$ (vi) N

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25. Write the conjugate base of the following :

(i) NH_3 (ii) HF (iii) H_3PO_4 (iv) HS^-.

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26. Explain ionic product of water . What is the effect of temperature on ionic product of water ?

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27. The nature of a solution can be expressed in terms of its $\left[H_3O^+\right]$. Explain.

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28. Explain the term pH of a solution . What is pH of blood ?

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29. How can you calculate the pH of a buffer soluiton ? Write the mathematical equation.

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30. Identify the acid-base pair in the following reaction :

$HSO_4^-(aq) + PO_4^{3-}(aq) \rightarrow SO_4^{2-}(aq) + HPO_4^{2-}(aq)$

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31. COMMON ION EFFECT

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32. DIFFERENCE BETWEEN IONIC PRODUCT AND SOLUBILITY PRODUCT

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33. When HCI gas is passed through the saturated solution of impure sodium chloride, pure sodium chloride is precipitate why

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Long Answer Question

1. Describe the general characteristics of the equilibria in the physical systems.

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2. What is chamical equilibrium ? Write the characteristics of the chemical equilibrium.

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3. Explain the following :

(i) A chemical equilibrium is of dynamic nature.

(ii) In a reversible reaction , equilibrium can be achieved from either sides.

(iii) Equilibrium is generally attained in reaction carried in close containers.

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4. Derive an expression for the relation between K_p and K_c State the law of chemical equilibrium.

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5. (a) Write the expressions for the concentration quotient for the reactions:

$(i) CrO_4^{2-}(aq) + Pb^{2+}(aq) \Leftrightarrow PbCrO_4(s)$

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

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

(b) Write the main characteristics of the equilibrium constant.

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6. In a reversible chemical reaction the equilibrium can be achieved from either sides. Justify

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7. State Le Chatelier's principle.

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8. Discuss briefly the factors which can alter the state of equilibrium in a reversible reaction ?

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9. What will be the effect of increase in pressure on the following equilibria :

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

$(ii) PCI_5(g) \Leftrightarrow PCI_3(g) + CI_2(g)$

$(iii) N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$

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

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10. (a) Discuss the effect of addition of inert gas on the equilibrium point when added at constant volume and at constant pressure ?

(b) By making use of Le Chatelier's principle , predict the influence of :

(i) temperature and pressure on the vaporisation of water.

(ii) temperature and pressure on the melting of ice .

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11. (a) How will you shoe that in a reversible reaction equilibrium can be achieved from either sides ?

(b) Enilst the factors on which the value of the equilibrium constant depends.

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12. What is the effect of temperature and pressure on the yields of products?

a. $N_2(s) + 3H_2(g) \Leftrightarrow 2NH_3 + xcal$

b. $N_2(g) + O_2(g) \Leftrightarrow 2NO(g) - ycal$

c. $2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g) + 46.9kcal$

d. $PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g) - 15.0kcal$

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13. For the reaction :

$PCI_5(g) \Leftrightarrow PCI_3(g) + CI_2(g)$

Which of the following are favourable for the forward reaction ? Justify your answer.

(i) Introduction of inert gas at constant volume

(ii) Introduction of inert gas at constant pressure

(iii) Increasing the volume of the container

(iv) Introducing PCI_5 at constant volume.

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14. Account for the following :

(i) Addition of CI_2 to the following equilibrium mixture increases the temperature of the system

$$SO_2CI_2 + \text{heat} \Leftrightarrow SO_2 + CI_2$$

(ii) Ice melts when pressure is applied on it.

(iii) Pressure has no effect on the reaction

$$H_2(g) + CI_2(g) \Leftrightarrow 2HCI(g)$$

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15. (a) How are the relative strengths of electrolytes expressed ?

(b) Silver chloride dissolves in water to a samll extent only. Is it a weak or strong electrolyte ?

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16. Discuss the Arrhenius theory of acids and bases. What are its limiations ?

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17. (a) What is the Lewis concept of acids and bases?

(b) Name three species which can cat as Lewis acids and Lewis bases.

(C) How does Lewis concept explain the acidic character of CO_2 and basic character of NH_3?

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18. A buffer has a reserve acidity and reserve alkalinity . Explain with a suitalbe example.

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19. What is an indicator ? Name the indicators commonly used in acid base titrations and discuss the specific role played by them.

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20. Assign for the following :

(i) An aqueous of NaCI is neutral

(ii) NH_3 is a Lewis as well as Bronsted base.

(iii) Phenolphthalein is not a suitable indicator for titration between HCI against NH_4OH.

(iv) pH value of an aqueous 10^{-2} M acetic acid solution is not 2.

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Very Short Answer Question

1. What is an electrolyte?

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2. How do electrolytes conduct electric current?

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3. How is dissociation constant of a weak electrolyte related tol its degree of dissociation ?

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4. How does H^+ exist in solution ?

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5. Define an acid and base according to Arrhenius theory .

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6. Can CO_2 act as acid according to Arrhenius concept ?

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7. Water is amphoteric according to which concept?

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8. Write the conjugate acid and base for H_2O

Watch Video Solution

9. Define pH value of a solution.

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10. Can a neutral solution have pH equal to 7 at all the temperature ?

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11. Write conjugate acid for the following :

(i) $C_2H_5NH_2$ (ii) CH_3COOH

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12. Can we prepare a solution with pH more than 14 ?

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13. Give an example of acidic buffer.

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14. Lewis acids are called electrophiles. Why?

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15. Select Lewis acid and Lewis base from the following :

$Cu^{2+}, H_2O, BF_3, OH^-$

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16. Mention the conjugate acid for each of the following :

$OH^-, CH_3COO^-, CI^- CO_3^{2-}, CH_3COOH, CH_3NH_2, NH_2^-, .$

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17. Arrange the following in increasing order of base strength.

$KOH, NH_4OH, Ca(OH)_2$.

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18. On the basis of the pH values classify the following as strong acids, strong bases , weak acids and weak bases :

Solution : ABCDEF

pH :8.8 0.1 5.2 14.0 6.0 8.4

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19. $AICI_3$ is the an acid according to which concept ?

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20. Give two example of cations which can act as Lewis acids.

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21. Define solubility product.

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22. Write the solubility product expression for :

$(i) BaCO_3(s) \Leftrightarrow Ba^{2+}(aq) + CO_3^{2-}(aq)$,

$(ii) Ag_2CrO_4(s) \Leftrightarrow 2Ag^{+}(aq) + CrO_4^{2-}(aq)$

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23. When does a salt get precipitated in solution ?

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24. The K_{sp} value of a salt is high. What does it indicate ?

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25. Out of pure water and 0.1 M KCI in which silver chloride will dissolve more ?

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26. Out of ZnS and CuS which has more K_{sp} value ?

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Multiple Choice Qestions Bank

1. For a reaction :

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

at 721 K, the value of the equilibrium constant is 50. If 0.5 mole each of H_2 and I_2 are added to the system the value of the equilibrium constant will be :

A. 0.02

B. 0.2

C. 50

D. 25

Answer: C

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2. $0.1M$ solution of which of the substances will behave basic?

A. Sodium borate

B. Ammonium chloride

C. Calcuium nitrate

D. Sodium sulphate

Answer: A

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3. In which of the following solvents will $AgBr$ has highest solubility?

A. $10^{-3}M$ NaBr

B. $10^{-3}MNH_4OH$

C. Pure water

D. $10^{-3}MHBr$

Answer: B

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4. In the gaseous phase reaction

$C_2H_4 + H_2 \Leftrightarrow C_2H_6$, the equilibrium constant can be expressed in the units to :

A. $\text{litre}^{-1}\ \ \text{mol}^{-1}$

B. $\text{mol}^2\ \ \text{litre}^{-2}$

C. litre mol^{-1}

D. mol litre

Answer: C

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5. According to Lewis concept acid is

A. Proton donor

B. Electron pair donor

C. Electron pair acceptor

D. Proton accetor

Answer: C

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6. Ostwald's dilution law is applicable to

A. Strong electrolytes only

B. Weak electrolytes only

C. Non-electrolytes

D. Strong and weak electrolytes.

Answer: B

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7. The pH of a solution of hydrochloric acid is 4. The molarity of this solution is

A. 4.0

B. 0.4

C. `0.0001

D. 0.04

Answer: C

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8. A compound having the formula NH_2CH_2COOH may behave

A. only as acid

B. only as base

C. both acid and base

D. neither acid nor base

Answer: C

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9. The K_{sp} of CuS, Ag_2S and HgS are $10^{-31}, 10^{-44}$ and 10^{-54} respectively. The solubility of these sulphides are in the order.

A. $Ag_2S > CuS < HgS$

B. $Ag_2S > HgS > CuS$

C. $HgS > Ag_2S > CuS$

D. $CuS > Ag_2S > HgS$

Answer: D

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10. Which of the following on reaction with H_2S does not produce metallic sulphide ?

A. $CdCI_2$

B. $ZnCI_2$

C. $COCI_2$

D. $CuCI_2$

Answer: C

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11. If K_{sp} for $HgSO_4$ is 6.4×10^{-5}, then solubility of this substance in mole per m^3 is

A. 8×10^{-6}

B. $8XX10^{-3}$

C. 4.6×10^{-5}

D. None of these

Answer: B

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12. A white salt is readily soluble in water and gives a colourless solution with a pH of about 9. The salt would be

A. NH_4NO_3

B. CH_3COONa

C. CH_3COONH_4

D. $CaCO_3$.

Answer: B

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13. The strongest conjugate base is

A. NO_3^-

B. CI^-

C. SO_4^-

D. CH_3COO^-

Answer: D

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14. A base according to Bronsted concept is a substance which can :

A. lose a pair of electrons

B. donate protons

C. Gain a pair or electrons

D. accept protons

Answer: A

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15. Ionisation constant of CH_3COOH is 1.7×10^{-5} and concentration fo H^+ in certain acetic acid solution is $3.4 \times 10^{-4}M$. The concentration of acetic acid solution is

A. 3.4×10^{-4}

B. 3.4×10^{-3}

C. 6.8×10^{-4}

D. 1.7×10^{-3}

Answer: A

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16. Solubility if M_2S type salt is 3.5×10^{-6}, then find out its solubility product

A. 1.7×10^{-6}

B. 3.4×10^{-16}

C. 1.7×10^{-16}

D. 6.8×10^{-12}

Answer: C

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17. The relationship between ionisation and change in concentration of any weak electrolyte is expressed as :

A. $\alpha = \frac{K_a}{C}$

B. $\alpha = \sqrt{\frac{K_a}{C}}$

C. $\alpha = K_a C$

D. $\alpha = \sqrt{\frac{K_a}{C^2}}$

Answer: B

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18. Reaction $2BaO_2(s) \Leftrightarrow 2BaO(s) + O_2(g), \Delta H = +ve.$ At equilibrium condition, pressure of O_2 is depended on:

A. increase in mass of BaO_2

B. increase in mass of BaO

C. increase in temperature on equilibrium

D. increase in mass of BaO_2 and BaO both.

Answer: C

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19. For the reaction :

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

A. $K_p = p_{(CaCO_3)}$

B. $K_p = p(CO_2)$

C. $K_p = \dfrac{1}{p_{(CaCO_3)}}$

D. $K_p = \dfrac{1}{p_{(CO_2)}}$

Answer: B

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20. The $[Ag^+] = 10^{-5}$ in a solution . The $[CI^-]$ to precipitate $AgCI(K_{sp}$ of $AgCI = 2 \times 10^{-12})$ is :

A. 10^{-5}

B. 10^{-7}

C. 10^{-8}

D. 10^{-9}

Answer: A

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21. The solubility product of a sparingly soluble salt AX_2 is 3.2×10^{-11}. Its solubility (in mo/L) is

A. 5.6×10^{-6}

B. 3.1×10^{-4}

C. 2×10^{-4}

D. 4×10^{-4}

Answer: C

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22. Which of the following is a buffer solution?

A. $CH_3COOH + CH_3COONa$

B. $CH_3COOH + CH_3COONH_4$

C. $CH_3COOH + NH_4CI$

D. $NaOH + HCI$

Answer: A

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23. The principal buffer present in human blood is

A. $NaH_2PO_4 + Na_2HPO_4$

B. $H_3PO_4 + NaH_2PO_4$

C. $CH_3COOH + CH_3COONa$

D. $H_2CO_3 + HCO_3^-$

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24. For reacrtion $2NOC1(g) \Leftrightarrow 2NO(g) + C1_2(g)$, K_c at $427^\circ C$ is 3×10^{-6} L mol^{-1}. The value of K_p is nearly

A. 7.5×10^{-5}

B. 2.50×10^{-5}

C. 2.5×10^{-4}

D. 1.75×10^{-4}

Answer: D

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25. Which of the following pairs consitutes buffer?

A. $NaOH$ and HCI

B. HNO_3 and NH_4NO_3

C. HCI and KCI

D. HNO_2 and $NaNO_2$

Answer: D

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26. A weak acid, HA, has a K_a of 1.00×10^{-5}. If 0.100 mol of the acid is dissolved in 1 L of water, the percentage of the acid dissociated at equilibrium is the closed to

A. $1.0\,\%$

B. $99.9\,\%$

C. $0.10\ \%$

D. $99.0\ \%$

Answer: A

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27. the value of equilibrium constant for the reaction

$HI(g) \Leftrightarrow 1/2H_2(g) + 1/2I_2(g) \quad \text{is} \quad 8.0$

The equilibrium constant for the reaction

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

A. 16

B. $1/8$

C. $1/16$

D. $1/64$

Answer: D

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28. The dissociation equilibrium of a gas AB_2 can be represented as :

$2AB_2 \Leftrightarrow 2AB(g) + B_2(g)$

The degree of dissocaition x is very small as compared to 1. The expression which relates the degree of dissociation (x) with equilibrium constant (K_p) and total pressure (p) is :

A. $(2K_p / P)^{1/2}$

B. (K_p / P)

C. $(2K_p / P)$

D. $(2K_p / P)^{1/3}$

Answer: D

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29. Which of the following molecules acts as a Lewis acid ?

A. $(CH_3)_2O$

B. $(CH_3)_3P$

C. $(CH_3)_3N$

D. $(CH_3)_3B$

Answer: D

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30. What is the $\left[OH^-\right]$ in the final solution prepared by mixing $20.0mL$ of $0.050MHCl$ with $30.0mL$ of $0.10MBa(OH)_2$?

A. 0.40 M

B. 0.0050 M

C. 0.12 M

D. 0.10 M

Answer: D

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31. What is $\left[H^{+}\right]$ in mol/L of a solution that is $0.20M$ in CH_3COONa and $0.1M$ in CH_3COOH? K_a for CH_3COOH is 1.8×10^{-5}?

A. 3.5×10^{-7}

B. 1.1×10^{-5}

C. 4.0×10^{-6}

D. 9.0×10^{-6}

Answer: D

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32. Ph of a saturated solution of $Ba(OH)_2$ is 12. The value of solubility product is :

A. 3.3×10^{-7}

B. 5.0×10^{-7}

C. 4.0×10^{-6}

D. 5.0×10^{-6}

Answer: B

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33. Equimolar solutions of the following substances were prepared separately. Which one of these has highest pH value?

A. $BaCI_2$

B. $AICI_2$

C. $LiCI$

D. $BeCI_2$

Answer: A

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34. Buffer solutions have constant acidity and alkalinity because

A. these give unionised acid or base on reaction with added acid or alkali

B. acids and alkalies in these solutions are shielded from attacks by other ions

C. They have large excess of H^+ or OH^- ions

D. they have fixed value of pH

Answer: A

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35. Given that equilibrium constant for the reaction $2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$ has a value of 278 at a particular temperature. What is the value of the equilibrium constant for the

following reaction at the same temperature ?

$$SO_3(g) \Leftrightarrow SO_2(g) + \frac{1}{2}O_2(g)$$

A. 1.8×10^{-3}

B. 3.6×10^{-3}

C. 6.0×10^{-2}

D. 1.3×10^{-5}

Answer: C

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36. Given the reaction between 2 gases represented by A_2 and B_2 to given the compound AB(g). $A_2(g) + B_2(g) \Leftrightarrow 2AB(g)$

At equilibrium, the concentrtation

of $A_2 = 3.0 \times 10^{-3} M$

of $B_2 = 4.2 \times 10^{-3} M$

of $AB = 2.8 \times 10^{-3} M$

If the reaction takes place in a sealed vessel at $527^{\circ}C$. then the value of K_c will be

A. 2.0

B. 1.9

C. 0.62

D. 4.5

Answer: C

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37. Which of these is least likely to act as Lewis base?

A. PF_3

B. CO

C. F^-

D. BF_3

Answer: D

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38. Which of the following salts will give highest pH in water?

A. $CuSO_4$

B. KCI

C. $NaCI$

D. Na_2CO_3

Answer: D

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39. For the reversible reaction

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g) + \quad \text{Heat}$

The equilibrium shifts in forward direction

A. by increasing the concentration of $NH_3(g)$

B. by decreasing the pressure

C. by decreasing the concentrations of $N_2(g)$ and $H_2(g)$

D. by increasing pressure and decreasing temperature.

Answer: D

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40. The K_{sp} of $Ag_2CrO_4, AgCl, AgBr$ and AgI are respectively, $1.1 \times 10^{-12}, 1.8 \times 10^{-10}, 5.0 \times 10^{-13}, 8.3 \times 10^{-17}$. Which one of the following salts will precipitate last if $AgNO_3$ solution is added to the solution containing equal moles of NaCl,NaBr,NaI and Na_2CrO_4 ?

A. $AgBr$

B. Ag_2CrO_4

C. Agl

D. $AgCI.$

Answer: B

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41. If the value of equilibrium constant for a particular reaction is 1.6×10^{12} , then art equilibrium the system will contain

A. mostly products

B. similar amounts of reactants and products

C. all reactans

D. mostly reactants

Answer: A

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42. If the equilibrium constant for

$N_2(g) + O_2(g) \Leftrightarrow 2NO(g)$ is K , the equilibrium

constant for $\frac{1}{2}N_2(g) + \frac{1}{2}O_2(g) \Leftrightarrow NO(g)$ will be

A. $\frac{1}{2}K$

B. K

C. K^2

D. $K^{1/2}$

Answer: D

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43. What is the pH of the resulting solution when equal volumes of $0.1MNaOH$ and $0.01MHCl$ are mixed?

A. 2.0

B. 7.0

C. 1.04

D. 12.65

Answer: D

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44. Which one of the following pairs of solution is not an acidic buffer?

A. CH_3COOH and CH_3COONa

B. H_2CO_3 and Na_2CO_3

C. H_3PO_4 and Na_3PO_4

D. $HCIO_4$ and $NaCIO_4$

Answer: D

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45. The solubility product of a salt having general formula MX_2 in water is 4×10^{-12}. The concentration of $M^{2+}ions$ in the aqueous solution of the salt is:

A. $1 \times 10^{-4} M$

B. $4 \times 10^{4} M$

C. $16 \times 10^{-6} M$

D. $2 \times 10^{-4} M$

Answer: A

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46. Which one of the following species cannot act as both Bronsted acid and base ?

A. H_2O

B. HCO_3^-

C. HSO_4^-

D. NH_2^-

Answer: D

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47. MY and NY_3 two nearly insoluble salts, have the same K_{sp} values of 6.2×10^{-13} at room temperature. Which statement would be true in rearged to MY and NY_3 ?

A. the salts MY and NY_3 are more soluble in 0.5 M KY than in pure water.

B. The addition of the salt of KY to solution of MY and NY_3 will have no effect on their solubilites.

C. The molar solubility of MY and NY_3 in water are identical.

D. The molar solubility of MY in water is less than that of NY_3

Answer: D

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48. The pH of a solution of AgCI(s) with solubility product 1.6×10^{-10} in 0.1 M Nacl solution would be :

A. $1.26 \times 10^{-5} M$

B. $1.6 \times 10^{-9} M$

C. $1.6 \times 10^{-11} M$

D. Zero

Answer: B

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49. The pH of a solution obtained by mixing 60 mL of 0.1 M NaOH solution and 40 mL of 0.15 MHCI solution is :

A. 10

B. 12

C. 2

D. 7

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50. The equilibrium constants for the following reactions

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g) N_2(g) + O_2(g) \Leftrightarrow 2NO(g)$

and $H_2(g) + 1/2O_2(g) \Leftrightarrow H_2O(Ig)$ are K_1, K_2 and K_3

respectively.

The equilibrium constant (K) for the reaction

$2NH_3(g) + 2^1/2)O_2(g) \Leftrightarrow 2NO(g) + 3H_2O(I)$ is

A. $K_2 . K_3^3 / K_1$

B. $K_2^2 K_3 / K_1$

C. $K_1 . K_2 / K_3$

D. $K_2 . K_3 / K_1$

Answer: D

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Select the correct Answer

1. In lime kiln the reaction given below does not proced to completion because

$CaCO_3 \Leftrightarrow CaO + CO_2$

A. of high temperature

B. CO_2 evolved escapes

C. CaO is removed

D. of low temperature

Answer: B

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2. K_p and K_c are related to each other as :

A. $K_p = K_c(RT)^{-\Delta n}$

B. $K_c = K_p(RT)^{-\Delta n}$

C. $K_p = (RT)^{\Delta n}/K_c$

D. $K_p - K_c = (RT)\Delta^n$

Answer: B

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3. The relation K_p and K_c for the reaction:

$2NO(g) + CI_2(g) \Leftrightarrow 2NOCI(g)$ is:

A. $K_p = K_c$

B. $K_p = K_c(RT)$

C. $K_p = K_c/RT$

D. $K_p = K_c/RT^2$

Answer: C

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4. In which of the following reactions K_p and K_c are equal ?

A. $2SO_2(g) + O_2(g) \Leftrightarrow 2SO_2(g)$

B. $PCI_5(g) \Leftrightarrow PCI_3(g) + CI_2(g)$

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

D. $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$

Answer: C

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5. A small value of equilibrium constant shows that:

A. The reaction is more in the forward direction than in the backward direction

B. the reaction is less in the forward direction and more in the bacward direction

C. the reaction proceeds very little both in the forward and backward directions.

D. The reaction is taking place at high temperature.

Answer: B

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6. Changing the volume of the system does not after the number of moles in which of the following equilibrium.

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

B. $PCI_5(g) \Leftrightarrow PCI_3(g) + CI_2(g)$

C. $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$

D. $SO_2CI_2(g) \Leftrightarrow SO_2(g) + CI_2(g)$

Answer: A

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7. For the reaction

$CO(g) + \frac{1}{2}O_2(g) \Leftrightarrow CO_2(g)$, K_p / K_c is

A. RT

B. $(RT)^{-1}$

C. $(RT)^{-1/2}$

D. $(RT)^{1/2}$

Answer: C

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8. For an equilibrium reaction, $N_2O_4(g) \Leftrightarrow 2NO_2(g)$, the concentrations of N_2O_4 and NO_2 at equilibrium are 4.8×10^{-2} and $1.2 \times 10^{-2} mol / L$

respectively. The value of K_c for the reaction is

A. $3 \times 10^{-1} \text{ mol } L^{-1}$

B. $3 \times 10^{-3} \text{ mol } L^{-1}$

C. $3 \times 10^{3} \text{ mol } L^{-1}$

D. $3.3 \times 10^{3} \text{ mol } L^{-1}$

Answer: B

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9. Which is the correct representation for the solubility product constant of Ag_2CrO_4?

A. $\left[Ag^{+}\right]^2\left[CrO_4^{2-}\right]$

B. $2Ag^{+}\left]\left[Cro_4^{2-}\right]\right.$

C. $\left[2Ag^{+}\right]\left[CrO_4^{2-}\right]$

D. $\left[2Ag^{+}\right]^2\left[CrO_4^{2-}\right]$

Answer: A

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10. The solubility product of Hg_2I_2 is equal to

A. $\left[Hg_2^{++}\right]\left[I^-\right]$

B. $\left[Hg^{++}\right]\left[I^-\right]$

C. $\left[Hg_2^{+}\right]\left[I^-\right]^2$

D. $\left[Hg^{++}\right]\left[I^-\right]^2$

Answer: C

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11. The units of solubility product of Ag_2SO_4 will be (connentration being expressed in mol L^{-1}):

A. mol L^{-1}

B. $mol^2 L^{-2}$

C. $mol^3 L^{-3}$

D. none of these

Answer: C

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12. Precipitation takes place when the ionic product

A. equals their solubility product

B. exceeds their solubility product

C. is less than their solubility product

D. is almost zero.

Answer: B

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13. What is the equilibrium expression for the reaction $P_{4(s)} + 5O_{2(g)} \Leftrightarrow P_4O_{10(s)}$?

A. $K_c = [O_2]^5$

B. $K_c = [P_4O_{10}] / [P_4][O_2]^5$

C. $K_c = [P_4O_{10}] / 4[P_4][O_2]$

D. $K_c = \frac{1}{([O_2]]^5}$

Answer: D

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14. 1M NaCI and 1M HCI are present in an aqueous solution. The solution is

A. not a buffer with $pH < 7$

B. not a buffer with $pH < 7$

C. a buffer with $pH < 7$

D. a buffer with $pH < 7$.

Answer: A

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15. Species acting as both Bronsted acid and base is:

A. $(HSO_4)^{2-}$

B. Na_2CO_3

C. $(NH_2)^{1-}$

D. $(OH)^{1-}$

Answer: A

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16. If the solubility of an aqueoues solution of $Mg(OH)_2$ be X mole litre, then K_{SP} of $Mg(OH)_2$ is:

A. $4x^3$

B. $108x^5$

C. $27x^4$

D. $9X.$

Answer: A

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17. Which of the following statements is not ture?

A. $pH + pOH = 14$ for all aqueous solutions.

B. The pH of $1 \times 10^{-8} MHCI$ solution is 8.a

C. 96500 C of electricity when passed through $CuSO_4$ solution deposits 1 gram equivalent of copper at the cathode.

D. The conjugate base of $H_2PO_4^-$ is HPO_4^{2-}

Answer: B

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18. The equilibrium constant for the given reaction:

$SO_{3(g)} \Leftrightarrow SO_{2(g)} + 1/2O_{2(g)}, \left(K_c = 4.9 \times 10^{-2}\right)$

The value of K_c for the reaction:

$2SO_{2(g)} + O_{2(g)} \Leftrightarrow 2SO_{3(g)}$, will be :

A. 416

B. 2.4×10^{-3}

C. 9.8×10^{-2}

D. 4.9×10^{-2}

Answer: A

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19. The pK_a of a weak acid (HA) is 4.5. The pOH of an aqueous buffered solution of HA in which $50\,\%$ of the acid is ionized is:

A. 7.0

B. 4.5

C. 2.5

D. 9.5

Answer: D

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20. The first and second dissociation constant of an acid H_2A are 1.0×10^{-5} and 5.0×10^{-10} repectively. The overall dissociation constant of the acid will be

A. 0.2×10^5

B. 5.0×10^{-5}

C. 5.0×10^{-15}

D. 5.0×10^{-15}

Answer: D

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21. The equilibrium constants K_{p1} and K_{p2} for the two equilibrium reactions are

$X \Leftrightarrow Y + Z$ and $A \Leftrightarrow 2B$

in the ratio 9 : 1. If the degree of dissociation of X and A be equal then the ratios of the total pressure at these equilibria will be :

A. $9:1$

B. $36:1$

C. $1:1$

D. $3:1$

Answer: B

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22. Solid $Ba(NO_3)$ is gradually dissolved in a $1.0 \times 10^{-4} M Na_2CO_3$ solution. At what concentrations of Ba^{2+}, will a precipitate begin to form?

(K_{SP} for $BaCO_3 = 5.1 \times 10^{-9}$)

A. $4.1 \times 10^{-5} M$

B. $5.1 \times 10^{-5} M$

C. $8.1 \times 10^{-8} M$

D. $8.1 \times 10^{-7} M$

Answer: B

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23. If $10^{-4} dm^3$ of water is introduced into a $1.0 dm^3$ flask to $300K$ how many moles of water are in the vapour phase when equilibrium is

established ? (Given vapour pressure of H_2O at $300K$ is $3170PaR = 8.314JK^{-1}mol^{-1}$) .

A. 1.27×10^{-3} mol

B. 5.56×11^{-3} mol

C. 1.53×10^{-2} mol

D. 4.46×10^{-2} mol

Answer: A

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24. Solubility product of silver bromide is 5.0×10^{-13}. The quantity of potassium bromide (molar mass taken as $120gmol^{-1}$) to be added to $1L$ of $0.05M$ solution of silver nitrate to start the precipitation of $AgBr$ is

A. $5.0 \times 10^{-8}g$

B. $1.2 \times 10^{-10}g$

C. $1.2 \times 10^{-9}g$

D. $6.2 \times 10^{-5} g$

Answer: C

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25. The pH of a 0.1 molar solution of the acid HQ is 3. The value of the ionisation constant, K_a of the acid is

A. 1×10^{-3}

B. 1×10^{-5}

C. 1×10^{-7}

D. 3×10^{-1}

Answer: B

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26. The equilibrium constant for the reaction

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

at temperature T is 4×10^{-4}.

The value of K_c for the reaction

$NO(g) \Leftrightarrow \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g)$

at the same temperature is

A. 2.5×10^2

B. 4×10^{-4}

C. 50.0

D. 0.02

Answer: C

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27. How many litres of water must be added to $1L$ of an aqueous solution of HCl with a pH of 1 to create an aqueous solution with pH of 2?

A. $9.0L$

B. $0.1l$

C. $0.9l$

D. $2.0L$

Answer: A

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28. For the reaction, $SO_2(g) + \frac{1}{2}O_2(g) \Leftrightarrow SO_3(g)$ if $K_p = K_C(RT)^x$ where, the symbols have usual meaning, then the value of x is (assuming ideality)

A. $= -1$

B. $-1/2$

C. $1/2$

D. 1

Answer: B

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

A. 3.84

B. 2.42

C. 4.44

D. 1.42

Answer: B

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30. In the reaction at constant volume

$C_{(s)} + CO_2(g) \Leftrightarrow 2CO_{(g)}$

argon gas is added which does not takes part in the reaction. Choose the correct statement.

A. the equilibrium constant is unchanged

B. The equilibrium shifts in the forward direction

C. The equilibrium shifts in the backward direction

D. The direction of equilibrium depends on the amount of argon added.

Answer: A

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31. The K_p value for the reaction.

$H_2 + I_2 \Leftrightarrow 2Hi$

at $460^\circ C$ is 49. If the initial pressure of H_2 and I_2 is 0.5 atm respectively , what will be the partial pressure of H_2 at equilibrium ?

A. 0.111 atm

B. 0.123 atm

C. 0.133 atm

D. 0.222 atm

Answer: A

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32. One mole of ammonia was completely absorbed in one litre solution each of $(1)1MHCI, (2)1MCH_3COOH$ and $(3)1MH_2SO_4$ at 298 K. The decreasing order for the pH of the resulting solution is

(Given , $K_b(NH_3) = 4.74$)

A. $2 > 3 > 1$

B. $1 > 2 > 3$

C. $2 > 1 > 3$

D. $3 > 2 > 1$

Answer: C

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33. The standard Gibbs energy change at $300K$ for the reaction $2A \Leftrightarrow B + C$ is 2494. $2J$. At a given time, the composition of the reaction mixture is $[A] = \frac{1}{2}, [B] = 2$ and $[C] = \frac{1}{2}$. The reaction proceeds in the

$(R = 8.314JK/\text{mole} = 2.718)$

A. forward direction because $Q < K_c$

B. reverse direction because $Q < K_c$

C. forward direction because $Q > K_c$

D. reverse direction because $Q > K_c$

Answer: D

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34. The ratio of volumes of CH_3COOH0.1 (N) to CH_3COONa 0.1 (N) required to prepare a buffer solution of pH 5.74 is

(given : pK_a of CH_3COOH is 4.74)

A. $10:1$

B. $5:1$

C. $1:5$

D. $1:10$

Answer: D

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35. Which of the following salts in aqueous solution has the lowest pH value?

A. $NaCIO$

B. $NaCIO_4$

C. $NaClO_3$

D. $NaClO_2$

Answer: B

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36. How many times a 0.1 M strong monobasic solution should be diluted so that the pH of the resulting solution is tripled ?

A. 50

B. 10

C. 25

D. 100

Answer: D

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37. Equilibrium constants K_1 and K_2 for the following equilibria

$NO(g) + 1/2O_2(g) \overset{K_1}{\Longleftrightarrow} NO_2(g)$ and 2NO_(2)(g) overset(K_(2)) (hArr)2NO(g)+O_(2)(g)`

are related as

A. $K_1 = \sqrt{K_2}$

B. $K_2 = \frac{1}{K_1}$

C. $K_1 = 2K_2$

D. $K_2 = \frac{1}{K_1^{-2}}$

Answer: D

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38. The equilibrium constant at $298K$ for a reaction, $A + B \Leftrightarrow C + D$ is 100. If the initial concentrations of all the four species were 1M each, then equilibirum concentration of D (in molL^{-1}) will be

A. 0.182

B. 0.818

C. 1.818

D. 1.182

Answer: C

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Comprehesion 1

1. Chemical equilibrium is attained in a reversible reaction carried in a close container and is of dynamic nature. The value of equilibrium constant may be expressed either as K_p and K_c and the two are related to each other as :

$K_p = K_c(RT)^{\Delta ng}$

Free energy change (ΔG) at equilibrium point is zero. The value of equilibrium constant gives the extent to which a particular reation has proceeded to attain the equilibrium . Its value gets reversed if the

reaction is reversed and becomes the square root of the initial value if the reaction is divided by 2.

A reaction attains equilibrium when the free energy change accompanying the reaction is :

A. Positive and large

B. Zero

C. Negative

D. Negative and small.

Answer: B

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Comprehesion 2

1. The equilibrium constant for the reversible reaction $N_2 + 3H_2 \Leftrightarrow 2NH_3$ is K and for the reaction $\frac{1}{2}N_2 + \frac{3}{2}H_2 \Leftrightarrow NH_3$, the equilibrium constant is K', . K and K' will be related as

A. $K = K$

B. $K = \sqrt{k}$

C. $K = \sqrt{K}$

D. $K \times K = 1$

Answer: B

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Comprehesion 3

1. Chemical equilibrium is attained in a reversible reaction carried in a close container and is of dynamic nature. The value of equilibrium constant may be expressed either as K_p and K_c and the two are related to each other as :

$K_p = K_c(RT)^{\Delta ng}$

Free energy change (ΔG) at equilibrium point is zero. The value of equilibrium constant gives the extent to which a particular reation has

proceeded to attain the equilibrium . Its value gets reversed if the reaction is reversed and becomes the square root of the initial value if the reaction is divided by 2.

For the reaction

$PCI_3(g) + CI_2(s) \Leftrightarrow PCI_5(g)$

The value of k_c at $250^\circ C$ is $\text{mol}^{-1}L^{-1}$. The value of k_p at the same temperature will be :

A. $0.61atm^{-1}$

B. $0.56atm^{-1}$

C. $0.83atm^{-1}$

D. $0.46atm^{-1}$

Answer: A

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Comprehesion 4

1. Chemical equilibrium is attained in a reversible reaction carried in a close container and is of dynamic nature. The value of equilibrium constant may be expressed either as K_p and K_c and the two are related to each other as :

$K_p = K_c(RT)^{\Delta ng}$

Free energy change (ΔG) at equilibrium point is zero. The value of equilibrium constant gives the extent to which a particular reation has proceeded to attain the equilibrium . Its value gets reversed if the reaction is reversed and becomes the square root of the initial value if the reaction is divided by 2.

when the two reactants A and B are mixed to give products C and D , the reaction quotient Q at initial stage of the reaction:

A. is zero

B. decreases with time

C. is independent of time

D. increases with time

Answer: D

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Comprehesion 5

1. For the chemical reaction

$3X(g) + Y(g) \Leftrightarrow X_3Y(g)$,

the amount of X_3Y at equilibrium is affected by

A. temperature and pressure

B. pressure only

C. temperature only

D. temperature pressure and catalyst.

Answer: A

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Comprehesion 6

1. Temperature pressure and molar concentration are the three factors which can disturb the equilibrium in a reversible reaction. Their effect is governed by Le Chatelier's principle . Whereas high concentration of the reactants always favours the formation of the products irrespective of its nature the effect of temperature and pressure depends upon the nature of the reaction . pressure does not disturb the equilibrium point in a reaction in which the reactants and products have same number of moles in the gaseous state.

For a reaction

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

at a given temperature the equilibrium amount of CO_2

(g) can be increased by

A. adding a catalyst

B. adding and inert gas

C. decreasing the volume of the container

D. increasing the amount of CO (g).

Answer: D

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Comprehesion 7

1. Temperature pressure and molar concentration are the three factors which can disturb the equilibrium in a reversible reaction. Their effect is governed by Le Chatelier's principle . Whereas high concentration of the reactants always favours the formation of the products irrespective of its nature the effect of temperature and pressure depends upon the nature of the reaction . pressure does not disturb the equilibrium point in a reaction in which the reactants and products have same number of moles in the gaseous state.

In a closed system

$A(s) \Leftrightarrow 2B(g) + 3C(g)$

if partical pressure of C is doubled then partial pressure of B will be :

A. $2\sqrt{2}$ times the original value

B. $\frac{1}{2}$ times the original value

C. 2 times of the original value

D. $\frac{1}{2\sqrt{2}}$ times the original value.

Answer: D

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Comprehesion 8

1. The strength of elctrolytes is expressed in terms of degree of dissociation α For strong electrolyte α is close to one and for weak electrolytes α is quite small. According to Ostwald Dilution Law $\alpha = \sqrt{\frac{K}{C}}$

For an acid $\left[H^+\right] = \sqrt{K_a C}$

For a base $\left[OH^-\right] = \sqrt{K_b C}$

The relative strengths of acids or bases can be compared in terms of the

square roots of their K_a or K_b values.

The dissociation constant of monobasic acids A,B and C are $10^{-4}, 10^{-6}$ and 10^{-10} respectively. The concentration of each is 0.1 M . Which is correct order or their pH values ?

A. $A < B < C$

B. $C < A < B$

C. $B < C < A$

D. $B < A \approx C$

Answer: A

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Comprehesion 9

1. The strength of elctrolytes is expressed in terms of degree of dissociation α For strong electrolyte α is close to one and for weak electrolytes α is quite small. According to Ostwald Dilution Law

$\alpha = \sqrt{\frac{K}{C}}$

For an acid $\left[H^+\right] = \sqrt{K_a C}$

For a base $\left[OH^-\right] = \sqrt{K_b C}$

The relative strengths of acids or bases can be compared in terms of the square roots of their K_a or K_b values.

A monoprotic acid in 0.1 M solution ionises to 0.001 % . Its ionisation constant is :

A. 1.0×11^{-3}

B. 1.0×10^{-6}

C. 1.0×10^{-8}

D. 1.0×10^{-11}

Answer: D

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Comprehesion 10

1. The strength of elctrolytes is expressed in terms of degree of dissociation α For strong electrolyte α is close to one and for weak electrolytes α is quite small. According to Ostwald Dilution Law $\alpha = \sqrt{\frac{K}{C}}$

For an acid $\left[H^{+}\right] = \sqrt{K_a C}$

For a base $\left[OH^{-}\right] = \sqrt{K_b C}$

The relative strengths of acids or bases can be compared in terms of the square roots of their K_a or K_b values.

At infinite dilution , the percentage ionisation of both strong and weak electrolytes is :

A. $1\ \%$

B. $20\ \%$

C. $50\ \%$

D. $100\ \%$

Answer: D

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Comprehesion 11

1. Thermal decomposition of gaseous X_2 to gaseous X at $298K$ takes place according to the following equation:

$X(g) \Leftrightarrow 2X(g)$

The standard reaction Gibbs energy $\Delta_r G^\circ$, of this reaction is positive. At the start of the reaction, there is one mole of X_2 and no X. As the reaction proceeds, the number of moles of X formed is given by β. Thus $\beta_{\text{equilibrium}}$ is the number of moles of X formed at equilibrium. The reaction is carried out at a constant total pressure of 2 bar. Consider the gases to behave ideally.

[Given, $R = 0.083L$ bar $K^{-1}mol^{-1}$)

The equilibrium constant K_p for this reaction at $298K$, in terms of $\beta_{\text{equilibrium}}$ is

A. $\dfrac{8\beta^2_{\text{equilibrium}}}{2-\beta_{\text{equilibrium}}}$

B. $\dfrac{8\beta^2_{\text{equilibrium}}}{4-\beta^2_{\text{equilibrium}}}$

C. $\dfrac{4\beta^2_{\text{equilibrium}}}{2-\beta_{\text{equilibrium}}}$

D. $\frac{4\beta_{\text{equilibrium}}^2}{4-\beta_{\text{equilibrium}}^2}$

Answer: B

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Comprehesion 12

1. Thermal decomposition of gaseous X_2 to gaseous X at 298 K takes place according to following equation

$X_2(g) \Leftrightarrow 2X(g)$

The standard reaction Gibbs energy $\Delta_r G^\circ$ of this reaction is positive . At the start of the reaction there is one mole of X_2 and no. X. As the reaction proceeds the number of moles of X formed is given by β. Thus $\beta_{\text{equilibrium}}$ is the the number of moles of X formed at equilibrium . The reaction is carried out a constant total pressure of 2 bar. Consider the gases to behave ideally.

$\left(\text{Given}: R = 0.083 L \text{ bar } K^{-1} \text{ mol}^{-1}\right)$

The incorrect statement among the following for this reaction is

A. Decrease in the total pressure will result in formation of more moles of gaseous X

B. At the start of the reaction , dissocition of gaseous X_2 takes place spontaneously

C. $\beta_{\text{equilibrium}} = 0.7$

D. $K_c < 7$

Answer: C

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Straight Objective Type MCQs

1. The pK_a of acteylsalicylic acid (aspirin) is 3.5. The pH of gastric juice in human stomach is about $2 - 3$ and the pH in the small intestine is about 8. Aspirin will be:

A. Unionised in the small intestine and in the stomach .

B. Completely ionised in the small intestine and in the stomach.

C. Ionised in the stomach and almost unionised in the small intestine.

D. Ionised in the small intestine and almost unionised in the equilibrium

Answer: D

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2. The equilibrium

$SO_2CI_2(g) \Leftrightarrow SO_2(g) + CI_2(g)$

is attained at $25^\circ C$ in a closed container and inert gas helium is introduced. Which of the following statement (s) is / are correct ?

(1).concentrations of SO_2, CI_2 and SO_2CI_2 change

(2). More chlorine is formed

(3).Concentration of SO_2 is reduced

(4).More SO_2CI_2 is formed

A. $1, 2, 3$

B. $2, 3, 4$

C. $3, 4$

D. None

Answer: D

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3. Amongest the following hydroxides, the one which has the lowest value of K sp at ordinary temperature is:

A. $Mg(OH)_2$

B. $Ca(OH)_2$

C. $Ba(OH)_2$

D. $Be(OH)_2$

Answer: D

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4. In a reaction $A_2(g) + 4B_2(g) \Leftrightarrow 2AB_4(g), \Delta H < 0$. The formation of AB_4 is not favoured by

A. low temperature and high pressure

B. high temperature nad low pressure

C. low temperature and low pressrue

D. high temperature and high pressrue

Answer: A

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5. The compound whose $0.1M$ solution is basic is

A. Ammonium acetate

B. Ammonium chloride

C. Ammonium Sulphate

D. Sodium acetate.

Answer: D

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6. For which of the following reaction $K_p = K_c$?

A. $NOCI(g) \Leftrightarrow 2NO(g) + CI_2(g)$

B. $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$

C. $H_2(g) + CI_2(g) \Leftrightarrow 2HCI(g)$

D. $PCI_3(g) + CI_2(g) \Leftrightarrow PCI_5(g)$

Answer: C

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7. The pH of the neutralisation point of 0.1 N ammonium hydroxide with 0.1 NHCI is

A. 1

B. 6

C. 7

D. 9

Answer: B

Watch Video Solution

8. For the reaction

$$PCI_5(g) \Leftrightarrow PCI_3(g) + CI_2(g)$$

The forward reaction at constant temperature is favoured by

(1).introducing an inert gas at constant volume

(2).introducing chloride gas at constant volume

(3).introduding as inert gas at constant pressure

(4). increasing the volume of the contianer

(5). Introducing PCI_5 at constant volume.

A. $1, 2$

B. $4, 5$

C. $2, 3, 4$

D. $3, 4, 5$

Answer: B

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9. The following equilibrium is established when hydrogen chloride is dissolved in acetic acid

$$HCl(aq) + CH_3COOH(aq) \Leftrightarrow Cl^-(aq) + CH_3COOH_2^+(aq)$$

The set that characterises the conjugate acid-base pairs is :

A. (HCI, CH_3COOH) and $\left(CH_3COOH_2^+, CI^-\right)$

B. $\left(HCI, CH_3COOH_2^+\right)$ and $HCI, \underset{\text{and } (CH_3COOH, CI^-)}{\left(CH_3COOH_2^+\right)}$

C. $\left(CH_3COOH_2^+, HCI\right)$ and $\left(CI^-CH_3COOH\right)$

D. $\left(HCI, CI^-\right)$ and $\left(CH_3COOH_2^+, CH_3COOH\right)$

Answer: D

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10. Which of the following solutions will have pH close to 1.0 ?

A. 100 ml of $(M/10)$ HCI + 100 ml of $(M/10)$ NaOH

B. 55 ml of $(M/10)$ HCI+ 45 ml of $(M/10)$ NaOh

C. 10ml of $(M/10)$ HCI + 90 ml of $(M/10)$ NaON

D. 75 ml of $(M/10)$ HCI + 25 ml of $(M/5)$ NaOH

Answer: D

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11. An equilibrium mixture for the reaction

$2H_2S(g) \Leftrightarrow 2H_2(g) + S_2(g)$

had 1 mole of H_2S, 0.2 mole of H_2 and 0.8 mole of S_2 in a 2 litre flask. The value of K_c in mol L^{-1} is

A. 0.004

B. 0.08

C. 0.016

D. 0.16

Answer: C

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12. The decreasing order of strength of the bases, OH^-, NH_2^-, $H-C\equiv C^-$ and $CH_3-CH_2^-$:

A. $CH_3-CH_2^- > NH_2^- > H-C\equiv C^- > OH^-$

B. $H - C \equiv C^- > CH_3 - CH_2^- > NH_2^- > OH^-$

C. $OH^- > NH_2^- > H - C \equiv C^- > CH_3 - CH_2^-$

D. $NH_2^- > H - C \equiv C^- > OH^- > CH_3 - CH_2^-$

Answer: B

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13. Fear or exitement, generally cause one to breathe rapidaly and it results in the decrease of concentration of CO_2 in blood. In what way it will change pH of blood ?

A. pH will increase

B. pH will decrease

C. No change

D. No change pH will adust to 7.

Answer: C

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14. The pK_a of HCN is 9.30. The pH of a solutin prepared by mixing 2.5 moles of KCN and 2.5 moles of HCN in water and making up the total volume to $500mL$ is

A. 9.30

B. 7.30

C. 10.30

D. 8.30

Answer: A

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15. In what manner will the increase of pressure affect the following equation ? $C(s) + H_2O(g) \Leftrightarrow CO(g) + H_2(g)$

A. Shift in the forward direction

B. Shift in the reverse direction

C. increase in the yield of hydrogen

D. No effect

Answer: B

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16. One "mole" of $N_2O_4(g)$ at $300K$ is kept in a closed container under 1 atm. It is heated to $600K$, when $20\,\%$ by mass of $N_2O_4(g)$ decomposes to $NO_2(g)$. The resultant pressure is

A. $1.2atm$

B. 2.4atm

C. 2.0 atm

D. 1.0 atm

Answer: B

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17. If pK_b for fluoride ion at $25^\circ C$ is 10.83 the ionisation constant of hydrofluoric acid at this temperature is

A. 1.74×10^{-5}

B. 3.52×10^{-3}

C. 6.75×10^{-4}

D. 5.38×10^{-2}

Answer: C

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18. the solubility of A_2B_3 is y mol dm^{-3}. Its solubility product is

A. $6y^4$

B. $64y^4$

C. $36Y^5$

D. $108y^5$

Answer: D

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19. For the reaction

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

at a given temperature the equilibrium amount of CO_2

(g) can be increased by

A. adding a suitable catalyst

B. adding an inert gas

C. decreasing the volume of the container

D. increasing the amount of CO (g)

Answer: D

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20. Which of the following statement (s) is (are) correct ?

(1) . The pH of 1.0×10^{-8} M solution of HCI is 8

(2). The conjugate base of $H_2PO_4^-$ is HPO_4^{2-}

(3). Autoprotolysis constant of water increases with temperature

(4). When a solution of a weak monoprotic acid is titrated against a strong base at half neutralization point pH $= (1/2)pK_a$

A. $2, 3$

B. $1, 2, 3$

C. $3, 4$

D. $2, 3, 4$

Answer: A

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21. For the chemical reaction

$3X(g) + Y(g) \Leftrightarrow X_3Y(g),$

the amount of X_3Y at equilibrium is affected by

A. temperature and pressure

B. temperature only

C. pressure only

D. temperature pressure and catalyst.

Answer: A

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22. The pH 0.1 M solution the following salts increases in the order.

A. $NaCI < NH_4CI < NaCN < HCI$

B. $HCI < NH_4CI < NaCI < NaCN$

C. $NaCN < NH_4CI < NaCI < HCI$

D. $HCI < NaCI < NaCN < NH_4CI$

Answer: B

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23. A buffer solution can be prepared from a mixture of

(1).Sodium acetate and acetic acid in water

(2).Sodium acetate and hydrochloric acid in water

(3).ammonia and ammonium chloride in water

(4). Ammonia and sodium hydroxide in water.

The correct answer is :

A. $1, 3, 4$

B. $2, 3, 4$

C. $1, 2, 4$

D. $1, 3$

Answer: D

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24. For the reversible reaction

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$

at $500^\circ C$, the value of K_p is 1.44×10^{-5} when the partial pressure is measured in atmosphere. The corresponding value of K_c with concentration in mol L^{-1} is

A. $1, 44 \times 10^{-5} / (0.082 \times 500)^{-2}$

B. $1.44 \times 10^{-5} / (8.314 \times 773)^{-2}$

C. $1.44 \times 10^{-5} / (0.082 \times 773)^{2}$

D. $1.44 \times 10^{-5} / (0.082 \times 773)^{-2}$

Answer: D

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25. When two reactants A and B are mixed to give products, C and D, the reaction quotient (Q) at the initial stages of the reaction

A. is zero

B. decreases with time

C. is independent of time

D. increases with time

Answer: D

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26. At constant temperature, the equilibrium constant (K_p) for the decomposition reaction

$N_2O_4 \Leftrightarrow 2NO_2$

is expressed by $K_p = 4x^2p/\left(1-x^2\right)$, where p=pressure x= extent of decomposition. Which of the following statements is true?

A. K_p increases with increase of P

B. K_p increases with increase of x

C. K_p increases with decreases of x

D. K_p remains constant with change in P and X.

Answer: D

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27. Consider the following equilibrium in a closed container

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

At a fixed temperature, the volume of the reaction container is halved. For this change, which of the following statement holds true regarding the equilibrium constant (K_p) and the degree of dissociation (α)?

A. Neither K_p nor α changes

B. Both K_p and α change

C. K_p changes but α does not change

D. K_p does not change order of solubility of :

Answer: D

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28. Identify the correct order of solubility of Na_2S, CuS and ZnS in aqueous solution

A. $CuS > ZnS > Na_2S$

B. $ZnS > Na_2S > CuS$

C. $Na_2S > CuS > ZnS$

D. $Na_2S > ZnS > CuS$

Answer: D

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29. A weak acid HX has $K_a = 1 \times 10^{-5} M$. If forms a salt NaX on reaction with alkali. The perentage degree of dissociation of 0.1 M solution of NaX

is

A. 1.0E-5

B. 0.01

C. 0.1

D. 0.15

Answer: B

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30. 0.1 mole of $CH_3NH_2\left(K_b = 5 \times 10^{-4}\right)$ is mixed with 0.08 mole of HCl and diluted to one litre. The $\left[H^+\right]$ in solution is

A. 8×10^{-2}

B. 2×10^{11}

C. 1.23×10^{-4}

D. 8×10^{-11}

Answer: D

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31. The solubility product constant (K_{sp}) of salts of types MX, MX_2, and M_3X at temperature T are 4.0×10^{-8}, 3.2×10^{-14}, and 2.7×10^{-15}, respectively. The solubilities of the salts at temperature T are in the order

A. $MX > MX_2 > M_3X$

B. $M_3X > MX_2 > MX$

C. $MX_2 > M_2X > MX$

D. $MX > M_3X > MX_2$

Answer: D

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32. Aqueous solutions of HNO_3, KOH, CH_3COOH,and CH_3COONa of identical concentrations are provided. The pair (s) of solution which form a buffer upon mixing is// are

A. HNO_3 and CH_3COOH

B. KHO and CH_3COONa

C. HNO_3 and CH_3COONa

D. CH_3COOH and CH_3COONa

Answer: D

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33. Upon treatment with ammonical H_2s, the metal ion that precipitates as a sulfide is

A. $Fe(III)$

B. $AI(III)$

C. $Mg(II)$

D. $Zn(II)$

Answer: D

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34. The K_{sp} of Ag_2CrO_4 is 1.1×10^{-12} at $298K$. The solubility (in mol/L) of Ag_2CrO_4 in a $0.1MAgNO_3$ solution is

A. 1.1×10^{-11}

B. 1.1×10^{-10}

C. 1.1×10^{-12}

D. 1.1×10^{-9}

Answer: B

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Multiple correct answer type mcqs

1. For the gas phase reaction

$C_2H_4 + H_2 \Leftrightarrow C_2H_6(\Delta H = -32.7\text{kcal})$

carried out in a vessel, the equilibrium concentration of C_2H_4 can be increased by

A. increasing the temperature

B. decreasing the pressure

C. removing some hydrogen (H_2)

D. adding some ethane (C_2H_6)

Answer: A::B::C::D

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2. Which of the following will favour the formation of NH_3 by Haber's process?

A. increases of temperature

B. increase of pressure

C. Addition of catalyst

D. Addition of promoter.

Answer: B::C::D

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3. Which of the following will not affect the value of equilibrium constant of a reaction?

A. Change in concentration of reactants

B. Change in temperature

C. Change in pressure

D. Addition of catalyst.

Answer: A::C::D

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4. The equilibrium

$SO_2CI_2(g) \Leftrightarrow SO_2(g) + CI_2(g)$

is attained at $25^\circ C$ in a closed container and inert gas helium is introduced. Which of the following statement (s) is / are correct ?

(1).concentrations of SO_2, CI_2 and SO_2CI_2 change

(2). More chlorine is formed

(3).Concentration of SO_2 is reduced

(4).More SO_2CI_2 is formed

A. Concentration of SO_2, CI_2 and SO_2CI_2 change

B. more of chlorine is formed

C. Concentration of SO_2 is reduced

D. More of SO_2CI_2 is formed.

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5. A buffer solution can be prepared from a mixture of

A. sodium acetate and acetic acid in water

B. sodium acetate and HCI in water

C. ammonia and ammonia chloride in water

D. ammonia and sodium hydroxide in water.

Answer: A::C

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6. When two reactants A and B are mixed to give products, C and D, the reaction quotient (Q) at the initial stages of the reaction

A. at initial state of reaction is zero

B. decreas with time

C. is independent of time

D. increases with time

Answer: A::D

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7. The thermal dissociation of equilibrium of $CaCo_3(s)$ is studied under different conditions

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

For this equilibrium, the correct statement (s) is/are

A. ΔH is dependent on T

B. K is independent of the initial amount of $CaCO_3$

C. K is dependent on the pressure of CO_2 at a given T

D. ΔH is independent of the catalyst if any.

Answer: A::B::D

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Iv.Assertion -Reason type question

1. Assertion : A catalyst does no alter the equilibrium constant of a reaction.

Reason : The catalyst forms a complex with the reactant and provides an alternate path with lowe energy of in activation for the reaction. The forward and reverse reaction are affected to the same extent.

A. if both assertion and reason are correct and reason is correct explanation for assertion.

B. if both assertion and reason are correct but reason is not correct explanation for assertion.

C. if assertion is correct but reason is incorrect.

D. if assertion and reason boht are incorrect.

Answer: A

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2. In the Haber process $N_2 + 3H_2 \Leftrightarrow 2NH_3$ pressure is about 200 atm in pressure of catalyst and temperature is kept $500^\circ C$ even though the reaction is exothermic.

Reason : Energy needed for this reaction is easily obtained at this temperature.

A. if both assertion and reason are correct and reason is correct explanation for assertion.

B. if both assertion and reason are correct but reason is not correct explanation for assertion.

C. if assertion is correct but reason is incorrect.

D. if assertion and reason boht are incorrect.

Answer: B

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3. Assertion : concentration of the reactant and product does not change with time at equilibrium for a a chemical reaction.

Reason : The rate of a reaction is zero at equilibrium .

A. if both assertion and reason are correct and reason is correct explanation for assertion.

B. if both assertion and reason are correct but reason is not correct explanation for assertion.

C. if assertion is correct but reason is incorrect.

D. if assertion and reason boht are incorrect.

Answer: A

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4. Assertion : The reaction $2NO(g) + O_2(g) \Leftrightarrow 2NO_2(g)$ is favoured in the forward direction with increase of pressure.

Reason : The reaction is exothermic.

A. if both assertion and reason are correct and reason is correct explanation for assertion.

B. if both assertion and reason are correct but reason is not correct explanation for assertion.

C. if assertion is correct but reason is incorrect.

D. if assertion and reason boht are incorrect.

Answer: B

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5. Assertion : Haber's synthesis of NH_3 is carried out in the presence of a catalyst.

Reason: the catalyst shifts the position of the equilibrium of the reaction $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$ to the product side.

A. if both assertion and reason are correct and reason is correct explanation for assertion.

B. if both assertion and reason are correct but reason is not correct explanation for assertion.

C. if assertion is correct but reason is incorrect.

D. if assertion and reason boht are incorrect.

Answer: C

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6. Assertion : When $CaCO_3(s)$ is heated the loss of $CO_2(g)$ from the system causes the reaction to go almost to completion to leava a residue of $CaO(s)$

Reason : Heating causes gas particles to move with more energy.

A. if both assertion and reason are correct and reason is correct explanation for assertion.

B. if both assertion and reason are correct but reason is not correct explanation for assertion.

C. if assertion is correct but reason is incorrect.

D. if assertion and reason boht are incorrect.

Answer: B

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7. Assertion : Acetic acid is a weak acid.

Reason : It has weak conjugate base.

A. if both assertion and reason are correct and reason is correct explanation for assertion.

B. if both assertion and reason are correct but reason is not correct explanation for assertion.

C. if assertion is correct but reason is incorrect.

D. if assertion and reason boht are incorrect.

Answer: C

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8. Assertion (A): pH of water increases with an increase in temperature.

Reason (R) : K_w or water increases with increase in temperature.

A. if both assertion and reason are correct and reason is correct explanation for assertion.

B. if both assertion and reason are correct but reason is not correct explanation for assertion.

C. if assertion is correct but reason is incorrect.

D. if assertion and reason boht are incorrect.

Answer: A

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9. Assertion (A): pH of HCI solution is less than that of acetic acid of the some concentartion.

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

A. if both assertion and reason are correct and reason is correct explanation for assertion.

B. if both assertion and reason are correct but reason is not correct explanation for assertion.

C. if assertion is correct but reason is incorrect.

D. if assertion and reason boht are incorrect.

Answer: C

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10. Assertion : For the reaction : $A(g) + B(g) \Leftrightarrow C(g) + D(g)$ at a given temperature , there will be no effect of the addition inert gas at constant pressure or at constant volume.

Reason : For the reaction $\Delta^n = 0$. Therefore there is no effect of addition of inert gas either at constant volume or at constant pressure.

A. if both assertion and reason are correct and reason is correct explanation for assertion.

B. if both assertion and reason are correct but reason is not correct explanation for assertion.

C. if assertion is correct but reason is incorrect.

D. if assertion and reason boht are incorrect.

Answer: A

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11. Assertion : For the physical equilibrium , Ice $\Leftrightarrow$ wate

On increasing temperature and increasing pressure more of water will form.

Reason : Since the forward reaction is endothermic in nature and the volume of water is lesser than the volume of ice.

A. if both assertion and reason are correct and reason is correct explanation for assertion.

B. if both assertion and reason are correct but reason is not correct explanation for assertion.

C. if assertion is correct but reason is incorrect.

D. if assertion and reason boht are incorrect.

Answer: A

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Reason type questions

1. Statement -1 HCO_3^- ion can act as a strong base.

Statement -2 CO_3^{2-} ion can act as a weak base.

A. Statements -1 is true , statement -2 is also true, statement -2 is the correct explanation of statement -1

B. Statement -1 is true , statement-2 is also true, statement-2 is not the correct explanation of statement-1

C. Statement -1 is true, statement -2 is false.

D. Statement -1 is false, satement-2 is true.

Answer: B

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2. Statement-1 An aqueous solution of CH_3COONH_4 can act as buffer.

Statement -2 An aqueous solution of pure salt can act as buffer.

A. Statements -1 is true , statement -2 is also true, statement -2 is the correct explanation of statement -2

B. Statement -1 is true , statement-2 is also true, statement-2 is not the correct explanation of statement-2

C. Statement -1 is true, statement -2 is false.

D. Statement -1 is false, satement-2 is true.

Answer: C

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3. Statement -1 Soda water becomes flat if kept open.

Statement -2 the amount of dissolved carbon dioxide decrease with increase in pressure.

A. Statements -1 is true , statement -2 is also true, statement -2 is the correct explanation of statement -3

B. Statement -1 is true , statement-2 is also true, statement-2 is not the correct explanation of statement-3

C. Statement -1 is true, statement -2 is false.

D. Statement -1 is false, satement-2 is true.

Answer: A

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4. Statement -1 Reaction between iron and steam is irreversible if carried in an open container.

Statement -2 An irreversible reaction cannot proceed in the reverse direction.

A. Statements -1 is true , statement -2 is also true, statement -2 is the correct explanation of statement -4

B. Statement -1 is true , statement-2 is also true, statement-2 is not the correct explanation of statement-4

C. Statement -1 is true, statement -2 is false.

D. Statement -1 is false, satement-2 is true.

Answer: B

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5. Assertion: Addition of silver ions to a mixture of aqueous sodium chloride and sodium bromide solution will first precipitate $AgBr$ rather than $AgCl$.

Reason : K_{sp} of $AgCl < K_{sp}$ of $AgBr$.

A. Statements -1 is true , statement -2 is also true, statement -2 is the correct explanation of statement -5

B. Statement -1 is true , statement-2 is also true, statement-2 is not the correct explanation of statement-5

C. Statement -1 is true, statement -2 is false.

D. Statement -1 is false, satement-2 is true.

Answer: C

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6. Asseration : In the dissociation of PCI_5 at constant pressure and temperature addition of helium at equilibrium increases the dissociation of PCI_5.

Reason : Helium removes CI_2 from the field of action.

A. Statements -1 is true , statement -2 is also true, statement -2 is the correct explanation of statement -6

B. Statement -1 is true , statement-2 is also true, statement-2 is not the correct explanation of statement-6

C. Statement -1 is true, statement -2 is false.

D. Statement -1 is false, satement-2 is true.

Answer: C

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Matrix - Match Type Questions

	Column I	Column II
1.	$(A) CH_3COONa$	(i) Almost neutral $pH > 7$ or < 7
	$(B) NH_4CI$	(ii) Acidic $pH < 7$
	$(C) NaNO_3$	(iii) Alkaline $pH > 7$
	$(D) CH_3COONH_4$	(iv) Neutral $pH = 7$

A. $(A) \rightarrow (iii), (B) \rightarrow (ii), (C) \rightarrow (iv), (D) \rightarrow (i)$

B. $(A) \rightarrow (ii), (B) \rightarrow (iv), (C) \rightarrow (i), (D) \rightarrow (iii)$

C. $(A) \rightarrow (i), (B) \rightarrow (iii), (C) \rightarrow (ii), (D) \rightarrow (iv)$

D. $(A) \rightarrow (iv), (B) \rightarrow (i), (C) \rightarrow (iii)(D) \rightarrow (ii)$

Answer: A

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	Column I	Column II
2.	$(A)Fe(OH)_3$	$(i)K_{sp} = s^2$
	$(B)Ag_2CrO_4$	$(ii)K_{sp} = 27s^4$
	$(C)CH_3COOAg$	$(iii)K_{sp} = 108s^5$
	$(D)Ca_3(PO_4)_2$	$(iv)K_{sp} = 4s^3$

A. $(A) \to (III), (B) \to (ii), (C) \to (iii), (D) \to (i)$

B. $(A) \to (ii), (B) \to (iv), (C) \to (i), (D) \to (iii)$

C. $(A) \to (i), (B) \to (iii), (C) \to (ii), (D) \to (iv)$

D. $(A) \to (iv), (B) \to (i), (C) \to (iii), (D) \to (ii)$

Answer: B

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