



## CHEMISTRY

### BOOKS - MODERN PUBLICATION CHEMISTRY

### (KANNADA ENGLISH)

## EQUILIBRIUM

#### Multiple Choice Questions Level I

1. When a system is at equilibrium.

A. 1. The concentration of reactants and products becomes equal

B. 2. The opposite reactions (forward and backward) stop

C. 3. The rate of backward reaction becomes very low

D. 4. The rate of forward and backward reactions become equal.

**Answer: D**

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2. If concentration is expressed as  $\text{mol L}^{-1}$ , the equilibrium constant, K for the reaction :



has the units :

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

B.  $\text{molL}^{-1}$

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

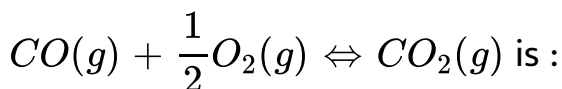
D. no units.

**Answer: A**



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**3.** The ratio of  $K_p / K_c$  for the reaction :



A. 1

B. RT

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

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

**Answer: D**



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4. At equilibrium the free energy change ( $\Delta G$ ) is :

A.  $\Delta G = 0$

B.  $\Delta G > 0$

C.  $\Delta G < 0$

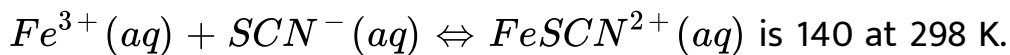
D. May have any value but is not equal to zero

**Answer: A**

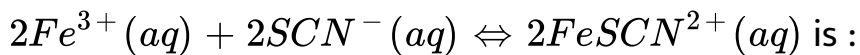


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5. The equilibrium constant for the reaction :



The equilibrium constant for the reaction :



A. 280

B. 140

C. 19600

D. 70

**Answer: C**



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6. In the lime kilns, the reaction :



goes to completion because :

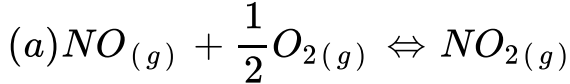
- A. of high temperature
- B. CaO is more stable than  $\text{CaCO}_3$
- C.  $\text{CO}_2$  escapes continuously
- D. CaO is not dissociated

**Answer: C**



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7. Equilibrium constants  $K_1$  and  $K_2$  for the following equilibria



(b)  $2\text{NO}_{2(g)} \rightleftharpoons 2\text{NO}_{(g)} + \text{O}_{2(g)}$  are related as :

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

B.  $K_2 = \frac{K_1}{2}$

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

D.  $K_2 = K_1^2$

**Answer: C**



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8. The system  $\text{PCl}_5(s) \rightleftharpoons \text{PCl}_3(g) + \text{Cl}_2(g)$  attains equilibrium. If the equilibrium concentration of  $\text{PCl}_3(g)$  is doubled, the concentration of  $\text{Cl}_2(g)$  would become :

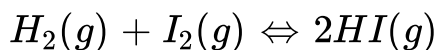
- A. 1/4 of its initial value
- B. 1/2 of its initial value
- C. Twice of its initial value
- D. unpredictable

**Answer: B**



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**9.** The equilibrium constant of the reaction,



is 64. If the volume of the container is reduced to half of its original volume, the value of equilibrium constant will be :

- A. 64



B.  $\frac{1}{64}$

C. 32

D. 16

**Answer: A**

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**10.** The equilibrium constant in a reversible chemical reaction at a given temperature :

A. depends on the initial concentration of the reactants.

B. does not depend upon the initial concentration of the reactants.

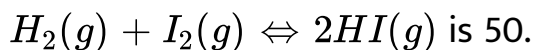
C. depends on the presents.

D. is characteristic of the duration of time till the equilibrium is maintained.

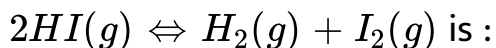
**Answer: B**

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**11.** The equilibrium constant at 717 K for the reaction



The equilibrium constant for the reaction



A. 0.50

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

C. 4.0

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

**Answer: B**



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12. In which of the following case, does the reaction go farthest to completion ?

A.  $K = 10^{10}$

B.  $K = 10^{-20}$

C.  $K = 10$

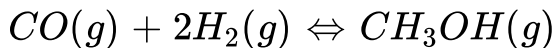
D.  $K = 1$

**Answer: A**



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13. For the reaction :



A.  $K_p = K_c$

B.  $K_p > K_c$

C.  $K_p < K_c$

D.  $K_c = 0$  but  $K_p \neq 0$

Answer: C



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14. In a reversible chemical reaction having two reactants in equilibrium, if the concentrations of reactants are doubled,

then the equilibrium constant will :

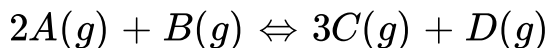
- A. also be doubled
- B. be halved
- C. become one - fourth
- D. remains the same

**Answer: D**



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**15.** For the reaction :



Two moles each of A and B are taken in a 2L flask. The following must always be true at equilibrium :

A.  $[A] = [B]$

B.  $[A] < [B]$

C.  $[B] = [C]$

D.  $[A] > [B]$

**Answer: B**



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**16.** If  $\alpha$  is the degree of dissociation of  $N_2O_4$  in the reaction :



then at equilibrium, the total number of moles of  $N_2O_4$  and

$NO_2$  present is :

A. 2

B.  $1 - \alpha$

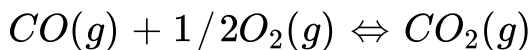
C.  $(1 - \alpha)^2$

D.  $1 + \alpha$

**Answer: D**

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**17.** For the reaction :



the partial pressures are :

$p(O_2) = 0.24$  atm,  $p(CO) = 0.4$  atm and  $p(CO) = 0.04$

atm. The equilibrium constant  $K_p$  is :

A. 0.3

B. 3.0

C. 9.0

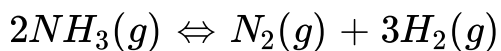
D. 0.03

**Answer: B**



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**18.** Two moles of ammonia gas are introduced into a previously evacuated 1 L flask in which it partially dissociates at high temperature as :



At equilibrium 1.0 mole of  $NH_3(g)$  is found. What is  $K_c$  ?

A. 0.75



B. 1.5

C. 1.68

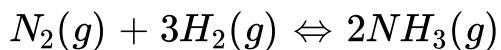
D. 0.46

**Answer: C**



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**19.** For the reaction at 800 K



the ratio of  $K_p$  and  $K_c$  is :

( $R = 0.082 \text{ L atm mol}^{-1} \text{ K}^{-1}$ )

A.  $2.3 \times 10^{-4}$

B.  $3.2 \times 10^{-6}$

C.  $2.3 \times 10^4$

D.  $3.2 \times 10^6$

**Answer: A**

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**20.** For the reaction :



the concentration of the equilibrium mixture at 300 K are

$[N_2O_4] = 4.8 \times 10^{-2} molL^{-1}$  and

$[NO_2] = 1.2 \times 10^{-2} molL^{-1}$ .  $K_c$  for the reaction is :

A. 0.25

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

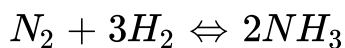
C.  $3 \times 10^3 \text{ molL}^{-1}$

D.  $3 \times 10^{-3} \text{ molL}^{-1}$

**Answer: D**

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**21.** For the gaseous reaction :



the partial pressure of  $H_2$  and  $N_2$  are 0.4 and 0.8 atm respectively. The total pressure of the entire system is 2.8 atm. What will be the value of  $K_p$  if all concentrations are given in atmospheres ?

A. 50

B. 0.02

C. 250

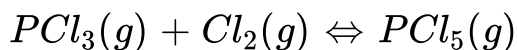
D. 31.25

**Answer: A**



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**22.** For the reaction :



the value of  $K_c$  at  $250^\circ C$  is 26. The value of  $K_p$  at this temperature will be : ( $R = 0.082 \text{ L atm mol}^{-1} K^{-1}$ )

A. 0.61

B. 0.46

C. 0.92

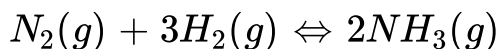
D. 0.57

**Answer: A**



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**23.** One mole of  $N_2$  and 3 moles of  $H_2$  are mixed in a litre flask. If 50 %  $N_2$  is converted into ammonia by the reaction.



then the total number of moles of gas at equilibrium is :

A. 1.5

B. 3.0

C. 4.5

D. 6.0

**Answer: B**



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**24.** Iodine gets 5% dissociated into atoms when 1.0 mole of  $I_2(g)$  is introduced into an evacuated flask of 1L capacity at 150 K. The  $K_c$  for the reaction.

$I_2(g) \rightleftharpoons 2I(g)$  at 1500 K is :

A.  $1.05 \times 10^{-2}$

B.  $2.1 \times 10^{-2}$

C. 10.5

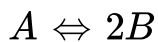
D. 21

**Answer: A**



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25. The equilibrium constant,  $K_p$  for the reaction :



is related to degree of dissociation  $\alpha$  of A and total pressure

P as :

A.  $\frac{4\alpha^2 P}{1 - \alpha^2}$

B.  $\frac{4\alpha^2 P^2}{1 - \alpha^2}$

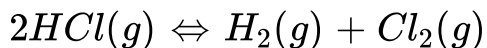
C.  $\frac{4\alpha^2 P^2}{1 - \alpha}$

D.  $\frac{4\alpha^2 P}{1 - \alpha}$

**Answer: A**

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26. For the equilibrium system :



the equilibrium constant is  $1.0 \times 10^{-5}$ . What is the concentration of HCl if the equilibrium concentration of  $\text{H}_2$  and  $\text{Cl}_2$  are  $1.2 \times 10^{-3} \text{ M}$  and  $1.2 \times 10^{-4} \text{ M}$  respectively ?

A.  $12 \times 10^{-4} \text{ M}$

B.  $12 \times 10^{-3} \text{ M}$

C.  $12 \times 10^{-2} \text{ M}$

D.  $12 \times 10^{-1} \text{ M}$

**Answer: C**



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27. In a chemical reaction, the rate constant for the backward reaction is  $7.5 \times 10^{-4}$  and the equilibrium constant is 1.5.

The rate constant for the forward reaction is :

A.  $5 \times 10^{-4}$

B.  $2 \times 10^{-3}$

C.  $1.125 \times 10^{-3}$

D.  $9.0 \times 10^{-4}$

**Answer: C**



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28. 1.1 mole of A are mixed with 2.2 mole of B and the mixture is then kept in a 1 L vessel till the equilibrium :



is reached. At equilibrium 0.2 moles of C are formed. The equilibrium constant for the reaction is :

A. 0.001

B. 0.002

C. 0.003

D. 0.004

**Answer: A**



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**29.** The equilibrium  $N_2 + O_2 \rightleftharpoons 2NO$  is established in a reaction vessel of 2.5 L capacity. The amounts of  $N_2$  and  $O_2$  taken at the start were respectively 2 moles and 4 moles. Half

a mole of nitrogen has been used up at equilibrium. The molar concentration of nitric oxide is :

A. 0.2

B. 0.4

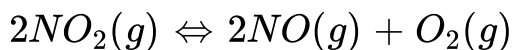
C. 0.6

D. 0.1

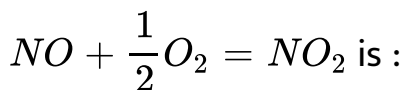
**Answer: B**

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**30.** For the reaction :



$K_c = 1.8 \times 10^{-6}$  at  $185^\circ C$ , the value of  $K_c$  for the reaction



A.  $0.9 \times 10^6$

B.  $7.5 \times 10^2$

C.  $1.95 \times 10^{-3}$

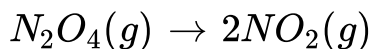
D.  $1.95 \times 10^3$

**Answer: B**



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**31.** The degree of dissociation of dinitrogen tetroxide



at temperature T and total pressure P is  $\alpha$ . Which one of the following expressions is correct for the equilibrium constant at this temperature ?

A.  $\frac{2\alpha}{1 - \alpha^2}$

B.  $\frac{\alpha^2 P}{1 - \alpha}$

C.  $\frac{4\alpha^2}{1 - \alpha^2}$

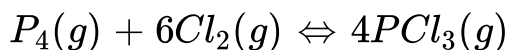
D.  $\frac{4\alpha^2 P}{1 - \alpha^2}$

**Answer: D**



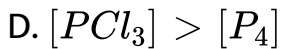
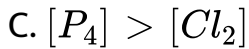
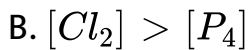
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**32. The equilibrium :**



is attained by mixing equal moles of  $P_4$  and  $Cl_2$  in an evacuated vessel. Then at equilibrium :

A.  $[Cl_2] > [PCl_3]$



**Answer: C**



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**33.** In a reaction :  $A + B \rightleftharpoons C + D$ , the initial concentrations of A and B were  $0.9 \text{ mol dm}^{-3}$  each. At equilibrium, the concentration of D was found to be  $0.6 \text{ mol dm}^{-3}$ . What is the value of equilibrium constant for the reaction ?

A. 3

B. 9

C. 4

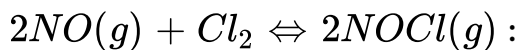
D. 8

**Answer: C**



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**34.** For the reaction :



which is true :

A.  $K_p = K_c \times RT$

B.  $K_p = K_c(RT)^2$

C.  $K_p = \frac{K_c}{RT}$

$$D. K_p = \frac{K_c}{(RT)^2}$$

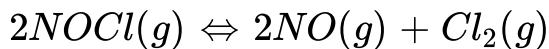
**Answer: C**



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**35.** The value of  $K_p$  for the reaction at 500 K is

$$1.8 \times 10^{-2} \text{bar}^{-1}.$$



$K_c$  for the reaction is

A.  $4.3 \times 10^{-4}$

B.  $4.3 \times 10^{-2}$

C.  $4.3 \times 10^{-6}$

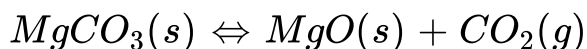
D.  $1.8 \times 10^{-2}$



**Answer: A**

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**36.** For the equilibrium :



which of the following expressions is correct ?

A.  $K_p = \frac{P_{MgO} \times P_{CO_2}}{P_{MgCO_3}}$

B.  $K_p = \frac{[MgO][CO_2]}{[MgCO_3]}$

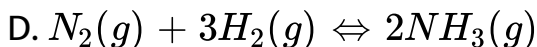
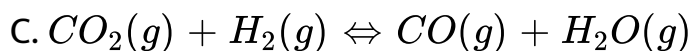
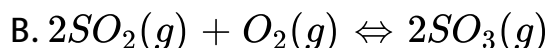
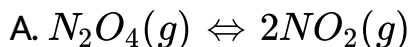
C.  $K_p = pMgO + pCO_2$

D.  $K_p = pCO_2$

**Answer: D**

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37. In which of the following reaction, pressure has no effect on equilibrium ?

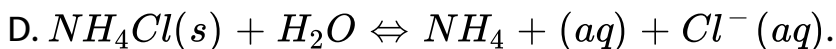
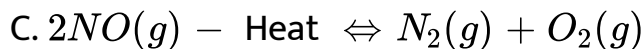
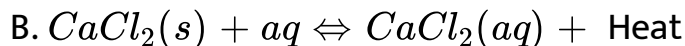
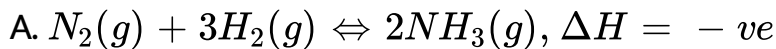


**Answer: C**



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38. In which of the following reaction, the equilibrium is shifted to the right by increasing temperature ?

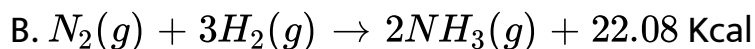
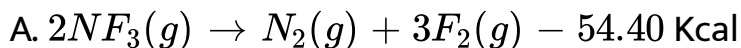


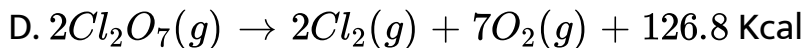
**Answer: D**



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**39.** For which of the following reactions is a combination of high pressure and high temperature helpful in obtaining a high yield of products ?

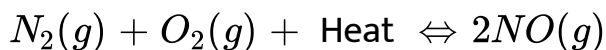




**Answer: C**

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**40.** For the equilibrium system.



Which of the following factors would cause the value of equilibrium constant to decrease ?

- A. Adding a catalyst.
- B. Decreasing the temperature
- C. Adding  $N_2$  gas

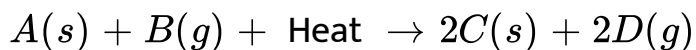
D. Adding NO(g).

**Answer: B**



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**41.** In a system.



equilibrium is established. The pressure of B vapour is doubled to re - stablish the equilibrium. The factor by which D is changed is :

A. 2

B. 3

C.  $\sqrt{2}$

D.  $\sqrt{3}$

**Answer: C**



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**42.** Consider the following equilibrium in a closed container :



At a fixed temperature, the volume of the reaction container is halved. For this change, which of the following statements, holds true regarding the equilibrium constant ( $K_p$ ) and the degree of dissociation ( $\alpha$ ) ?

- A. neither  $K_p$  nor  $\alpha$  changes.
- B. both  $K_p$  and  $\alpha$  change
- C.  $K_p$  changes but  $\alpha$  does not change

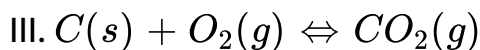
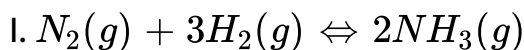
D.  $K_p$  does not change but  $\alpha$  changes.

**Answer: C**



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**43.** When each of the following species are transferred to a flask having double volume of the earlier flask, in which of the following cases, equilibrium constant is affected ?



A. I, III

B. II, III

C. I, IV

D. I, III, IV

**Answer: C**



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**44.** Which of the following can act as Lowry - Bronsted acid as well as a base ?

A.  $Cl^-$

B.  $HCO_3^-$

C.  $H_3O^+$

D.  $SO_4^{2-}$

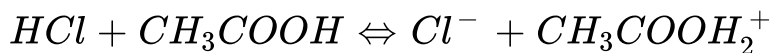


Answer: B

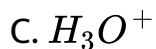
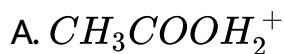


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45. In the acid - base reaction,



the conjugate acid of acetic acid is

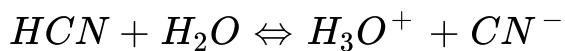


Answer: A

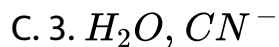


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46. In the reaction :



the conjugate acid - base pair is



Answer: B



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47. Conjugate acid of  $\text{NH}_2^-$  is :



**Answer: D**



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**48.** The pH value is maximum for :



**Answer: C**



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49. At  $90^\circ C$ , pure water has  $[H_3O^+] = 10^{-6} molL^{-1}$ . The value of  $K_w$  at  $90^\circ C$  is :

A.  $1 \times 10^{-6}$

B.  $1 \times 10^{-8}$

C.  $1 \times 10^{-12}$

D.  $1 \times 10^{-14}$

**Answer: C**



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

A. 8

B. 6

C. 7.06

D. 6.96

**Answer: D**



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51. The pH of an aqueous solution at  $25^{\circ}C$  is 6.1 its p(OH) is :

A. 12.2

B. 7.9

C. 3.9

D. 6.1

**Answer: B**



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52. The pH of  $10^{-10}$  M NaOH solution is nearest to :

A. 10

B. 4

C. 7

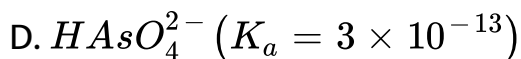
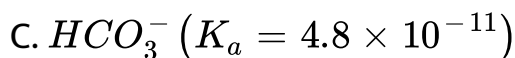
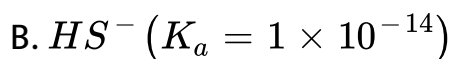
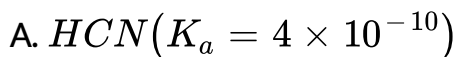
D. -4

**Answer: C**



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53. Which of the following acids is the strongest ?



**Answer: A**

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54. The pH of  $10^{-7}$  HCl aqueous solution of HCl at  $25^\circ\text{C}$  is :

A. 7.0

B. less than 7

C. more than 7

D. None of the above (A-C)

**Answer: B**



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**55.** Which of the following acids is stronger than benzoic acid

( $K_a = 6.3 \times 10^{-5}$ ) ?

A. A ( $K_a = 1.62 \times 10^{-7}$ )

B. B ( $pK_a = 6$ )

C. C ( $pK_a = 4$ )

D. D ( $K_a$ )  $1.0 \times 10^{-5}$



**Answer: C**



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**56.** At  $100^{\circ}C$ ,  $K_w = 10^{-12}$ , pH of pure water at  $100^{\circ}C$  will be

A. 6.0

B. 7.0

C. 8.0

D. 12.0

**Answer: A**



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57. The pH of a solution is 5. Its hydrogen ion concentration is increased 100 times. Its pH will be :

A. 7

B. 3

C. nearly 7

D. does not change.

**Answer: B**



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58. The pH of  $H_2SO_4$  is 2. Its molar concentration is :

A. 0.01

B. 0.005

C. 0.02

D. 0.05

**Answer: B**



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**59.** What will be the pOH of a neutral solution at  $50^{\circ}C$  if its  $pK_w$  is 13.38 at  $50^{\circ}C$ .

A. 6.6

B. 7.0

C. 6.69

D. 7.31

**Answer: C**



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**60.** The pH of 0.001 M NaOH solution is

A. 3

B. 10

C. 12

D. 11

**Answer: D**



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61. For 100 times increase in concentration of  $H^+$  ions :

- A. pH increases by 2 units
- B. pH decreases by 2 units
- C. pH remains unaltered
- D. pH decreases by 1 unit.

**Answer: B**

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62. The pH of  $0.10M NH_3$  solution ( $K_b = 1.8 \times 10^{-5}$ ) is :

- A. 2.87
- B. 11.13

C. 1

D. 13

**Answer: B**



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**63.** The pH of  $2.5 \times 10^{-1}$  M HCN solution ( $K_a = 4 \times 10^{-10}$ )

is :

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

B. 2.0

C. 4.7

D. 5.0

**Answer: D**



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**64.** The ionisation constant for acetic acid is  $1.8 \times 10^{-5}$ . At what concentration will it be dissociated to 2% ?

A. 1 M

B. 0.018 M

C. 0.18 M

D. 0.045 M

**Answer: D**



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65. The pH of an aqueous solution of a 0.1 M solution of a weak monoprotic acid which is 1% ionised is :

A. 1

B. 2

C. 3

D. 11

**Answer: C**



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66. 50 ml of 0.1 N HCl and 50 ml of 0.1 N NaOH are mixed. The pH of the resulting solution is :

A. 1



B. 2

C. 7

D. 9

**Answer: C**



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**67.** 1 ml of 0.1 N HCl is added to 1 L solution of sodium chloride. The pH of the resulting solution is

A. 7

B. 1

C. 4

D. 2

**Answer: C**



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**68.** 100 ml of 0.1 N NaOH are mixed with 100 ml of 0.2 N HCl solution and the whole solution is made upto 1 litre. The pH of the resulting solution is :

A. 1

B. 2

C. 3

D. 4

**Answer: B**



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69. The pH of a solution whose  $[OH^-] = 10^{-7}$  M is :

A. 14

B. zero

C. 7

D. -7

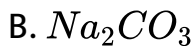
**Answer: C**



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70. Which of the following will have highest pH value in water solution ?

A. NaCl



**Answer: B**



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**71.** 0.2 molar solution of formic acid is ionized to 3.2 %. Its ionisation constant is :

A.  $9.6 \times 10^{-3}$

B.  $2.05 \times 10^{-4}$

C.  $1.25 \times 10^{-6}$

D.  $4.8 \times 10^{-5}$

**Answer: B**



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**72.** A certain sample of beer has a pH of 10. The concentration of hydrogen ions in the beer is :

A.  $10^{10} M$

B.  $10^{-2} M$

C.  $10^{-4} M$

D.  $10^{-10} M$

**Answer: D**



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73. A 0.01 M ammonia solution is 5% ionized, the concentration of  $OH^-$  ion is :

- A. 0.005 M
- B. 0.0001 M
- C. 0.0005 M
- D. 0.05 M

**Answer: C**

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74. Which of the following aqueous salt solutions is expected to have pH less than 7 ?

- A.  $CH_3COOK$



**Answer: D**



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**75.** The pH of  $2.5 \times 10^{-1}$  M HCN solution ( $K_a = 4 \times 10^{-10}$ )

is :

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

B. 2.0

C. 4.7

D. 5.0

**Answer: D**



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**76.** An acid solution of  $\text{pH} = 6$  is diluted 1000 times, the  $\text{pH}$  of the final solution becomes :

A. 6.95

B. 6

C. 3

D. 9

**Answer: A**



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77. 50 ml of solution of pH = 1 is mixed with 50 ml of solution of pH = 2. The pH of the mixture is nearly :

- A. 2
- B. 1.74
- C. 1.26
- D. 0

**Answer: C**

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78. The concentration of  $H^+$  ion in a sample of soft drink is  $3.8 \times 10^{-3} M$ . Its pH is :

- A. 3.42

B. 4.58

C. 2.42

D. 3.82

**Answer: C**



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**79.** ionisation constant of  $CH_3COOH$  is  $1.7 \times 10^{-5}$  and concentration of  $H^+$  is  $3.4 \times 10^{-4}$ . Then the initial concentration of  $CH_3COOH$  molecules is :

A.  $3.4 \times 10^{-4}$

B.  $3.4 \times 10^{-3}$

C.  $6.8 \times 10^{-3}$

D.  $1.7 \times 10^{-3}$

**Answer: C**



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**80.** A weak acid, HA has a  $K_a$  of  $1.00 \times 10^{-5}$ . If 0.100 mol of this acid is dissolved in one litre of water, the percentage of acid dissociated at equilibrium is closest to :

A. 1.00 %

B. 99.9 %

C. 0.100 %

D. 99.0 %

**Answer: A**



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**81.** Calculate the pOH of a solution at  $25^{\circ}\text{C}$  that contains  $1 \times 10^{-10}\text{M}$  of hydronium ions i.e  $\text{H}_3\text{O}^+$  :

A. 4.00

B. 9.00

C. 1.00

D. 7.00

**Answer: A**



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**82.** When a strong acid is titrated using a weak base, the pH value at equivalence point is :

A. 7

B.  $> 7$

C.  $< 7$

D.  $\approx 7$

**Answer: C**



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**83.** An acid solution of pH = 6 is diluted 1000 times, the pH of the final solution becomes :

- A. between 5 and 6
- B. between 6 and 7
- C. between 10 and 11
- D. between 7 and 8

**Answer: D**



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**84.** An acidic buffer solution can be prepared by mixing solution :

- A.  $CH_3COOH$  and  $CH_3COONa$
- B.  $CH_3CONH_2$  and KOH
- C.  $CH_3COOH$  and NaOH

D.  $CH_3NH_2$  and  $K_2CO_3$

**Answer: A**



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**85.** The buffer solution contains equal concentration of  $X^-$  and HX. The  $K_b$  for  $X^-$  is  $10^{-10}$ . The pH of the buffer solution is :

A. 4

B. 7

C. 10

D. 14

**Answer: A**



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**86.** The common example of buffer having pH of about 7.4 is :

A. Milk

B. Blood

C. Water

D. Lime water

**Answer: B**



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**87.** Which of the following is a buffer ?



A. HCl and NaCl

B. NaOH and  $NaNO_3$

C. KOH and KCl

D.  $NH_4OH$  and  $NH_4Cl$

**Answer: D**



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**88.** The pH of a buffer solution containing a weak acid ( $pK_a$ )

and its salt is :

A.  $pH = pK_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$

B.  $pH = pK_a + \log \frac{[\text{Acid}]}{[\text{Salt}]}$

C.  $pH = \frac{1}{2}pK_a + \log \frac{[\text{Acid}]}{[\text{Salt}]}$

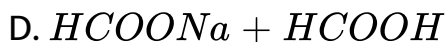
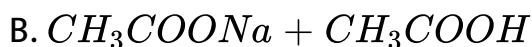
$$D. pH = \log pK_a + \log \frac{[\text{Acid}]}{[\text{Salt}]}$$

Answer: A



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89. Which of the following combinations would not result in the formation of a buffer solution ?



Answer: C



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90. The aqueous solution of aluminium chloride is acidic due to :

- A. Anion hydrolysis
- B. Formation of  $Al(OH)_3$
- C. Hydrolysis of cation and anion
- D. Cationic hydrolysis

**Answer: D**



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91. For the salt of weak acid and strong base, the hydrolysis constant is given by the expression :

A.  $K_h = \frac{K_w}{K_b}$

B.  $K_h = \frac{K_w}{K_a K_b}$

C.  $K_h = K_a$

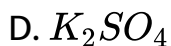
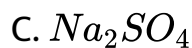
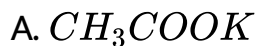
D.  $K_h = \frac{K_w}{K_a}$

**Answer: D**



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**92.** Which of the following undergoes hydrolysis ?

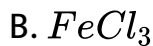
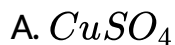


**Answer: A**



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**93.** Which of the following aqueous solutions has pH greater than 7 ?



**Answer: D**



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94. The pH of a buffer solution containing ratio of concentration of salt of weak acid and weak acid equal to 2 is ( $pK_a = 4.75$ ,  $\log 2 = 0.3010$ ) :

A. 4.45

B. 5.05

C. 1.425

D. 13.699

**Answer: B**



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95. Which of the following relation is correct for degree of hydrolysis of  $CH_3COONH_4$  ?

A.  $h = \sqrt{\frac{K_h}{c}}$

B.  $h = \sqrt{\frac{K_a}{K_b}}$

C.  $h = \sqrt{\frac{K_w}{K_a K_b}}$

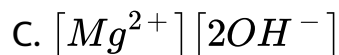
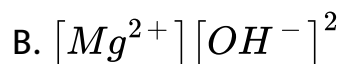
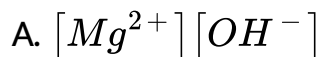
D.  $h = \sqrt{\frac{K_a K_b}{K_h}}$

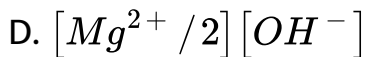
**Answer: C**



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**96.** The solubility product of  $Mg(OH)_2$  may be written as :





**Answer: B**



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97. If  $x$  is the solubility in  $\text{mol L}^{-1}$  of  $Ca_3(PO_4)_2$ . Its  $K_{sp}$  is equal to :

A.  $x^5$

B.  $108x^5$

C.  $6x^5$

D.  $4x^4$

**Answer: B**



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98. At a certain temperature, the solubility of the salt  $M_m A_n$  in water is  $s$  moles per litre. The solubility product of the salt is :

A.  $M^m A^n$

B.  $(m + n)s^{m+n}$

C.  $m^m n^n s^{m+n}$

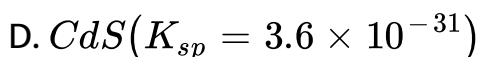
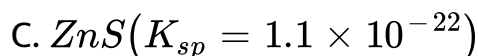
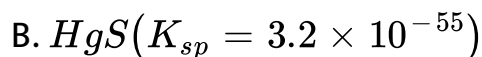
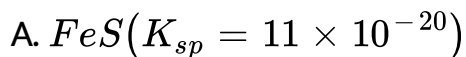
D.  $M^m A^n s$

**Answer: C**



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99. Which of the following metal sulphides will be precipitated first from a solution having almost equal concentration of metal ion ?



**Answer: B**



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100. When  $NH_4Cl$  is added to a solution of  $NH_4OH$ ,

- A. The dissociation of  $NH_4OH$  increases
- B. The concentration of  $OH^-$  ions increases
- C. Dissociation of  $NH_4Cl$  decreases
- D. The concentration of  $OH^-$  ions decreases

**Answer: D**



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**101.** The concentration of  $Ag^+$  ion in a given saturated solution of  $AgCl$  at  $25^\circ C$  is  $1.06 \times 10^{-5} g$  ion per litre. Thus, the solubility product of  $AgCl$  is :

A.  $0.353 \times 10^{-10}$

B.  $0.530 \times 10^{-10}$

C.  $1.12 \times 10^{-10}$

D.  $2.12 \times 10^{-10}$

**Answer: C**

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**102.** The solubility product of a sparingly soluble salt AB at room temperature is  $1.21 \times 10^{-6} M^2$ . Its molar solubility is :

A.  $1.21 \times 10^{-6} M$

B.  $1.1 \times 10^{-4} M$

C.  $1.1 \times 10^{-3} M$

D.  $1.1 \times 10^{-5} M$

**Answer: C**



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**103.** The solubility product of a compound  $MX_2$  is  $3.2 \times 10^{-11}$ . Its solubility is :

A.  $0.8 \times 10^{-4}$

B.  $2 \times 10^{-3}$

C.  $2 \times 10^{-4}$

D.  $1.6 \times 10^{-6}$

**Answer: C**



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**104.** Solubility product of  $PbCl_2$  at 298 K is  $1.0 \times 10^{-6}$ . At this temperature solubility of  $PbCl_2$  in moles per litre is :

A.  $(1.0 \times 10^{-6})^{1/2}$

B.  $(1.0 \times 10^{-6})^{1/3}$

C.  $(0.25 \times 10^{-6})^{1/3}$

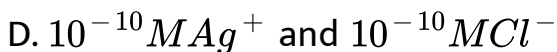
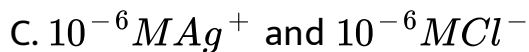
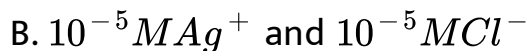
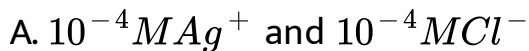
D.  $(0.25 \times 10^{-6})^{1/2}$

**Answer: C**



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**105.** When equal volume of the following solutions are mixed, precipitation of  $AgCl$  ( $K_{sp} = 1.8 \times 10^{-10}$ ) will occur only with :



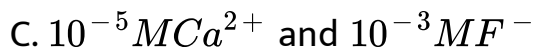
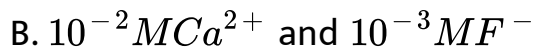
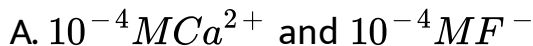
**Answer: A**



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**106.** The precipitate of calcium fluoride ( $K_{sp} = 1.7 \times 10^{-10}$ )

is obtained when equal volumes of the following are mixed :



D.  $10^{-3}MCa^{2+}$  and  $10^{-5}MF^{-}$

**Answer: B**



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**107.** The solubility of  $CaF_2$  is  $2 \times 10^{-4}molL^{-1}$ . Its solubility product is :

A.  $2.0 \times 10^{-8}$

B.  $4.0 \times 10^{-12}$

C.  $8.0 \times 10^{-12}$

D.  $3.2 \times 10^{-11}$

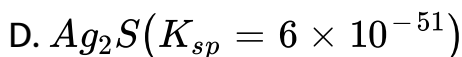
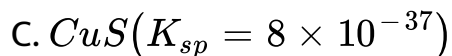
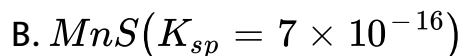
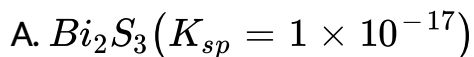
**Answer: D**



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108. Which of the following is most soluble ?



Answer: B



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109. The solubility product of strontium fluoride is  $8.0 \times 10^{-11}$ . At what concentration of  $Sr^{2+}$  ion the

precipitation of strontium fluoride would start from a solution containing  $0.01M F^-$  ion ?

A.  $8. \times 10^{-9}M$

B.  $8 \times 10^{-13}M$

C.  $8.0 \times 10^{-7}M$

D.  $1.25 \times 10^{-9}M$

**Answer: C**



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**110.** A solution contains  $0.01 M$  metal ion ( $Zn^{2+}$  and  $Cu^{2+}$ ).

It is saturated by passing  $H_2S$  gas in the M. The solubility

products of  $ZnS$  and  $CuS$  are  $3.0 \times 10^{-22}$  and  $8.0 \times 10^{-36}$

respectively. Which of the following will occur ?

- A. ZnS will precipitate
- B. CuS will precipitate
- C. Both ZnS and CuS will precipitate
- D. Both  $Zn^{2+}$  and  $Cu^{2+}$  will remain in the solution.

**Answer: B**



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## Multiple Choice Questions Level II

1. Which of the following statements is not correct ?

- A. The solubility of  $NH_4Cl$  increases with increase of temperature.

B. The equilibrium constant value depends upon the presence of catalyst.

C. The equilibrium can be attained only if the system is closed.

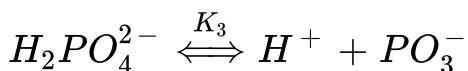
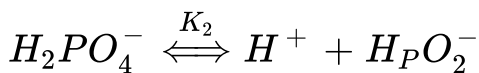
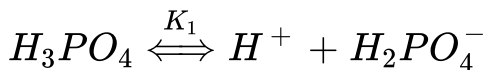
D. Both chemical and physical equilibrium are dynamic.

**Answer: B**

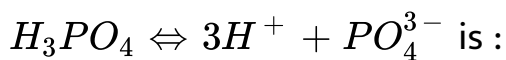


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**2. Phosphoric acid ionises as :**



The equilibrium constant, K for the reaction :



A.  $K_1 / K_2 K_3$

B.  $K_1 + K_2 + K_3$

C.  $K_3 / K_1 K_2$

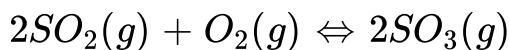
D.  $K_1 K_2 K_3$

**Answer: D**

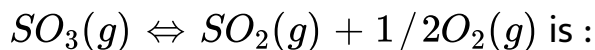


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**3.** The equilibrium constant for the reaction



is 256 at 1000 K. The equilibrium constant for the reaction :



A. 16

B.  $\frac{1}{256}$

C. 256

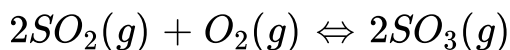
D.  $\frac{1}{16}$

**Answer: D**



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4. The equilibrium constant,  $K_p$  for the reaction



is  $4.0 \text{ atm}^{-1}$  at 1000 K. What would be the partial pressure of  $SO_2$  if at equilibrium the amount of  $SO_2$  and  $SO_3$  is the same ?

A. 16.0 atm

B. 0.25 atm

C. 1 atm

D. 0.75 atm

**Answer: B**



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5. At  $30^\circ\text{C}$ ,  $K_p$  for the dissociation reaction :



is  $2.9 \times 10^{-2}$  atm. If the total pressure is 1 atm, the degree of dissociation of  $\text{SO}_2\text{Cl}_2$  is : (assume  $1 - \alpha^2 = 1$ ).

A. 87 %

B. 13 %

C. 17 %

D. 29 %

**Answer: C**

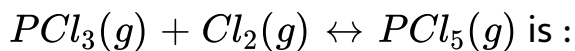


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**6.** At a given temperature, the equilibrium constant for the reaction :



is  $2.4 \times 10^{-3}$ . At the same temperature, the equilibrium constant for the reaction :



A.  $2.4 \times 10^{-3}$



B.  $-2.4 \times 10^{-3}$

C.  $4.2 \times 10^2$

D.  $4.8 \times 10^{-2}$

**Answer: C**



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7. If  $K_{a_1}$  and  $K_{a_2}$  of sulphuric acid are  $1 \times 10^{-2}$  and  $1 \times 10^{-6}$  respectively, then concentration of sulphate ions in  $0.01M H_2SO_4$  solution will be :

A.  $1 \times 10^{-2}$

B.  $0.01 \times 10^{-8}$

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

D.  $0.01 \times 10^{-10}$

**Answer: A**



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8. The pH of a solution is 6. Sufficient amount of acid is added to decrease the pH to 2. The increase in hydrogen ion concentration is :

- A. 1. four times
- B. 2.  $1/4$  times
- C. 3. hundred times
- D. 4. Ten thousand times

**Answer: D**



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9. In a buffer solution of weak acid and its salt, when the concentration of salt to acid is increased by 10 times, the pH of the solution,

A. decreases 10 times

B. increases 10 times

C. increases by 1

D. decreases by 1

**Answer: C**



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10. What will be the pOH of  $0.5 \times 10^{-4} M H_2SO_4$  solution ?

A. 4

B. 10.5

C. 10

D. 6

**Answer: C**



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11. Given that  $K_a$  for acetic acid is  $1.8 \times 10^{-5}$  and  $K_b$  for  $NH_4OH$  is  $1.8 \times 10^{-5}$  at  $25^\circ C$ . Predict the nature of aqueous solution of ammonium acetate.

A. acidic

B. basic

C. slightly acidic

D. neutral

**Answer: D**



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**12.** The dissociation constant of two acids are  $K_1$  and  $K_2$ . The relative strengths of two acids are given by :

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

B.  $\log \frac{K_1}{K_2}$

C.  $\frac{K_1 + \sqrt{K_2}}{K_2 + \sqrt{K_1}}$

D.  $\left(\frac{K_1}{K_2}\right)^{3/2}$

**Answer: A**



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**13.** The addition of solid sodium carbonate to pure water causes :

- A. increase in  $H^+$  ion concentration
- B. decrease in pH
- C. an increase in pH
- D. no change in pH

**Answer: C**



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14. The solubility product of a compound MX is  $2.5 \times 10^{-9}$  at  $25^\circ C$ . Its solubility at  $25^\circ C$  is :

A.  $2.5 \times 10^{-5}$

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

C.  $2.5 \times 10^{-6}$

D.  $5 \times 10^{-4}$

**Answer: B**



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15. What would be the solubility of AgCl in 0.1 M NaCl solution? ( $K_{sp}$  for AgCl =  $1.2 \times 10^{-10}$ )

A. 0.1 M

B.  $1.2 \times 10^{-6} M$

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

D.  $1.2 \times 10^{-10} M$

**Answer: C**



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**16.** A 0.1 M solution of a weak acid HA is 1% dissociated. The approximate value of dissociation constant is :

A.  $1.0 \times 10^{-4} molL^{-1}$

B.  $0.1 \times 10^{-2} molL^{-1}$

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



D.  $0.1 \times 10^{-4} \text{ mol L}^{-1}$

**Answer: D**



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17. The solubility of a compound  $MX_2$  at  $25^\circ C$  is  $5.0 \times 10^{-3}$  mol/L. Its solubility product at that temperature is :

A.  $25 \times 10^{-6}$

B.  $5.0 \times 10^{-11}$

C.  $5.0 \times 10^{-7}$

D.  $1.25 \times 10^{-9}$

**Answer: C**



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18. When a 0.1 M solution of an acid at room temperature has degree of ionisation of 10%, the concentration of hydroxyl ions is :

A.  $10^{-2}$

B.  $10^{-12}$

C.  $10^{-11}$

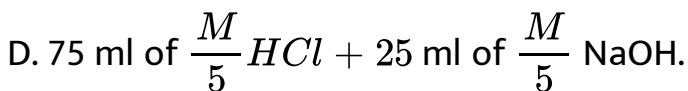
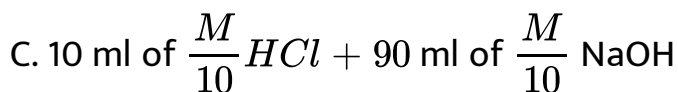
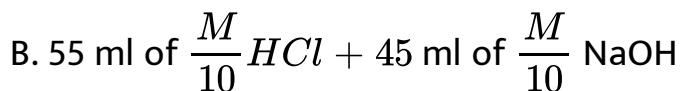
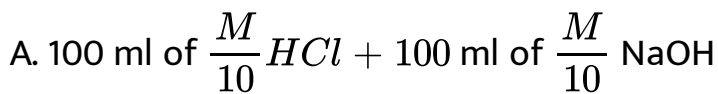
D.  $10^{-9}$

**Answer: B**



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19. Which of the following mixture solution has  $pH \approx 1.0$  ?



**Answer: D**



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**20.** A buffer solution contains 0.1 M each of acetic acid and sodium acetate. The pH of the buffer solution is ( $pK_a(CH_3COOH) = 4.75$ ):

A. 4.75

B. 5.75

C. 6.75

D. 9.25

**Answer: A**

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21. Ammonium cyanide is a salt of  $NH_4OH$  ( $K_b = 1.8 \times 10^{-5}$ ) and  $HCN$  ( $K_a = 4.0 \times 10^{-10}$ ).

The hydrolysis constant of 0.1 M  $NH_4CN$  at  $25^\circ C$  is :

A. 1.4

B.  $7.2 \times 10^{-15}$

C.  $7.2 \times 10^{-1}$

D.  $1.4 \times 10^{-6}$

**Answer: A**



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22. When 0.01 moles of sodium hydroxide are added to a buffer solution, its pH changes from 4.745 to 4.815. The buffer capacity of the buffer solution is :

A. 0.07

B. 0.14

C. 0.28

D. 0.07

**Answer: B**



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23. Let the solubilities of AgCl in water, in 0.01 M  $CaCl_2$ , in 0.01 M NaCl and 0.05M  $AgNO_3$  be  $S_1, S_2, S_3$  and  $S_4$  respectively. Which of the following relationship between these quantities is correct ?

A.  $S_1 > S_2 > S_3 > S_4$

B.  $S_1 > S_2 = S_3 > S_4$

C.  $S_4 > S_2 > S_3 > S_1$

D.  $S_1 > S_3 = S_2 > S_4$

**Answer: B**



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

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

B.  $10^{-3}$  M  $NH_4OH$

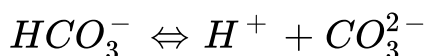
C. Pure water

D.  $10^{-3}$  M HBr.

**Answer: B**

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25. For the equilibrium :



$$K = 4.8 \times 10^{-11}, [CO_3^{2-}] = 1.1 \times 10^{-3} M,$$

$$[\text{HCO}_3^-] = 9.8 \times 10^{-3} \text{ M}$$

The pH of the solution is :

A. 8.37

B. 9.37

C. 6.0

D. 8.0

**Answer: A**



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**26.** The pH of solution obtained by mixing equal volumes of two aqueous solutions of pH 5 and pH 3 of the same substance is :



A. 3.5

B. 4.5

C. 3.3

D. 4

**Answer: C**



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**27.** The conjugate acid of  $NH_2^-$  is :

A.  $NH_3$

B.  $NH_2OH$

C.  $NH_4^+$

D.  $N_2H_4$

**Answer: A**



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**28.** 50 ml of 0.1 M HCl and 50 ml of 0.2 M NaOH are mixed. The pH of the resulting solution is :

A. 1.30

B. 4.2

C. 12.70

D. 11.70

**Answer: A**



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29. Solubility of AgCl will be minimum in :

A. 0.01 M NaCl

B. 0.01M  $CaCl_2$

C. Pure water

D. 0.001M  $AgNO_3$

**Answer: B**



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30. The pH of an aqueous solution of  $Mg(OH)_2$  is 9.0. If the solubility product of  $Mg(OH)_2$  is  $1 \times 10^{-11}$ , what is  $[Mg^{2+}]$  ?

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

B.  $1.0 \times 10^{-4}$

C.  $1 \times 10^{-2}$

D. 0.1

**Answer: D**



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**31.** Equal volumes of two solutions of pH 4 and pH 11 are mixed. The pH of the resulting solution will be :

A. 7.5

B. 3.35

C. 13

D. 3.04

**Answer: B**



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**32.** At 298 K, the solubility product of MI is  $10^{-6}$  (conc. Are expressed as mol  $kg^{-1}$ ). The solubility of MI in 0.1 molal KI solution is :

A.  $10^{-6} mol kg^{-1}$

B.  $10^{-5} mol kg^{-1}$

C.  $10^{-4} mol kg^{-1}$

D.  $10^{-3} mol kg^{-1}$

**Answer: B**



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**33.** The  $pK_a$  of HCN is 9.30. The pH of a solution prepared by mixing 2.5 moles of KCN and 2.5 moles of HCN in water and making up the total volume of 500 ml is :

A. 9.30

B. 7.30

C. 10.30

D. 8.30

**Answer: A**



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34. If the solubility of lithium sodium hexafluoro aluminate  $Li_3Na_3(AlF_6)_2$  is  $x \text{ mol L}^{-1}$ , then its solubility product is equal to :

A.  $18x^3$

B.  $12x^3$

C.  $x^8$

D.  $2916x^8$

**Answer: D**



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35. The  $K_{sp}$  of  $BaCrO_4$  is  $2.4 \times 10^{-10} M^2$ . The maximum concentration of  $Ba(NO_3)_2$  possible without precipitation

in a  $6 \times 10^{-4} M K_2CrO_4$  solution is

A.  $4 \times 10^{-7} M$

B.  $1.2 \times 10^{10} M$

C.  $6 \times 10^{-4} M$

D.  $3 \times 10^{-4} M$

**Answer: A**

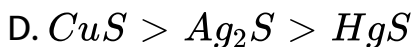
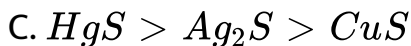


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**36.** The  $K_{sp}$  of  $CuS$ ,  $Ag_2S$  and  $HgS$  are  $10^{-31}$ ,  $10^{-44}$  and  $10^{-54}$  respectively. The solubility of these hydrides are in the order :

A.  $Ag_2S > CuS > HgS$





**Answer: D**



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**37.** In a saturated solution of calcium phosphate, the concentration of  $PO_4^{3-}$  ions is  $3.3 \times 10^{-7} M$ . The  $K_{sp}$  of  $Ca_3(PO_4)_2$  will be :

A.  $1.32 \times 10^{-31}$

B.  $1.32 \times 10^{-32}$

C.  $1.32 \times 10^{-33}$

D.  $1.32 \times 10^{-35}$

**Answer: B**



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**38.** How many grams of  $CaC_2O_4$  will be dissolved in 1L of distilled water to make its saturated solution ? (

$K_{sp}$  of  $CaC_2O_4 = 2.5 \times 10^{-9}$  and mol. wt. of

$CaC_2O_4 = 128$ ) :

A. 0.0064 g

B. 0.0128 g

C. 0.0032 g

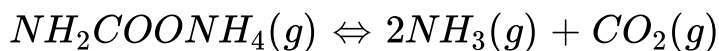
D. 0.0640 g

**Answer: A**



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**39.** For the reaction :



equilibrium pressure was found to be 3 atm at 1000 K.  $K_p$  is :

A.  $\frac{4}{27}$

B. 4

C. 27

D.  $\frac{27}{4}$

**Answer: B**



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40. It has been found that the pH of a 0.01 M solution of an organic acid is 4.15. The concentration of the anion of the acid is :

A. 4.15

B. 3.85

C.  $7.08 \times 10^{-5}$

D.  $7.08 \times 10^{-4}$

**Answer: C**



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41. Solubility product of silver bromide is  $5.0 \times 10^{-13}$ . The quantity of potassium bromide (molar mass taken as 120 g  $mol^{-1}$ ) to be added to 1 litre of 0.05 M solution of silver nitrate to start the precipitation of AgBr is :

A.  $2.5 \times 10^{-14} g$

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

C.  $1.2 \times 10^{-11} g$

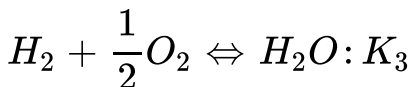
D.  $2.5 \times 10^{-9} g$

**Answer: B**

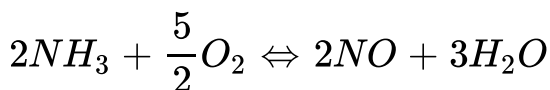


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42. The following equilibrium are given :



The equilibrium constant of the reaction :



in terms of  $K_1$ ,  $K_2$  and  $K_3$  is :

A.  $K_1 \cdot K_2 \cdot K_3$

B.  $K_1 K_2 / K_3$

C.  $K_1 K_3^2 / K_2$

D.  $K_2 K_3^3 / K_1$

**Answer: D**



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43. Which of the following is true for diprotic acid,  $H_2X$  ?

A.  $K_{a2} > K_{a1}$

B.  $K_{a1} > K_{a2}$

C.  $K_{a2} = \frac{1}{K_{a1}}$

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

**Answer: B**



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

A.  $1.0 \times 10^{-5} \text{ mol L}^{-1}$

B.  $1.0 \times 10^{-6} \text{ mol L}^{-1}$

C.  $2.0 \times 10^{-6} \text{ mol L}^{-1}$

D.  $1.0 \times 10^{-7} \text{ mol L}^{-1}$

**Answer: D**



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**45.** The hydrogen ion concentration of a  $10^{-8}$  M HCl aqueous solution at 298 K ( $K_w = 10^{-14}$ ) is :

A.  $1.05 \times 10^{-7} \text{ M}$

B.  $9.525 \times 10^{-8} \text{ M}$

C.  $1.0 \times 10^{-8} \text{ M}$



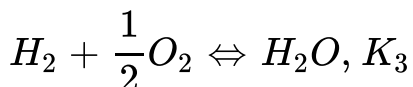
$$D. 1.0 \times 10^{-6} M$$

**Answer: A**



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**46.** The following equilibrium constants are given :



The equilibrium constant for the oxidation of  $NH_3$  by oxygen to give NO is :

A.  $K_2 \frac{K_3^2}{K_1}$

B.  $K_2^2 K_3 / K_1$

C.  $K_1 K_2 / K_3$

D.  $K_2 K_3^3 / K_1$

Answer: D



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47. Consider the reaction where  $K_p = 0.497$  at 500 K.



If the three gases are mixed in a rigid container so that the partial pressure of each gas is initially 1 atm, which is true ?

A. More  $PCl_5$  will be produced

B. More  $PCl_3$  will be produced

C. Equilibrium will be established when 50% reaction is complete

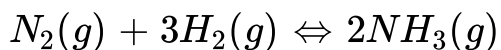
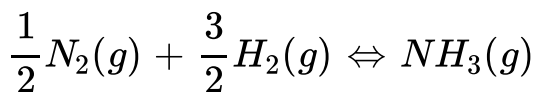
D. None of the above

Answer: A



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48.  $K_p$  and  $K'_p$  are equilibrium constants of the two reactions given below :



Therefore  $K_p$  and  $K'_p$  are related by :

A.  $K_p = K_p'^2$

B.  $K_p = \sqrt{K_p'}$

C.  $K_p = 2K_p'$

D.  $K_p = K'_p$

**Answer: B**



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**49.** The solubility product of a sparingly soluble metal hydroxide,  $M(OH)_2$  at 298 K is  $5 \times 10^{-16} \text{ mol}^3 \text{ dm}^{-9}$ . The pH value of its aqueous and saturated solution is :

A. 5

B. 9

C. 11.5

D. 2.5

**Answer: B**



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50. Determine pH of the solution that results from addition of 20 ml of  $0.01M Ca(OH)_2$  to 30 ml of 0.01 M HCl.

A. 11.30

B. 10.53

C. 2.70

D. 8.35

**Answer: A**



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51. The solubility product of iron (III) hydroxide is  $1.6 \times 10^{-39}$ . If  $x$  is the solubility of iron (III) hydroxide, then which of the following expressions can be used to calculate  $x$ ?

A.  $K_{sp} = x^4$

B.  $K_{sp} = 9x^4$

C.  $K_{sp} = 27x^3$

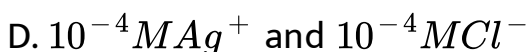
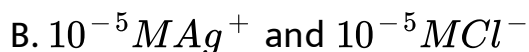
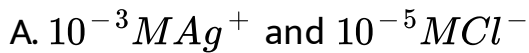
D.  $K_{sp} = 27x^4$

**Answer: D**



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52. When equal volume of the following solutions are mixed, precipitation of  $AgCl$  ( $K_{sp} = 1.8 \times 10^{-10}$ ) will occur only with :



**Answer: D**



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53. Solubility of  $CaF_2$  in terms of its solubility product is given by :

A.  $s = (K_{sp})^{\frac{1}{3}}$

B.  $s = \left(\frac{K_{sp}}{2}\right)^{\frac{1}{3}}$

C.  $s = \left(\frac{K_{sp}}{4}\right)^{\frac{1}{3}}$

D.  $s = \left(\frac{K_{sp}}{2}\right)^{\frac{1}{2}}$

**Answer: C**



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**54.** When 200 ml of aqueous solution of HCl (pH = 2) is mixed with 300 ml of of an aqueous solution of NaOH (pH = 12), the pH of the resulting mixture is :

A. 10

B. 2.7



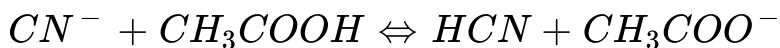
C. 4.0

D. 11.2

**Answer: D**

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55. The dissociation constants of acetic acid and HCN at  $25^\circ\text{C}$  are  $1.5 \times 10^{-4}$  and  $4.5 \times 10^{-10}$  respectively. The equilibrium constant for the equilibrium.



A.  $3 \times 10^{+5}$

B.  $3 \times 10^{-4}$

C.  $3 \times 10^{-5}$

D.  $3 \times 10^4$

**Answer: D**



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**56.** The ionisation constant of ammonium hydroxide is  $1.77 \times 10^{-5}$  at 298 K. Hydrolysis constant of ammonium chloride is :

A.  $6.5 \times 10^{-12}$

B.  $5.65 \times 10^{-13}$

C.  $5.65 \times 10^{-12}$

D.  $5.65 \times 10^{-10}$

**Answer: D**



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57. For the reaction  $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ , the standard free energy is  $\Delta G^\circ > 0$ . The equilibrium constant ( $K$ ) would be

A.  $K = 0$

B.  $K > 1$

C.  $K = 1$

D.  $K < 1$

Answer: D



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58.  $PCl_5$ ,  $PCl_3$  and  $Cl_2$  are at equilibrium at 500 K in a closed container and their concentrations are  $0.8 \times 10^{-3} \text{ mol L}^{-1}$ ,  $1.2 \times 10^{-3} \text{ mol L}^{-1}$  respectively. The value of  $K_c$  for the reaction

$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$  will be

A.  $1.8 \times 10^{-3} \text{ mol L}^{-1}$

B.  $1.8 \times 10^3$

C.  $1.8 \times 10^{-3} \text{ L mol}^{-1}$

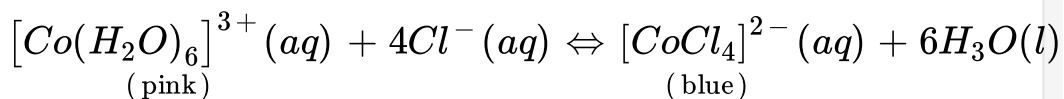
D.  $0.55 \times 10^4$

**Answer: B**



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59. When hydrochloric acid is added to cobalt nitrate solution at room temperature, 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 correct answer.



- 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  $\Delta H$  cannot be predicted on the basis of this information.

**Answer: A**



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60. The pH of neutral water at  $25^{\circ}\text{C}$  is 7.0. As the temperature increases, ionization of water increases, however the concentration of  $\text{H}^{+}$  ions and  $\text{OH}^{-}$  ions are equal. What will be the pH of pure water at  $60^{\circ}\text{C}$ ?

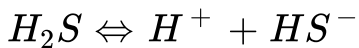
- A. Equal to 7.0
- B. Greater than 7.0
- C. Less than 7.0
- D. Equal to zero

**Answer: C**



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61.  $K_{a_1}$ ,  $K_{a_2}$  and  $K_{a_3}$  are the respective ionisation constants for the following reactions.



The correct relationship between  $K_{a_1}$ ,  $K_{a_2}$  and  $K_{a_3}$  is

A.  $K_{a_3} = K_{a_1} \times K_{a_2}$

B.  $K_{a_3} = K_{a_1} = K_{a_1} + K_{a_2}$

C.  $K_{a_3} = K_{a_1} - K_{a_2}$

D.  $K_{a_3} = K_{a_1} / K_{a_2}$

**Answer: A**



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62. Acidity of  $BF_3$  can be explained on the basis of which of the following concepts ?

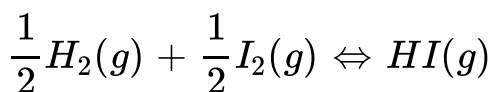
- A. Arrhenius concept
- B. Bronsted Lowry concept
- C. Lewis concept
- D. Bronsted Lowry as well as Lewis concept.

**Answer: C**



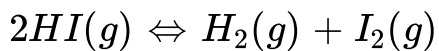
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63. At 500 K, equilibrium constant,  $K_c$ , for the following reaction is 5.





What would be the equilibrium constant  $K_c$  for the reaction



A. 0.04

B. 0.4

C. 25

D. 2.5

**Answer: A**



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**64.** Which of the following options will be correct for the stage of half completion of the reaction  $A \rightleftharpoons B$ ?

A.  $\Delta G^\circ = 0$

B.  $\Delta G^\circ > 0$

C.  $\Delta G^\circ < 0$

D.  $\Delta G^\circ = -RT \ln 2$

**Answer: A**



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**65.** The ratio of the forward reaction is two times that of the reverse reaction at a given temperature and identical concentration.  $K_{\text{equilibrium}}$  is

A. 0.5

B. 1.5

C. 2.5

D. 2.0

**Answer: D**



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**66.** When rain is accompanied by a thunder storm, the collected rainwater will have pH value

- A. 1. slightly higher than that when the thunder storm is not there
- B. 2. uninfluenced by the thunder storm
- C. 3. depends upon the amount of dust in air
- D. 4. slightly lesser than of rain water without thunder storm.

**Answer: D**



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**67.**  $H_2S$  gas when passed through solution of cations containing HCl precipitates the cations of second group of qualitative analysis but not those belonging to the fourth group. It is because

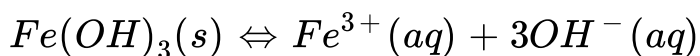
- A. presence of HCl decreases the sulphide ion concentration
- B. sulphides of group IV cations are unstable in HCl
- C. solubility product of group II sulphides is more than that of group IV sulphides

D. presence of HCl increase the sulphide ion concentration

**Answer: A**

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**68.** If the concentration of  $OH^-$  ions in the reaction



is decreased by  $1/4$  times, then equilibrium concentration of  $Fe^{3+}$  will increase by

A. 8 times

B. 16 times

C. 64 times

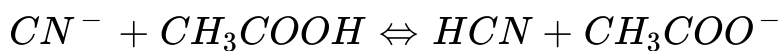
D. 4 times

Answer: C



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69. The dissociation constants of acetic acid and HCN at  $25^\circ\text{C}$  are  $1.5 \times 10^{-4}$  and  $4.5 \times 10^{-10}$  respectively. The equilibrium constant for the equilibrium.



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

B.  $3 \times 10^{-4}$

C.  $3 \times 10^4$

D.  $3 \times 10^5$

**Answer: C**



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70. What is the  $[OH^-]$  in the final solution prepared by mixing 20 mL of 0.050 M HCl with 30.0 mL of 0.10M  $Ba(OH)_2$  ?

A. 0.40 M

B. 0.0050 M

C. 0.12 M

D. 0.10 M

**Answer: D**



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71. A buffer solution contains 0.1 mole of sodium acetate dissolved in  $1000\text{cm}^3$  of 0.1 M acetic acid. To the above buffer solution, 0.1 mole of sodium acetate is further added and dissolved. The pH of the resulting buffer is

A.  $pK_a$

B.  $pK_a + 2$

C.  $pK_a - \log 2$

D.  $pK_a + \log 2$

**Answer: D**



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72. A buffer solution is prepared in which the concentration of  $NH_3$  is 0.30 M and concentration of  $NH_4^+$  is 0.20 M. If equilibrium constant  $K_b$  for  $NH_3$  equals  $1.8 \times 10^{-5}$ , what is the pH of the solution ?

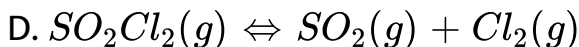
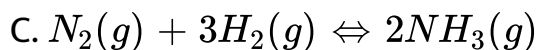
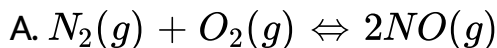
- A. 9.08
- B. 9.43
- C. 11.72
- D. 8.72

**Answer: B**



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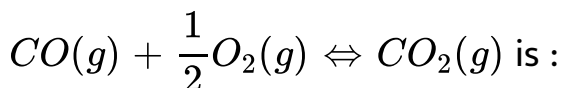
73. In which of the following equilibrium, change in volume of the system does not alter the number of moles ?



**Answer: A**

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74. The ratio of  $K_p / K_c$  for the reaction :



A. 1

B.  $RT$

C.  $1/\sqrt{RT}$

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

**Answer: C**



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75. A solution of  $10^{-3} M$  each in  $Mn^{2+}$ ,  $Fe^{2+}$ ,  $Zn^{2+}$  and  $Hg^{2+}$  is heated with  $10^{-16} M$  sulphide ion. If  $K_{sp}$  of  $MnS$ ,  $FeS$ ,  $ZnS$  and  $HgS$  are  $10^{-15}$ ,  $10^{-23}$ ,  $10^{-20}$  and  $10^{-54}$  respectively which one will precipitate first ?

A.  $FeS$

B. MnS

C. HgS

D. ZnS

**Answer: C**



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**76.** The conjugate base of  $H_2PO_4^-$  is :

A.  $H_3PO_4$

B.  $P_2O_5$

C.  $PO_4^{3-}$

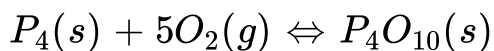
D.  $HPO_4^{2-}$

Answer: D



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77. What is the equilibrium expression for the reaction :



A.  $K = [O_2]^5$

B.  $K_c = \frac{[P_4O_{10}]}{5[P_4][O_2]}$

C.  $K_c = \frac{[P_4O_{10}]}{[P_4][O_2]^5}$

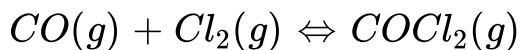
D.  $K_c = \frac{1}{[O_2]^5}$

Answer: D



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78. For the reaction :



the  $K_p/K_c$  is equal to :

A.  $\sqrt{RT}$

B.  $RT$

C.  $1/RT$

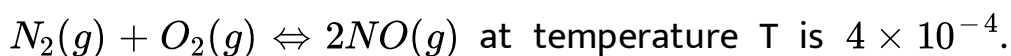
D. 1.0

**Answer: B**



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79. The equilibrium constant for the reaction



The value of  $K_c$  for the reaction

$NO(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g)$  at the same temperature is :

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

B. 50

C.  $2.5 \times 10^2$

D. 0.02

**Answer: B**



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**80.** The molar solubility (in mol  $L^{-1}$ ) of a sparingly soluble salt  $MX_4$  is 's'. The corresponding solubility product is  $K_{sp}$ .

'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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**81.** A weak acid HX has the dissociation constant  $1 \times 10^{-5} M$ .

It forms a salt NaX on reaction with alkali. The percentage hydrolysis of 0.1 M solution of NaX is :

A. 0.0001 %

B. 0.01 %



C. 0.1 %

D. 0.15 %

**Answer: B**



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**82.** The exothermic formation of  $ClF_3$  is represented by the reaction :



Which of the following will increase the quantity of  $ClF_3$  in an equilibrium mixture of  $Cl_2$ ,  $F_2$  and  $ClF_3$  ?

A. Increasing the temperature

B. Removing  $Cl_2$

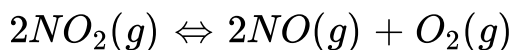
C. Increasing volume of the container

D. Adding  $F_2$

**Answer: D**

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**83.** For the reaction :



$$[K_c = 1.8 \times 10^{-6} \text{ at } 184^\circ C, R = 0.0831 \text{ kJ (mol, K)}]$$

When  $K_p$  and  $K_c$  are compared at  $184^\circ C$ , it is found that :

A.  $K_p$  is greater than  $K_c$

B.  $K_p$  is less than  $K_c$

C.  $K_p = K_c$

D. whether  $K_p$  is greater than, less than or equal to  $K_c$  depend upon the total gas pressure.

**Answer: A**

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**84.** What is the conjugate base of  $OH^-$  ?

A.  $O_2$

B.  $H_2O$

C.  $O^-$

D.  $O^{2-}$

**Answer: D**

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85. Hydrogen ion concentration in mol/L in a solution of pH = 5.4 will be :

A.  $3.98 \times 10^{-8}$

B.  $3.88 \times 10^6$

C.  $3.68 \times 10^{-6}$

D.  $3.98 \times 10^{-6}$

**Answer: D**



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86. 0.1 mol of  $CH_3NH_2$  ( $K_b = 5.0 \times 10^{-4}$ ) is mixed with 0.08 mol of HCl and diluted to one litre. What will be the  $H^+$  ion concentration in the solution ?

A.  $8 \times 10^{-2} M$

B.  $8 \times 10^{-11} M$

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

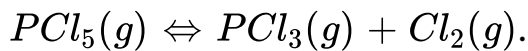
D.  $8 \times 10^{-5} M$

**Answer: B**



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87. Phosphorus pentachloride dissociates as follows in a closed vessel



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

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

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

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

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

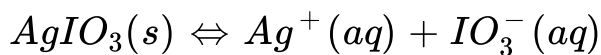
**Answer: D**



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**88.** In a saturated solution of the sparingly soluble strong electrolyte.  $AgIO_3$  (molecular mass = 283), the equilibrium

which sets in is :



If the solubility product constant,  $K_{sp}$  of  $AgIO_3$  at a given temperature is  $1.0 \times 10^{-8}$ , what is the mass of  $AgIO_3$  contained in 100ml of its saturated solution ?

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

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

C.  $1.0 \times 10^{-4}g$

D.  $28.3 \times 10^{-2}g$

**Answer: A**



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89. The first and second dissociation constants of an acid  $H_2A$  are  $1.0 \times 10^{-5}$  and  $5.0 \times 10^{-10}$  respectively. The overall dissociation constant of the acid will be :

A.  $5.0 \times 10^{15}$

B.  $5.0 \times 10^{-15}$

C.  $0.2 \times 10^5$

D.  $5.0 \times 10^{-5}$

**Answer: B**



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90. The  $pK_{a0}$  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. 2.5

B. 9.5

C. 7.0

D. 4.5

**Answer: B**



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### Multiple Choice Questions Level Iii

1. Solid  $Ba(NO_3)_2$  is gradually dissolved in a  $10^{-4}MNa_2CO_3$  solution. At what concentration 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.  $8.1 \times 10^{-8} M$

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

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

**Answer: C**



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**2.** In aqueous solution the ionization constants for carbonic acid are :

$$K_1 = 4.2 \times 10^{-7} \text{ and } K_2 = 4.8 \times 10^{-11}$$

Select the correct statement for a saturated 0.034 M solution of carbonic acid.

- A. The concentration of  $H^+$  and  $HCO_3^-$  are approximately equal.
- B. The concentration of  $H^+$  is double that of  $CO_3^{2-}$ .
- C. The concentration of  $CO_3^{2-}$  is 0.034 M.
- D. The concentration of  $CO_3^{2-}$  is greater than that of  $HCO_3^-$ .

**Answer: A**



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3. At  $25^{\circ}\text{C}$  the solubility product of  $\text{Mg}(\text{OH})_2$  is  $1.0 \times 10^{-11}$ . At which pH, will  $\text{Mg}^{2+}$  ions start precipitating in the form of  $\text{Mg}(\text{OH})_2$  from a solution of  $0.001\text{M Mg}^{2+}$  ions ?

A. 1

B. 8

C. 9

D. 10

**Answer: D**



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4. Solubility product of silver bromide is  $5.0 \times 10^{-13}$ . The quantity of potassium bromide (molar mass taken as  $120 \text{ g mol}^{-1}$ ) to be added to 1 litre of  $0.05 \text{ M}$  solution of silver nitrate to start the precipitation of  $\text{AgBr}$  is :

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

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

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

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

**Answer: D**



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5. A vessel at 1000 K contains  $CO_2$  with a pressure of 0.5 atm. Some of the  $CO_2$  is converted into CO on the addition of graphite. If the total pressure at equilibrium is 0.8 atm, the value of K is :

- A. 0.3 atm
- B. 0.18 atm
- C. 1.8 atm
- D. 3 atm

**Answer: C**



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6. The  $K_{sp}$  for  $Cr(OH)_3$  is  $1.6 \times 10^{-30}$ . The molar solubility of this compound in water is :

A.  $\sqrt[3]{1.6 \times 10^{-30}}$

B.  $\sqrt[4]{1.6 \times 10^{-30} / 27}$

C.  $1.6 \times 10^{-30} / 27$

D.  $\sqrt{1.6 \times 10^{-30}}$

**Answer: B**

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7. An acid HA ionises as



The pH of 1.0 M solution is 5. Its dissociation constant would be :

A. 5

B.  $5 \times 10^{-8}$

C.  $1 \times 10^{-5}$

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

**Answer: D**



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8. The pH of a 0.1 molar solution of the acid HQ is 3. The value of the ionization constant,  $K_a$  of this acid is :

A.  $1 \times 10^{-7}$



B.  $3 \times 10^{-7}$

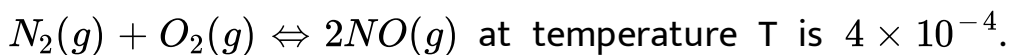
C.  $1 \times 10^{-3}$

D.  $1 \times 10^{-5}$

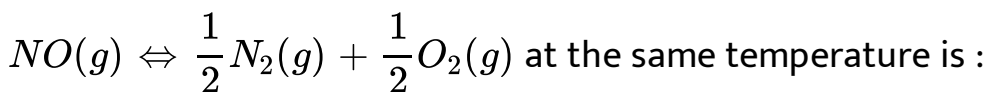
**Answer: D**

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9. The equilibrium constant for the reaction



The value of  $K_c$  for the reaction



A. 50.0

B. 0.02

C.  $2.5 \times 10^2$

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

**Answer: A**



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**10.** How many litres of water must be added to 1 litre of an aqueous solution of HCl with a pH of 1 to create an aqueous solution with pH of 2 ?

A. 0.1 L

B. 0.9 L

C. 2.0 L

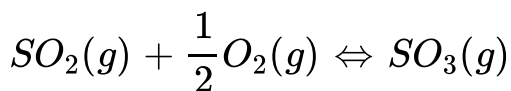
D. 9.0 L

**Answer: D**



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**11.** For the reaction :



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.  $\frac{1}{2}$

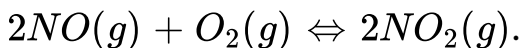
D.  $1$

**Answer: B**



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12. The following reaction is performed at 298 K



The standard free energy of formation of NO (g) is 86.6 kJ / mol at 298 K. What is the standard free energy of formation of  $NO_2(g)$  at 298 K? ( $K_p = 1.6 \times 10^{12}$ ).

A.  $1. R(298) \ln(1.6 \times 10^{12}) - 86600$

B.  $86600 + R(298)\ln(1.6 \times 10^{12})$

C.  $86600 - \frac{\ln(1.6 \times 10^{12})}{R(298)}$

D.  $0.5[2 \times 86,600 - R(298)\ln(1.6 \times 10^{12})]$ .

**Answer: D**

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13. The standard Gibbs energy change at 300 K for the reaction  $2A \rightleftharpoons B + C$  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 the : [R = 8.314 J/K/mol,  $e = 2.718$ ]

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  $Q < K_c$

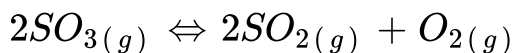
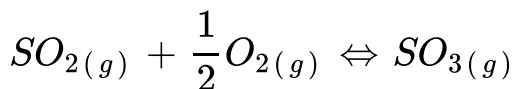
**Answer: B**



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## Recent Examination Questions

1. Consider the following gaseous equilibria with equilibrium constants  $K_1$  and  $K_2$  respectively.



The equilibrium constants are related as .....

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

B.  $2K_1 = K_2^2$

C.  $K_2 = \frac{2}{K_1^2}$

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

**Answer: A**



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2. 0.023g of sodium metal is reacted with  $100\text{cm}^3$  of water.

The pH of the resulting solution is :

A. 10

B. 11

C. 9

D. 12

**Answer: D**



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3. A buffer solution contains 0.1 mole of sodium acetate dissolved in  $1000\text{cm}^3$  of 0.1 M acetic acid. To the above buffer

solution, 0.1 mole of sodium acetate is further added and dissolved. The pH of the resulting buffer is

A.  $pK_a - \log 2$

B.  $pK_a$

C.  $pK_a + 2$

D.  $pK_a + \log 2$

**Answer: D**



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4. One  $dm^3$  solution containing  $10^{-5}$  moles each of  $Cl^-$  ions and  $CrO_4^{2-}$  ions is treated with  $10^{-4}$  moles of silver nitrate. Which one of the following observations is made ?



$$[K_{sp}Ag_2CrO_4 = 4 \times 10^{-12}]$$

$$[K_{sp}AgCl = 1 \times 10^{-10}]$$

- A. Precipitation does not occur
- B. Silver chromate gets precipitated first
- C. Silver chloride gets precipitated first
- D. Both silver chromate and silver chloride start precipitating simultaneously.

**Answer: A**



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5. pH value of which one of the following is NOT equal to one ?

A. 1. 0.1M  $CH_3COOH$

B. 2. 0.1M  $HNO_3$

C. 3. 0.05M  $H_2SO_4$

D. 4.  $50\text{cm}^3 0.4M HCl + 50\text{cm}^3 0.2M NaOH$ .

**Answer: A**



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6. The pH of the solution obtained by mixing 100 mL of a solution of pH = 3 with 400 mL of a solution of pH = 4 is :

A.  $3 - \log 2.8$

B.  $7 - \log 2.8$

C.  $4 - \log 2.8$

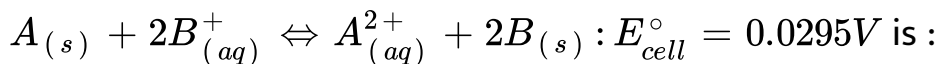
D.  $5 - \log 2.8$

**Answer: C**



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7. The equilibrium constant of the reaction :



A. 10

B.  $2 \times 10^2$

C.  $3 \times 10^2$

D.  $2 \times 10^5$

**Answer: A**



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8. The equilibrium constant of a reaction is 0.008 at 298 K. The standard free energy change of the reaction at the same temperature is :

A.  $+ 11.96kJ$

B.  $- 11.96kJ$

C.  $- 5.43kJ$

D.  $- 8.46kJ$

**Answer: A**



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9. 5 mL of 0.4N NaOH is mixed with 20 mL of 0.1N HCl. The pH of the resulting solution will be :

A. 6

B. 7

C. 8

D. 5

**Answer: B**

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10. On adding which of the following the pH of 20 mL of 0.1 N HCl will not alter ?

- A. 1 mL of 1 N HCl
- B. 20 mL of distilled water
- C. 1 mL of 0.1 N NaOH
- D. 500 mL of HCl of pH = 1.

**Answer: D**



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**11.** The yield of the products in the reaction,

$A_{2(g)} + 2B_{(g)} \rightleftharpoons C_{(g)} + Q \text{ kJ}$  would be higher at :

- A. 1. high temperature and high pressure
- B. 2. high temperature and low pressure
- C. 3. low temperature and high pressure

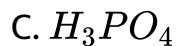
D. 4. low temperature and low pressure

Answer: C



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12. The conjugate base of  $H_2PO_4^-$  is :

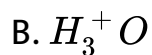
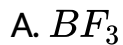


Answer: B



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13. Identify a species which is 'NOT' a Bronsted acid but a Lewis acid.



**Answer: A**



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14. The pH of  $10^{-8}$  M HCl solution is :

A. 8



B. 6.9586

C. more than 8

D. slightly more than 7.

**Answer: B**



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**15.** An example for a neutral buffer is :

A. 1. ammonium hydroxide and ammonium chloride

B. 2. acetic acid and sodium acetate

C. 3. acetic acid and ammonium hydroxide

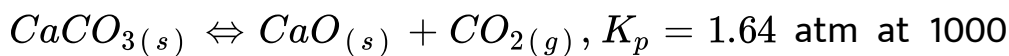
D. 4. citric acid and sodium citrate.

**Answer: C**



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**16.** For the equilibrium:



K, 50 g of  $CaCO_3$  in a 10 litre closed vessel is heated to 1000

K. Percentage of  $CaCO_3$  that remains unreacted at

equilibrium is (Given  $R=0.082 \text{ L atm } K^{-1} \text{ mol}^{-1}$ ).

A. 40

B. 50

C. 60

D. 20

**Answer: C**



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17. The number of  $H^+$  ions present in 1 ml of a solution whose pH is 13 is :

A.  $6.022 \times 10^{10}$

B.  $6.022 \times 10^7$

C.  $6.022 \times 10^{20}$

D.  $6.022 \times 10^{23}$

**Answer: B**



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