



## CHEMISTRY

### NCERT - FULL MARKS CHEMISTRY(TAMIL)

#### IONIC EQUILIBRIUM

##### Example

1. Calculate the concentration of  $OH^-$  in a fruit juice which contains  $2 \times 10^{-3} M$ ,  $H_3O^+$  ion. Identify the nature of the solution.



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2. Calculate the pH of 0.001M HCl solution

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3. Calculate pH of  $10^{-7}$  M HCl

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4. A solution of 0.10M of a weak electrolyte is found to be dissociated to the extent of 1.20% at  $25^{\circ}C$  . Find the dissociation constant of the acid

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5. Calculate the pH of 0.1M  $CH_3COOH$  solution.

Dissociation constant of acetic acid is  $1.8 \times 10^{-5}$

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6. Find the pH of a buffer solution containing 0.20 mole per litre sodium acetate and 0.18 mole per litre acetic acid.  $K_a$

for acetic acid is  $1.8 \times 10^{-5}$

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7. What is the pH of an aqueous solution obtained by mixing

6 gram of acetic acid and 8.2 gram of sodium acetate and

making the volume equal to 500 ml. (Given:  $K_a$  for acetic acid is  $1.8 \times 10^{-5}$ )

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8. Calculate i) the hydrolysis constant, ii) degree of hydrolysis and iii) pH of 0.1M  $CH_3COONa$  solution ( $pK_a$  for  $CH_3COOH$  is 4.74).

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9. Establish a relationship between the solubility product and molar solubility for the following

a)  $BaSO_4$  b)  $Ag_2(CrO_4)$

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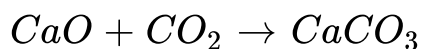
## Evaluate Yourself

1. Write a balanced equation for the dissociation of the following in water and identify the conjugate acid - base pairs.

(i)  $NH_4^+$  (ii)  $H_2SO_4$  (iii)  $CH_3COOH$

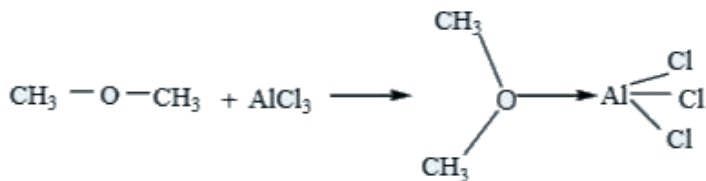
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2. Identify the Lewis acid and the Lewis base in the following reactions.



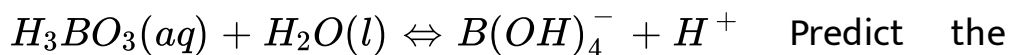
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3. Identify the Lewis acid and the Lewis base in the following reactions.



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4.  $H_3BO_3$  accepts hydroxide ion from water as shown below



nature of  $H_3BO_3$  using Lewis concept

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5. At a particular temperature, the  $K_w$  of a neutral solution was equal to  $4 \times 10^{-14}$ . Calculate the concentration of  $[H_3O^+]$  and  $[OH^-]$

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6. Calculate pH of  $10^{-8} M H_2SO_4$

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7. Calculate the concentration of hydrogen ion in moles per litre of a solution whose pH is 5.4

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8. Calculate the pH of an aqueous solution obtained by mixing 50ml of 0.2 M HCl with 50ml 0.1 M NaOH

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9.  $K_b$  for  $NH_4OH$  is  $1.8 \times 10^{-5}$ . Calculate the percentage of ionisation of 0.06M ammonium hydroxide solution.

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10. Explain the buffer action in a basic buffer containing equimolar ammonium hydroxide and ammonium chloride.

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11. Calculate the pH of a buffer solution consisting of 0.4M  $CH_3COOH$  and 0.4M  $CH_3COONa$ . What is the change in the pH after adding 0.01 mol of HCl to 500ml of the above buffer solution. Assume that the addition of HCl causes negligible change in the volume. Given: ( $K_a = 1.8 \times 10^{-5}$ .)

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12. How can you prepare a buffer solution of pH 9. You are provided with 0.1M  $NH_4OH$  solution and ammonium chloride crystals. (Given:  $pK_b$  for  $NH_4OH$  is 4.7 at  $25^\circ C$ )

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13. What volume of 0.6M sodium formate solution is required to prepare a buffer solution of pH 4.0 by mixing it with 100ml of 0.8M formic acid. (Given:  $pK_a$  for formic acid is 3.75.)

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14. Calculate the i) hydrolysis constant, ii) degree of hydrolysis and iii) pH of 0.05M sodium carbonate solution  $pK_a$  for  $HCO_3^-$  is 10.26.

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Evaluation Choose The Correct Answer

1. Concentration of the  $Ag^+$  ions in a saturated solution of  $Ag_2C_2O_4$  is  $2.24 \times 10^{-4} \text{ mol L}^{-1}$  solubility product of  $Ag_2C_2O_4$  is

A.  $2.42 \times 10^{-8} \text{ mol}^3 \text{ L}^{-3}$

B.  $2.66 \times 10^{-12} \text{ mol}^3 \text{ L}^{-3}$

C.  $4.5 \times 10^{-11} \text{ mol}^3 \text{ L}^{-3}$

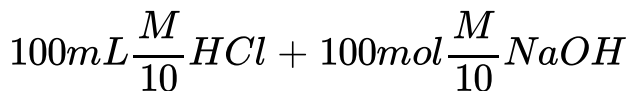
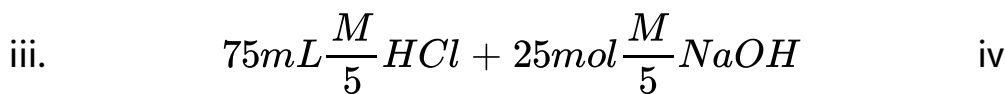
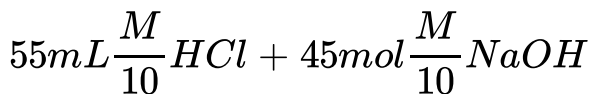
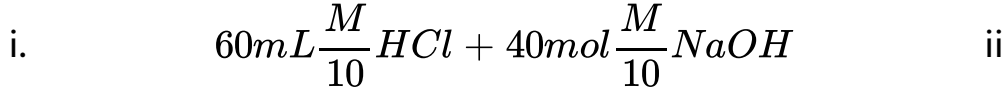
D.  $5.619 \times 10^{-12} \text{ mol}^3 \text{ L}^{-3}$

**Answer:**



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2. Following solutions were prepared by mixing different volumes of NAOH of HCL different concentrations.



pH of which one of them will be equal to 1?

A. iv

B. i

C. ii

D. iii

**Answer:**



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3. The solubility of  $BaSO_4$  in water is  $2.42 \times 10^{-3} gL^{-1}$  at 298K. The value of its solubility product ( $K_{sp}$ ) will be (Given molar mass of  $BaSO_4 = 233 gmol^{-1}$ )

A.  $1.08 \times 10^{-14} mol^2 L^{-2}$

B.  $1.08 \times 10^{-12} mol^2 L^{-2}$

C.  $1.08 \times 10^{-10} mol^2 L^{-2}$

D.  $1.08 \times 10^{-8} mol^2 L^{-2}$

**Answer:**



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4. pH of a saturated solution of  $Ca(OH)_2$  is 9. The Solubility product ( $K_{sp}$ ) of  $Ca(OH)_2$ .

A.  $0.5 \times 10^{-15}$

B.  $0.25 \times 10^{-10}$

C.  $0.125 \times 10^{-15}$

D.  $0.5 \times 10^{-10}$

**Answer:**



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5. Conjugate base for bronsted acids  $H_2O$  and HF are

A.  $OH^-$  and  $H_2FH^+$  respectively

B.  $H_3O^+$  and  $F^-$  respectively

C.  $OH^-$  and  $F^-$  respectively

D.  $H_3O^+$  and  $H_2F^+$  respectively

**Answer:**



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**6. Which will make basic buffer ?**

A.

50mL of  $0.1MNaOH$  + 25mL of  $0.1MCH_3COOH$

B.

100mL of  $0.1MCH_3COOH$  + 100mL of  $0.1MNH_4OH$

C. 100mL of  $0.1MHCl$  + 200mL of  $0.1MNH_4OH$

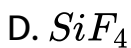
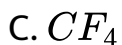
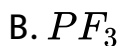
D. 100mL of  $0.1MHCl$  + 100mL of  $0.1MNaOH$

**Answer:**



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7. Which of the following fluoro - compounds is most likely to behave as a Lewis base?



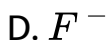
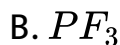
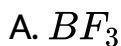
**Answer:**



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8. Which of these is not likely to act as lewis base?

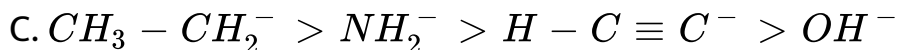
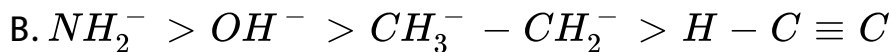
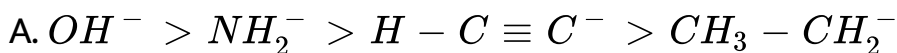
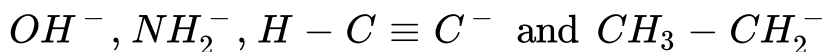


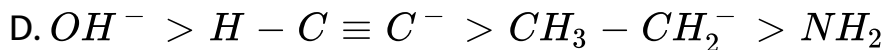


**Answer:**

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**9.** What is the decreasing order of strength of bases?





**Answer:**



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10. The aqueous solutions of sodium formate, anilinium chloride and potassium cyanide are respectively

- A. acidic, acidic, basic
- B. basic, acidic, basic
- C. basic, neutral, basic
- D. none of these

**Answer:**



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11. The percentage of pyridine ( $C_5H_5N$ ) that forms pyridinium ion ( $C_5H_5NH$ ) in a 0.10M aqueous pyridine solution ( $K_b$  for  $C_5H_5N = 1.7 \times 10^{-9}$ ) is

- A. 0.006 %
- B. 0.013 %
- C. 0.77 %
- D. 1.6 %

**Answer:**



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12. Equal volumes of three acid solutions of pH 1, 2 and 3 are mixed in a vessel. What will be the  $H^+$  ion concentration in the mixture?

A.  $3.7 \times 10^{-2}$

B.  $10^{-6}$

C. 0.111

D. none of these

**Answer:**



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13. The solubility of  $AgCl$  (s) with solubility product  $1.6 \times 10^{-10}$  in 0.1M NaCl solution would be

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

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

C.  $1.26 \times 10^{-11} M$

D. Zero

**Answer:**



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**14.** If the solubility product of lead iodide is  $3.2 \times 10^{-8}$ , its solubility will be

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

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

C.  $1.6 \times 10^{-5} M$

D.  $1.8 \times 10^{-5} M$

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15. Using Gibb's free energy change,  $\Delta G^\circ = 57.34 \text{kJ mol}^{-1}$ , for the reaction,  $X_2Y_{(s)} \rightleftharpoons 2X^+ + Y^{2-}(aq)$  calculate the solubility product of  $X_2Y_2$  in water at 300 K ( $R = 8.3 \text{J K}^{-1} \text{Mol}^{-1}$ )

A.  $10^{-10}$

B.  $10^{-12}$

C.  $10^{-14}$

D. can not be calculated from the given data

**Answer:**



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**16.**  $MY$  and  $NY_3$ , are insoluble salts and have the same  $K_{sp}$  values of  $6.2 \times 10^{-13}$  at room temperature. Which statement would be true with regard to  $MY$  and  $NY_3$  ?

- A. The salts  $MY$  and  $NY_3$  are more soluble in 0.5M  $KY$  than in pure water
- B. The addition of the salt of  $KY$  to the suspension of  $MY$  and  $NY_3$  will have no effect on their solubility's
- C. The molar solubilities of  $MY$  and  $NY_3$  in water are identical

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



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17. What is the pH of the resulting solution when equal volumes of 0.1M NaOH and 0.01M HCl are mixed?

A. 2.0

B. 3

C. 7.0

D. 12.65



**Answer:**



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**18.** The dissociation constant of a weak acid is  $1 \times 10^{-3}$ . In order to prepare a buffer solution with a  $\text{pH} = 4$ , the  $[\text{Acid}]/[\text{Salt}]$  ratio should be

- A. 4 : 3
- B. 3 : 4
- C. 10 : 1
- D. 1 : 10

**Answer:**



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19. The pH of  $10^{-5} M KOH$  solution will be

A. 9

B. 5

C. 19

D. none of these

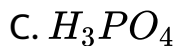
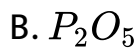
**Answer:**



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20.  $H_2PO_4^-$  the conjugate base of

A.  $PO_4^{3-}$



**Answer:**



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**21.** Which of the following can act as lowery - Bronsted acid well as base?



**Answer:**



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22. The pH of an aqueous solution is Zero. The solution is

- A. slightly acidic
- B. strongly acidic
- C. neutral
- D. basic

**Answer:**



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23. The hydrogen ion concentration of a buffer solution consisting of a weak acid and its salts is given by

A.  $[H^+] = \frac{K_a[\text{acid}]}{[\text{salt}]}$

B.  $[H^+] = K_a[\text{salt}]$

C.  $[H^+] = K_a[\text{acid}]$

D.  $[H^+] = \frac{K_a[\text{salt}]}{[\text{acid}]}$

**Answer:**

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24. Which of the following relation is correct for degree of hydrolysis of ammonium acetate ?

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

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

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

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

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25. Dissociation constant of  $NH_4OH$  is  $1.8 \times 10^{-5}$  the hydrolysis constant of  $NH_4Cl$  would be

A.  $1.8 \times 10^{-19}$

B.  $5.55 \times 10^{-10}$

C.  $5.55 \times 10^{-5}$

D.  $1.80 \times 10^{-5}$

**Answer:**

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## Evaluation Answer The Following Questions

1. Calculate the pH of 0.04 M  $HNO_3$  Solution.

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2. Calculate the pH of  $1.5 \times 10^{-3}$  M solution of  $Ba(OH)_2$

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3. 50ml of 0.05M  $HNO_3$  is added to 50ml of 0.025M KOH .  
Calculate the pH of the resultant solution.

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4. The  $K_a$  value for HCN is  $10^{-9}$  . What is the pH of 0.4M  
HCN solution?

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5. Calculate the extent of hydrolysis and the pH of 0.1 M  
ammonium acetate Given that  $K_a = K_b = 1.8 \times 10^5$

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6. Solubility product of  $Ag_2CrO_4$  is  $1 \times 10^{-12}$ . What is the solubility of  $Ag_2CrO_4$  in 0.01M  $AgNO_3$  solution?

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7. Write the expression for the solubility product of  $Ca_3(PO_4)_2$

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8. A saturated solution, prepared by dissolving  $CaF_2(s)$  in water, has  $[Ca^{2+}] = 3.3 \times 10^{-4}M$  What is the  $K_{sp}$  of  $CaF_2$ ?

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9.  $K_{sp}$  of AgCl is  $1.8 \times 10^{-10}$ . Calculate molar solubility in 1 M  $AgNO_3$



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10. A particular saturated solution of silver chromate  $Ag_2CrO_4$  has  $[Ag^+] = 5 \times 10^{-5}$  and  $[CrO_4]^{2-} = 4.4 \times 10^{-4} M$ . What is the value of  $K_{sp}$  for  $Ag_2CrO_4$ ?



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11. Write the expression for the solubility product of  $Hg_2Cl_2$



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12.  $K_{sp}$  of  $Ag_2CrO_4$  is  $1.1 \times 10^{-12}$  what is solubility of  $Ag_2CrO_4$  in 0.1M  $K_2CrO_4$ .



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13. Will a precipitate be formed when 0.150 L of 0.1M  $Pb(NO_3)_2$  and 0.100L of 0.2 M NaCl are mixed?

$$K_{sp}(PbCl_2) = 1.2 \times 10^{-5}$$



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14.  $K_{sp}$  of  $Al(OH)_3$  is  $1 \times 10^{-15} M$ . At what pH does  $1.0 \times 10^{-3} M Al^{3+}$  precipitate on the addition of buffer of  $NH_4Cl$  and  $NH_4OH$  solution?



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