CHEMISTRY

BOOKS - DISHA PUBLICATION CHEMISTRY (HINGLISH)

EQUILIBRIUM

Jee Main 5 Years At A Glance

1. The gas phase reaction $2NO_2(g) \rightarrow N_2O_4(g)$ is an exothermic reaction. The decomposition of N_2O_4 in equilibrium mixture of $NO_2(g)$ and N_2O_4 can be increased by :

A. addition of an inert gas at constant pressure

B. lowering the temperature

C. increasing the pressure

D. addition of an inert gas at constant volume

Answer: C

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2. Which of the following salts is the most basic in aqueous solution?

A. $Al(CN)_3$

B. CH_3COOK

C. $FeCl_3$

D. $Pb(CH_3COO)_2$

Answer: B

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3. An aqueous solution contains $0.10M H_2S$ and 0.20 M HCl. If the equilibrium constants for the formation of HS^- from H_2S is 1.0×10^{-7}

and that of S^{2-} from HS^- ions is 1.2×10^{-13} then the concentration of S^{2-} ions in aqueous solution is

A. 5×10^{-8}

B. 3×10^{-20}

C. 6×10^{-21}

D. 5×10^{-19}

Answer: B

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4. An aqueous solution contains an unknown concentration of Ba^{2+}. When 50 mL of a 1 M solution of Na_2SO_4 is added, $BaSO_4$just begins to precipitate. The final volume is 500 mL. The solubility product of $BaSO_4$ is 1×10^{-10}. What is the original concentration of Ba^{2+}?

A. $5 \times 10^{-9} M$

B. $2 \times 10^{-9} M$

C. $1.1 \times 10^{-9} M$

D. $1.0 \times 10^{-10} M$

Answer: C

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5. Addition of sodium hydroxide solution to a weak acid (HA) results in a buffer of pH 6. If ionisation constant of HA is 10^{-5}, the ratio of salt to acid concentration in the buffer solution will be :

A. $4:5$

B. $1:10$

C. $10:1$

D. $5:4$

Answer: C

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6. 50 mL of 0.2M ammonia solution is treated with 25 mL of 0.2 M HCl. If pK_b of ammonia solution is 4.75 the pH of the mixture will be :

A. 3.75

B. 4.75

C. 8.25

D. 9.25

Answer: D

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7. pK_a of a weak acid (HA) and pB_b of a weak base (BOH) are 3.2 and 3.4 respectively. The pH of their salt (AB) solution is

A. 7.2

B. 6.9

C. 7.0

D. 1.0

Answer: B

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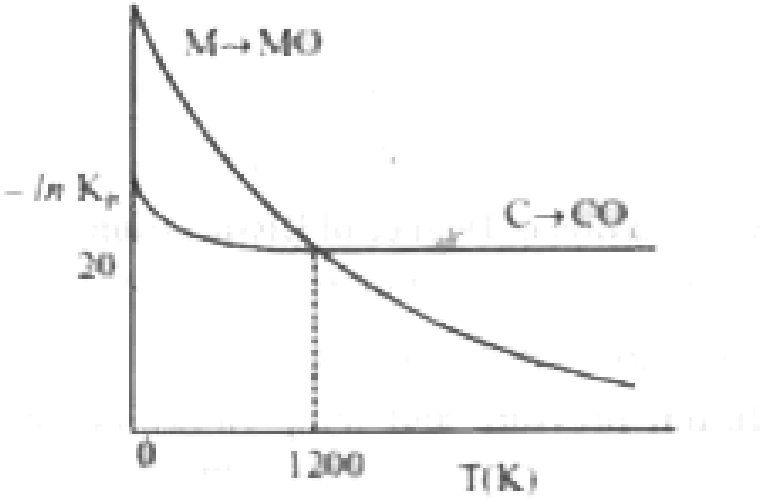
8. The plot shows the variation of $-InK_p$ versus temperature for the two reactions.

$M(s) + \frac{1}{2}O_2(g) \rightarrow MO(s)$ and $C(s) + \frac{1}{2}O_2(g) \rightarrow CO(s)$



Identify the correct statement :

A. At $T < 1200K$, oxidation of carbon is unfavourable.

B. Oxidation of carbon is favourable at all temperatures.

C. At $T > 1200K$, the reaction $MO(s) + C(s) \rightarrow M(s) + CO(g)$ is spontaneous.

D. At $T > 1200K$, carbon will reduce MO(s) to M(s).

Answer: C

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9. For the reaction,

$A(g) + B(g) \rightarrow C(g) + D(g)$, ΔH° and ΔS°

are respectively,

$-29.8kJmol^{-1}$ and $-0.100kJK^{-1}mol^{-1}$ at 298 K

The equilibrium constant for the reaction at 298 K is :

A. 1.0×10^{-10}

B. 10

C. 1

D. 1.0×10^{10}

Answer: C

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10. 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. 1.818

B. 1.182

C. 0.182

D. 0.818

Answer: A

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11. Gaseous N_2O_4 dissociates into gaseous NO_2 according to the reaction :

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

At 300 K and 1 atm pressure, the degree of dissociation of N_2O_4 is 0.2. If one mole of N_2O_4 gas is contained in a vessel, then the density of the equilibrium mixture is :

A. 1.56 g/L

B. 6.22 g/L

C. 3.11 g/L

D. 4.56 g/L

Answer: C

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12. 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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13. At certain temperature $50\,\%$ of HI is dissociated into H_2 and I_2 the equilibrium constant is

A. 1.0

B. 3.0

C. 0.5

D. 0.25

Answer: A

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14. 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. $-\frac{1}{2}$

C. $\frac{1}{2}$

D. 1

Answer: B

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Exercise 1 Concept Builder Topicwise Topic 1 Law Of Mass Action Equilibrium Constant Kc And Kp And Its Applications

1. A cylinder fitted with a movable piston contains liquid water in equilibrium with water vapour at $25^{\circ}C$. Which of the following operation results in a decrease in the equilibrium vapour pressure at 25° C?

A. Moving the piston downward a short distance

B. Removing a small amount of vapour

C. Removing a small amount of the liquid water

D. Dissolving salt in the water

Answer: D

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2. In line kilns, the following reaction,

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

proceeds to completion because of

A. of the high temperature.

B. CaO is more stable than $CaCO_3$

C. CaO is not dissociated.

D. CO_2 escapes continuously.

Answer: D

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3. Which of the following conditions represents an equilibrium?

A. Freezing of ice in an open vessel, temperature of ice is constant.

B. Few drops of water is present along with air in a balloon, temperature of balloon is constant.

C. Water is boiling in an open vessel over stove, temperature of water is constant.

D. All the statements (a), (b) and (c) are correct for the equilibrium.

Answer: B

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4. Which of the following statement(s) is/are correct regarding chemical equilibrium?

(i) Equilibrium is maintained rapidly.

(ii) The concentration of reactants and products become same at equilibrium.

(iii) The concentration of reactants and products are constant but different.

(iv) Both forward and backward reactions occur at all times with same speed.

A. (i) and (iii)

B. (i), (ii) and (iii)

C. (iii) and (iv)

D. (i), (iii) and (iv)

Answer: C

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5. At the triple point of water there exists an equilibrium between

A. ice and water

B. ice and vapours

C. ice, water and vapours

D. none of the above.

Answer: C

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6. 2mole of PCl_5 were heated in a closed vessel of $2litre$ capacity. At equilibrium $40\,\%$ of PCl_5 dissociated into PCl_3 and Cl_2. The value of the equilibrium constant is:

A. 0.53

B. 0.267

C. 2.63

D. 5.3

Answer: B

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7. For the following reaction in gaseous phase $CO(g) + \frac{1}{2}O_2 \rightarrow CO_2 \frac{K_P}{K_c}$ is

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

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

C. (RT)

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

Answer: B

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8. At a given temperature the equilibrium constant for the reaction of $PCl_5 \Leftrightarrow PCl_3 + Cl_2$ is 2.4×10^{-3}. At the same temperature, the equilibrium constant for the reaction

$PCl_3(g) + Cl_2(g) \Leftrightarrow PCl_5(g)$ is :

A. 2.4×10^{-3}

B. $-.24 \times 10^{-3}$

C. 4.2×10^{2}

D. 4.8×10^{-2}

Answer: C

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9. Which of the following is correct for the reaction?

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

A. $K_p = K_c$

B. $K_p < K_c$

C. $K_p > K_c$

D. Pressure is required to predict the correlation

Answer: B

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10. K_1 and K_2 are equilibrium constants for reaction (i) and (ii)

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

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

then,

A. $K_1 = \left(\frac{1}{K_2}\right)^2$

B. $K_1 = K_2^2$

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

D. $K_1 = (K_2)^0$

Answer: A

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11. 5 mole of $NH_4HS(s)$ start to decompose at a particular temperature in a closed vessel. If pressure of $NH_3(g)$ in the vessel is 2 atm, then K_p for the reaction, $NH_4HS(s) \Leftrightarrow NH_3(g) + H_2S(g)$, will be

A. 2

B. 4

C. 0.4

D. 0.8

Answer: B

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12. For homogeneous gas reaction $4NH_3 + 5O_2 \Leftrightarrow 4NO + 6H_2O$. The equilibrium constant K_c has the unit of

A. mol lit^{-1}

B. $\text{mol}^{-1}\text{lit}^{-1}$

C. $\text{mol}^2\text{lit}^{-2}$

D. unitless

Answer: A

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13. If the K_p for the equilibrium,

$M.5H_2O(s) \Leftrightarrow M.3H_2O(s) + 2H_2O(g)$ is 1×10^{-4}. Then $M.5H_2O(s)$ will show efflorescence when it is exposed to an atmosphere where vapour pressure of water is

A. more than 10^{-2} atm

B. below 10^{-2} atm

C. more than 10^{-4} atm

D. below 10^{-4} atm

Answer: B

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14. For the reaction $2NO_2(g) \Leftrightarrow 2NO(g) + O_2(g)$

$K_c = 1.8 \times 10^{-6}$ at $184^\circ C$, $R = 0.00831 kJ/$ (mol.K) when K_p and K_c

are compared at $184^{\circ}C$, it is found

A. Whether K_p is greater than, less than or equal to K_c depends upon the total gas pressure

B. $K_p = K_c$

C. K_p is less than K_c

D. K_p is greater than K_c

Answer: D

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15. For the reversible reaction

$N_2(g) + 3H_2(g) hAr 2NH_3(g)$

at $500^{\circ}C$ the value of K_p is 1.44×10^{-5} when partial pressure is measured in atmosphere. The corresponding value of K_e with concentration in mol/L is

A. $\frac{1.44 \times 10^{-5}}{(0.082 \times 500)^{-2}}$

B. $\frac{1.44 \times 10^{-5}}{(8.314 \times 773)^{-2}}$

C. $\frac{1.44 \times 10^{-5}}{(0.082 \times 773^2)}$

D. $\frac{1.44 \times 10^{-5}}{(0.082 \times 773)^{-2}}$

Answer: D

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16. The partial pressure of $CH_3OH_{(g)}, CO_{(g)}$ and $H_{2(g)}$ in equilibrium mixture for the reaction, $CO_{(g)} + 2H_{2(g)} \Leftrightarrow CH_3OH_{(g)}$ are 2.0, 1.0 and 0.1 atm respectively at $427^\circ C$. The value of K_P for deomposition of CH_3OH to CO and H_2 is:

A. $5 \times 10^{-3} atm^{-2}$

B. $2 \times 10^{-2} atm^{-2}$

C. $5 \times 10^{-2} atm^2$

D. $2 \times 10^{-1} atm^2$

Answer: A

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17. At constant temperature, the equilibrium constant (K_p) for the decomopsition reaction $N_2O_4 \Leftrightarrow 2NO_2$ is expressed by $K_p = \frac{(4x^2P)}{(1-x^2)}$, where P = pressure, x = extent of decomposition. Which one of the following statement is true ?

A. K_p increases with increase of P

B. K_p increases with increase of x

C. K_p increases with decrease of x

D. K_p remains constant with change in P and x

Answer: D

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18. For the reaction $A + B \Leftrightarrow C + D$, the initial concentrations of A and B are equal. The equilibrium concentration of C is two times the equilibrium concentration of A. The value of equilibrium constant is .....

A. 1

B. 3

C. 4

D. 2

Answer: C

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19. The decomposition of N_2O_4 to NO_2 is carried out at $280^\circ C$ in chloroform. When equilibrium is reached, 0.2 mol of N_2O_4 and 2×10^{-3} mol of NO_2 are present in a $2L$ solution. The equilibrium constant for the reaction

$N_2O_4 \Leftrightarrow 2NO_2$ is

A. 1×10^{-2}

B. 2×10^{-3}

C. 1×10^{-5}

D. 2×10^{-5}

Answer: C

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20. For the reaction $H_2(g) + I_2(g) \Leftrightarrow 2HI(g)$ at 721 K the value of equilibrium constant (K_c) is 50. When the equilibrium concentration of both is 0.5 M, the value of K_p under the same condtions will be

A. 0.02

B. 0.2

C. 50

D. 50 RT

Answer: C

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21. 1.0 mole of $AB_5(g)$ is placed in a closed container under one atmosphere and at 300K. It is heated to 600K, when 20% by mass of it dissociates as

$AB_5(g) \rightarrow AB(g) + 2B_2(g)$. The resultant pressure is

A. 1.2 atm

B. 2.4 atm

C. 1.4 atm

D. 2.8 atm

Answer: D

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22. The reaction quotient (Q) for thereaction

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

is given by

$$Q = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

The reaction will proceed from right to left if where K_C is the equilibrium constant.

A. Q=0

B. $Q = K_c$

C. $Q < K_c$

D. $Q > K_c$

Answer: D

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23. In the decomposition reaction $AB_5(g) \Leftrightarrow AB_3(g) + B_2(g)$, at equilibrium in a 10 litre closed vessel at $227^\circ C$, 2 moles of AB_3, 5 moles

of B_2 and 4 moles of AB_5, are present. The equilibrium contstant K_c for the formation of $AB_5(g)$ is

A. 0.25

B. 4.0

C. 0.04

D. 2.5

Answer: A

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24. For a reaction the free energy change, $\Delta G = -RT \ln K_p + RT \ln Q_p$ where K_P = equilibrium constant, Q_P= reaction quotient. For the reaction to be in equilibrium state

A. $\frac{Q_p}{K_p} > 1$

B. $\frac{Q_p}{K_p} < 1$

C. $\frac{Q_p}{K_p} = 1$

D. $Q_pK_p = 1$

Answer: C

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Exercise 1 Concept Builder Topicwise Topic 2 Relation Between K Q G And Factors Effecting Equilibrium

1. What is the effect of halving the pressure by doubling the volume on the following system at $500^\circ C$?

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

A. Shift to reactant side

B. Shift to product side

C. Liquefaction of HI

D. No effect

Answer: D

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2. The equilibrium constant for a reacton

$N_2(g) + O_2(g) = 2NO(g)$ is 4×10^{-4} at $2000K$. In the presence of catalyst, the equilibrium constant is attained 10 times faster. The equilibrium constant in the presence of catalyst, at $2000K$ is

A. 10×10^{-4}

B. 4×10^{-2}

C. 4×10^{-4}

D. 40×10^{-4}

Answer: C

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3. The formation of SO_3 takes place according to the following reaction, $2SO_2 + O_2 \Leftrightarrow 2SO_3$, $\Delta H = 45.2$ kcal The formation of SO_3 is favoured

by

A. increase in temperature

B. removal of oxygen

C. increase of volume

D. increase of pressure

Answer: D

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4. 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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5. Consider the reaction $2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$ for which $K_c = 278M^{-1}$.0.001 mole ofeach of the reagents $SO_2(g), O_2(g)$ and $SO_3(g)$ are mixed in a 1.0 L flask . Dterminr=e the reaction quotient of the system and the spontaneus direction of the system:

A. Q_c = 1000, the equilibrium shifts to the right

B. Q_c 1000, the equilibrium shifts to the left

C. Q_c= 0.001, the equilibrium shifts to the left

D. Q_c= 0.001, the equilibrium shifts to the right

Answer: B

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6. For the reaction $XCO_3 \Leftrightarrow XO(s) + CO_2(g), K_p = 1.642atm \quad at 727^\circ C$ If 4 moles of XCO_3 was put into a 50 litre container and heated to $727^\circ C$

What mole percent of the XCO_3 remains unreacted at equilibrium ?

A. 20

B. 25

C. 50

D. None of these

Answer: D

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7. The pressure on a sample of water at its triple point is reducend while the temperature is held contant .Which phases changes are favoured?

(1) melting of ice

(2)sublimation of ice

(3) vaporization of liquid water

A. I only

B. III only

C. II only

D. II and III

Answer: D

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8. The equilibrium constant K_p for a homogeneous gaseous reaction is 10^{-8}. The standard Gibbs free energy change $\Delta G^{\ominus}$ for the reaction $\left(\text{using} R = 2 cal K^{-1} mol^{-1}\right)$ is

A. 10.98kcal

B. -1.8kcal

C. $-4.1454 kcal$

D. $+4.1454kcal$

Answer: A

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9. For the reaction

$NH_4HS(g) \Leftrightarrow NH_3(g) + H_2S(g)$

in a closed flask, the equilibrium pressure is P atm. The standard free energy of the reaction would be:

A. $-RT\ln p$

B. $-RT(\ln p - \ln 2)$

C. $-2RT\ln p$

D. $-2RT(\ln p - \ln 2)$

Answer: D

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Exercise 1 Concept Builder Topicwise Topic 3 Theories Of Acids And Bases Lonic Product Of Water And Ph Scale

1. Among boron trifluoride, stannic chloride and stannous chloride, Lewis acid is represented by

A. only stannic chloride

B. boron trifluoride and stannic chloride

C. boron trifluoride and stannous chloride

D. only boron trifluoride

Answer: C

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2. Which one of the following compounds is not a protoric acid?

A. $SO_2(OH)_2$

B. $B(OH)_3$

C. $PO(OH)_3$

D. $SO(OH)_2$

Answer: B

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3. The strongest Bronsted base is :

A. ClO_3^-

B. ClO_2^-

C. ClO_4^-

D. ClO^-

Answer: D

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4. Which equilibrium can be described as an acid- base reaction using the Lewis acid-base definition but not using the Bronsted-Lowry definition

A. $2NH_3 + H_2SO_4 \Leftrightarrow 2NH_4^+ + SO_4^{2-}$

B. $NH_3 + CH_3COOH \Leftrightarrow NH_4^+ + CH_3COO^-$

C. $H_2O + CH_3COOH \Leftrightarrow H_3O^+ + CH_3COO^-$

D. $\left[Cu(H_2O)_4\right]^{2-} + 4NH_3 \leftrightarrow \left[Cu(NH_3)_4\right]^{2+} + 4H_2O$

Answer: D

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5. Which of the following has highest pH ?

A. $\frac{M}{4}KOH$

B. $\frac{M}{4}NaOH$

C. $\frac{M}{4}NH_4OH$

D. $\frac{M}{4}Ca(OH)_2$

Answer: D

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6. The pH of a 10^{-3} M HCl solution at $25^{\circ}C$ if it is diluted 1000 times, will be-

A. 3

B. zero

C. 5.98

D. 6.02

Answer: C

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7. What will be the pH of a solution formed by mixing 50 mL of 0.5 M HCl solution and 150 mL of 0.5 M NaOH solution and 300 mL H_2O ?

A. 13

B. 12.7

C. 7

D. 11

Answer: A

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8. Which of the following statements about pH and H^+ ion concentration is incorrect ?

A. Addition of one drop of concentrated HCl in NH_4OH solution decreases pH of the solution .

B. A solution of the mixture of one equivalent of each of CH_3COOH and NaOH has a pH of 7

C. pH of pure neutral water is not zero

D. A cold and cencentrated H_2SO_4 has lower H^+ ion concentration then a dilute solution of H_2SO_4

Answer: B

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9. The value of ionic product of water at 393K is

A. less then 1×10^{-14}

B. greater then 1×10^{-14}

C. equal to 1×10^{14}

D. equal to 1×10^{-7}

Answer: B

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10. What will be the H^+ concentration in a solution prepared by mixing 50.0 ml of 0.20 m NaCl, 25 ml of 0.10 M NaOH and 25.0 ml of 0.30 M HCl?

A. 0.5 M

B. 0.05 M

C. 0.02 M

D. 0.10 M

Answer: B

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11. What is the pH of a 10^{-4} M ,MOH solution at 330K, if , if K_w at 330 is $10^{-13.6}$?

A. 4

B. 9.0

C. 10

D. 9.6

Answer: D

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12. Which of the following increasing order of pH of 0.1 M solution of the compounds (A) $HCOONH_4$, (B) CH_3COONH_4 , (C) CH_3COONa and (D) NH_4Cl is correct ?

A. $A < D < BC$

B. $D < A < CB$

C. $A < D < C < B$

D. $D < A < BC$

Answer: D

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13. On increasing the temperature of pure water

A. both pH and pOH increase

B. both pH and pOH decrease

C. pH increases and pOH decreases

D. pH decreases and pOH increases

Answer: B

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Exercise 1 Concept Builder Topicwise Topic 4 Ionization Of Weak Acids And Bases And Relation Between Ka And Kb

1. The dissociation constant of two acids HA_1 and HA_2 are 3.14×10^{-4} and 1.96×10^{-5} respectively . The relative strength of the acids will be approximately

A. $1:4$

B. $4:1$

C. $1:16$

D. $16:1$

Answer: B

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2. At $298K$ a$0.01MCH_3COOH$ solution is $1.34\,\%$ ionized. The ionization constant K_a for acetic acid will be

A. 1.82×10^{-5}

B. 18.2×10^{-5}

C. 0.182×10^{-5}

D. none of these

Answer: A

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3. Ka_1, Ka_2 and Ka_3 are the respective 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 Ka_1, Ka_2 and Ka_3 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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4. A mono basic weak acid solution has a molarity of 0.005 and pH of 5. What is its percentage ionisation in this solutino ?gt

A. 2

B. 0.2

C. 0.5

D. 0.25

Answer: B

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5. Which of the following will occur if0.1 M solution of a weak acid is diluted to 0.01 M at constant temperature

A. $\left[H^{+}\right]$ will decrease to 0.01 M

B. pH will decrese

C. percentage ionization will increase

D. K_a will increase

Answer: C

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6. At certain temperature, dissociation constant of formic acid and acetic acid are 1.8×10^{-4} and 1.8×10^{-5} respectively. At what concentration of acetic solution, the H_3O^+ ion concentration is same as that in 0.001 M formic acid solution

A. 0.001M

B. 0.01M

C. 0.1M

D. 0.0001M

Answer: B

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7. The degree of dissociation of acetic acid in a 0.1 M solution is 1.32×10^{-2}, find out the pKa :-

A. 1.50×10^{-4}

B. 1.80×10^{-16}

C. 1.76×10^{-5}

D. 1.2×10^{-3}

Answer: C

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Exercise 1 Concept Builder Topicwise Topic 5 Common Lon Effect Salt Hydrolysis Buffer Solutions And Solubility Product

1. Solubility of salt A_2B_3 is 1×10^{-4}, its solubility product is

A. 1.08×10^{20}

B. 1.08×10^{18}

C. 2.6×10^{-18}

D. 1.08×10^{-18}

Answer: D

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2. Which of the following metal sulphides has maximum solubility in water?

A. CdS $\left(K_{sp} = 36 \times 10^{-30}\right)$

B. $FeS\left(K_{sp} = 11 \times 10^{-20}\right)$

C. $HgS\left(K_{sp} = 32 \times 10^{-54}\right)$

D. $ZnS\left(K_{sp} = 11 \times 10^{-22}\right)$

Answer: B

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3. What are the units in which the solubility product of $Ca_3(PO_4)_2$ is expressed?

A. $moldm^{-3}$

B. mol^2dm^{-6}

C. mol^3dm^{-9}

D. mol^5dm^{-15}

Answer: D

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4. Consider the following equilibrium

$$AgCl\downarrow + 2NH_3 \Leftrightarrow \left[Ag(NH_3)_2\right]^+ + Cl^-$$

White precipitate of AgCl appears on adding which of the following?

A. NH_3

B. aqueous NaCl

C. aqueous HNO_3

D. aqueous NH_4Cl

Answer: C

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5. A saturated solution of $Ag_2SO_4 is 2.5 \times 10^{-2} M$. The value of its solubility product is

A. 62.5×10^{-6}

B. 6.25×10^{-4}

C. 15.625×10^{-6}

D. 3.125×10^{-6}

Answer: A

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6. The solubility of AgI in NaI solutions is less than that in pure water because:

A. the temperature of the solution decreases.

B. solubility product of Agl is less than that of Nal.

C. of common ion effect.

D. Agl forms complex with Nal.

Answer: C

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7. A litre of solution is saturated with AgCl To this solution if 1.0×10^{-4} Mole of solid NaCI is added , what will be the $\left[Ag^{+}\right]$, assuming no volume change

A. More

B. Less

C. Equal

D. Zero

Answer: B

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8. The solubility product of a sparingly soluble salt BA_2 is 4×10^{-12}. The solubility of BA_2 is

A. 4×10^{-4}

B. 4×10^{-12}

C. 4×10^{-3}

D. 1×10^{-4}

Answer: D

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9. The pH of an acidic buffer mixture is:

A. > 7

B. $= 7$

C. < 7

D. depends upon K_a of the acid

Answer: D

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10. The pH of a weak mono acidic base, neutralized upto 80% with a strong acid in a dilute solution, is 7.40. The ionization constant of the base is

A. 1.0×10^{-5}

B. 1.6×10^{-7}

C. 1.0×10^{-6}

D. None of these

Answer: C

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11. Which of the following solution cannot act as buffer?

A. $NaH_2PO_4 + H_3PO_4$

B. $CH_3COOH + CH_3COONa$

C. $HCl + NH_4Cl$

D. $H_3PO_4 + NaH_2PO_4$

Answer: C

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12. A buffer solution is prepared by mixing 0.1 M ammonia and 1.0 M ammonium chloride. At 298 K, the pK_b of NH_4OH is 5.0. The pH of buffer is :

A. 10.0

B. 9.0

C. 6.0

D. 8.0

Answer: A

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13. A physician wishes to prepare a buffer solution at pH = 3.58 that efficiently resist changes in pH yet contains only small concentration of the buffering agents. Which one of the following weak acid together with its sodium salt would be best to use ?

A. m-chlorobenzoic acid $(pK_a = 3.98)$

B. p-chlorocinnamic acid $(pK_a = 4.41)$

C. 2,5-dihydroxybenzoic acid $(pK_a = 2.97)$

D. acetoacetic acid $(pK_a = 3.58)$

Answer: D

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14. 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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15. The correct order of increasing solubility of AgCl in (A) water, (B)0,1 M NACI, (C)0.1 M, BaCl2, (D)0,1 M NH_3 is

A. $D > A > B > C$

B. $D > C > B > A$

C. $B > A > D > C$

D. $A > D > B > C$

Answer: A

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16. The molar solubility (in mol L^{-1}) of a sparingly soluble salt MX_4 is $'s'$. The corresponding solubility product K_{sp}, $'s'$ is given in terms of K_{sp} by the relation

A. $s = (256K_{sp})^{1/5}$

B. $s = (128K_{sp})^{1/4}$

C. $s = (K_{sp}/128)^{1/4}$

D. $s = (K_{sp}/256)^{1/5}$

Answer: D

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17. Solubility product of M(OH), is 10^{-14}. What should be the concentration of M^{2+} in 0.1 M solution of NH_4OH, if NH_4OH gets 10% ionised?

A. 10^{-10}

B. 10^{-5}

C. 10^{-12}

D. 10^{-4}

Answer: A

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Exercise 2 Concept Applicator

1. PCl_5 s dissociating 50% at $250^\circ C$ at a total pressure of P atm. If equilibrium constant is K_p, then which of the following relation is numerically correct -

A. $K_p = 3P$

B. $P = 3K_p$

C. $P = \frac{2K_p}{3}$

D. $K_p = \frac{2P}{3}$

Answer: B

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2. An amount of solid NH_4HS is placed in a flask already containing ammonia gas at a certain temperature and 0.50 atm pressure.Ammonium hydrogen sulphide decomposes to yield NH_3 and H_2S gases in the flask.When the decomposition reaction reaches equilibrium, the total pressure in the flask rises to 0.84 atm ? The equilibrium constant for NH_4HS decomposition at this temperature is :

A. 0.11

B. 0.17

C. 0.18

D. 0.30

Answer: A

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3. 3.2 moles of hydrogemn iodide was heted in a sealed bulb at $444^\circ C$ till the equilibrium state was reached. Its degree of dissociation sat this

temperature was found to be $22\,\%$. The number of moles of hydrogen iodide present at equilibrium is

A. 2.496

B. 1.87

C. 2

D. 4

Answer: A

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4. For the reaction is equilibrium :

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

If P_{Br_2} is $\frac{P}{9}$ at equilibrium and P is total pressure, prove that $\frac{K_p}{P}$ is equal to $\frac{1}{81}$.

A. $\frac{1}{3}$

B. $\frac{1}{81}$

C. $\frac{1}{9}$

D. $\frac{1}{27}$

Answer: B

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5. A gaseous compound of molecular mass 82.1 dissociates on heating to 400 K as

$X_2Y_4(g) \Leftrightarrow X_2(g) + Y_2(g)$

he density of the equilibrium mixture at a pressure of 1 atm and temperature of 400K is $2.0gL^{-1}$. The percentage dissociation of the compound is

A. 0.125

B. 0.485

C. 0.901

D. 0.25

Answer: A

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6. In the reaction $AB(g) \Leftrightarrow A(g) + B(g)$ at $30^{\circ}C, k_p$ for the dissociation equilibrium is $2.56 \times 10^{-2} atm.$ If the total pressure at equilibrium is 1 atm, then the percentage dissociation of AB is

A. 0.87

B. 0.13

C. 0.435

D. 0.16

Answer: D

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7. Ammonium carbamate dissociates on heating as:

$NH_2COONH_4(g) \Leftrightarrow 2NH_3(g) + CO_2(g)$

The equilibrium constant K_p for the reaction, at some temperature is $3.2 \times 10^{-5} atm^3$. Calculate the partial pressure of NH_3 in the equilibrium system at the same temperature.

A. $2.0 \times 10^{-2} atm$

B. $4,0 \times 10^{-2} atm$

C. $3.2 \times 10^{-2} atm$

D. 6.4×10^{-2} atm

Answer: B

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8. Consider the partial decomposition of A as

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

At equilibrium 700 mL gaseous mixture contains 100 mL of gas Cat 10 atm and 300 K. What is the value of K_p for the reaction?

A. $\frac{40}{7}$

B. $\frac{1}{28}$

C. $\frac{10}{28}$

D. $\frac{28}{10}$

Answer: C

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9.

$CuSO_4.5H_2O(s) \Leftrightarrow CuSO_4.3H_2O(s) + 2H_2O(g), K_p = 4 \times 10^{-4} atm^2$

If the vapour pressure of water is 38 toor then percentage of relatative humidity is :(Assume all data at constant temperture)

A. 4

B. 10

C. 40

D. None of these

Answer: C

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10. For which of the following reactions at equilibrium at constant temperature, doubling the volume will cause a shift to the right?

A. $H_2(g) + Cl_2(g) \Leftrightarrow 2HCl(g)$

B. $2CO(g) + O_2(g) \Leftrightarrow 2CO_2(g)$

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

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

Answer: D

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11. The following two reactions:

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

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

are simultaneously in equilibrium in a container at constant volume. A few moles of $CO(g)$ are later introduced into the vessel. After some time, the new equilibrium concentration of

A. Cl_2 is greater.

B. PCl_5 is less.

C. PCl_3 remain unchanged.

D. PCl_5 is greater.

Answer: B

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12. The element Bi melts at $271^\circ C$ and has density of 9.73 g/mL as a solid and 10.05 g/mL as a liquid at this temperature. For the equilibrium

$Bi(s) \Leftrightarrow Bi(l)$ the melting point is favoured in this endothermic reaction either by

A. increasing temperature, decreasing pressure

B. decreasing temperature, decreasing pressure

C. increasing temperature, increasing pressure

D. there is no effect of pressure on melting poin

Answer: C

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13. At $25^{\circ}C$, the dissociation constant of a base. BOH is 1.0×10^{-12}. The concentration of hydroxyl ions in 0.01M aqueous solution of the base would be

A. $1.0 \times 10^{-5} molL^{-1}$

B. $1.0 \times 10^{-6} molL^{-1}$

C. $2.0 \times 10^{-6} molL^{-1}$

D. $1.0 \times 10^{-7} molL^{-1}$

Answer: D

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14. Which of the following will decrease the pH of a 50 ml solution of $0.01 MHCI$?

A. Addition of 50 mL of 0.01 MHCI

B. Addition of 50 mL of 0.002 M HCl

C. Addition of 150 mL of 0.002 M HCl

D. Addition of 5 mL of 1 MHCI

Answer: D

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15. K_1 & K_2 for oxalic acid are 6.5×10^{-2} and 6.1×10^{-5} respectively . What will be the $\left[OH^-\right]$ in a $0.01M$ solution of sodium oxalate

A. 9.6×10^{-6}

B. 1.4×10^{-1}

C. 1.3×10^{-6}

D. 1.3×10^{-8}

Answer: C

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16. The degree of dissociation of 0.1 M weak acid HA is 0.5%. If 2 mL of 1.0MHA solution is diluted to 32 mL the degree of dissociation of acid and H_3O^+ ion concentration in the resulting solution will be respectively

A. $0.02 \text{ and } 3.125 \times 10^{-4}$

B. $1.25 \times 10^{-3} \text{ and } 0.02$

C. $6.02 \text{ and } 1.25 \times 10^{-3}$

D. $0.02 \text{ and } 8.0 \times 10^{-12}$

Answer: C

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17. pH of two solutions :

I. 50 mL of 0.2 MHCl + 50 mL of 0.2 MHA $\left(K_a = 1.0 \times 10^{-5}\right)$ and

II. 50 mL of 0.2 M HCl +50 mL of 0.2 M NaA will be respectively

A. 0.70 and 2.85

B. 1 and 2.85

C. 1 and 3

D. 3 and 1

Answer: C

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18. Which of the following, when mixed, will give a solution with $pH > 7$?

A. 100 mL 0.1 MHCI+ 100 mL 0.1 MKCI

B. $100mL0.1MH_2SO_4 + 100mL0.1MNaOH$

C. $100mL0.1MCH_3COOH + 100mL0.1MKOH$

D. $50mL0.1MHCl + 50mL0.1MCH_3COONa$

Answer: C

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19. For preparing a buffer solution of $pH6$ by mixing sodium accetate and acetic, the ratio of the concentration of salt and acid should be $\left(K_a = 10^{-5}\right)$

A. $1:10$

B. $10:1$

C. $100:1$

D. $1:100$

Answer: B

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20. 1 M NH_4OH and $1MHCl$ are mixed to make a total volume of 300 mL. If pH of the mixture is 9.26 and $pK_A\left(NH_4^+\right) = 9.26$ then what would be the volume ratio of NH_4OH and HCl

A. 225 mL, 75 mL

B. 200 mL, 100 mL

C. 100mL., 200 mL

D. 150mL, 150 mL

Answer: C

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21. The sum of pH and pK_b for a basic buffer solution is 13. The ratio of the concentration of the base to that of the salt is

A. 10

B. 1

C. 0.05

D. 0.1

Answer: D

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22. Solubilities of three sparingly soluble salts $XY(K_{sp})$, $XY_2(K'_{sp})$ and $X_2Y_3(K''_{sp})$ are equal in water. What will be the correct order of their solubility products

A. $K_{sp} < K'_{sp} < K''_{sp}$

B. $K_{sp} < K''_{sp} < K'_{sp}$

C. $K''_{sp} < K'_{sp} < K_{sp}$

D. $K''_{sp} < K_{sp} < K'_{sp}$

Answer: C

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23. The solubility product of AgI at $25^\circ C$ is $1.0 \times 10^{-16} mol^2 L^{-2}$. The solubility of AgI in $10^{-4} N$ solution of KI at $25^\circ C$ is approximately (in $molL^{-1}$)

A. 1.0×10^{-8}

B. 1.0×10^{-16}

C. 1.0×10^{-12}

D. 1.0×10^{-10}

Answer: C

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24. The precipitate of $Ag_2CrO_4\left(K_{\text{sp}} = 1.9 \times 10^{-12}\right)$ is obtained when equal volumes of the following are mixed.

A. $10^{-5}MAg^{+}$ and $10^{-3}MCrO_4^{2-}$

B. $10^{-5}MAg^{+}$ and $10^{-2}MCrO_4^{2-}$

C. $10^{-4}MAg^{+}$ and $10^{-2}MCrO_4^{2-}$

D. $10^{-7}MAg^{+}$ and $10^{-3}MCrO_4^{2-}$

Answer: C

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25. The 0.001 M Solution of Mg $(NO_3)_2$ is adjusted to pH9, K_{sp} of Mg $(OH)_2$ is 8.9×10^{-12}. At this pH

A. $Mg(OH)_2$ will be precipitated.

B. $Mg(OH)_2$ is not precipitated.

C. $Mg(OH)_3$ will be precipitated.

D. $Mg(OH)_3$ is not precipitated.

Answer: B

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26. In a saturated solution of the spatingly soluble strong electrolyte $AgIO_3$ (molecular mass $= 283$) the equilibrium which sets in is

$AgIO_3(s) \Leftrightarrow Ag^+(aq) + IO_3^-(aq)$

If the solubility product constant K_{SP} of $AgIO_3$ at a given temperature is 1.0×10^{-8}, what is the mass of $AgIO_3$ cotained in $100mL$ of its saturated solution?

A. 1.0×10^{-4}

B. 28.3×10^{-2}g

C. $2.83 \times 10^{-3}g$

D. $1.0 \times 10^{-7} g$

Answer: C

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27. The solubility of AgSCN in 0.002 M NH_3 is (K_{sp} for $AgSCN = 1.0 \times 10^{-12}$, K_d for $Af(NH_3)_2^+ = 1.0 \times 10^{-8}$)

A. $3 \times 10^{-5} M$

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

C. $4 \times 10^{-5} M$

D. $2 \times 10^{-5} M$

Answer: D

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28. When sulphur (in the form of S_B) is heated at temperature T, at equilibrium , the pressure of S_B falls by $30\,\%$ from $1.0atm$, because $S_B(g)$ in partially converted into $S_2(g)$.

Find the value of K_P for this reaction.

A. 2.96

B. 6.14

C. 204.8

D. None of these

Answer: A

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29. Phosphorus pentachloride dissociates as follows in a closed reaction vessel.

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

If total pressure at equilibrium of the reactions mixture is P and degree of dissociation of $PCl_5$is x, the partial pressure of PCl_3 will be:

A. $\left(\frac{x}{x-1}\right)P$

B. $\left(\frac{x}{1-x}\right)P$

C. $\left(\frac{x}{1+x}\right)P$

D. $\left(\frac{2x}{1-x}\right)P$

Answer: C

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30. For the reaction

$H_2(g) + CO(g) \Leftrightarrow CO(g) + H_2O(g)$, if the initial concentration of $[H_2] = [CO_2]$and x moles /litres of hydrogen is consummed at equilibrium , the correct expression of K_p is :

A. $\frac{x^2}{(1-x^2)}$

B. $\frac{(1+x^2)}{(1-x^2)}$

C. $\frac{x^2}{(2+x^2)}$

D. $\frac{x^2}{(2-x^2)}$

Answer: A

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