THE GURUKUL INSTITUTE

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IONIC EQUILIBRIUM

Determination of pH of Acids and Bases

1. 0.2 (M) solution of monobasic acid is dissociated to 0.95% calculate its dissociation constant. Given α = 0.0095; C = 0.2 mole lit^{-1}.
2. Calculate pH for 0.01 N $Ca(OH)_2$

Exercise 1

1. Calculate pH of a solution of a mixture of 10 ml 0.1 M HCL and 40 ml 0.2 M HBr.
2. What is the pH of 10^{-8} (N) HCL?
3. Calculate pH of basic solution having $[OH^-] = 4 \times 10^{-6}$ M
4. K_w for H_2o is 9.62 x 10^{-14} at 60^oC. What is nature of the solution whose
   (a) pH = 6.7 (b) pH= 6.35

Determination of pH due to Hydrolysis of Salts

1. Calculate the pH at the equivalence point during the titration of 0.1 M, 25 ml CH_3COOH with 0.05 M NaOH solution, K_a (CH_3COOH) = 1.8 x 10^{-5}
   (A) 9.63 (B) 8.63 (C) 10.63 (D) 11.63
2. Write expression of pH of the aqueous solution of salt
   (A) Made of strong base and weak acid
   (B) Made of strong acid and weak base
   (C) Made of weak acid and weak base. Which one is independent upon the concentration of Salt?
3. when 0.2 moles of CH_3COOH are neutralized with 0.2 moles NaOH in 0.5 litre of water the resulting solution is slightly alkaline. Calculate pH of resulting solution $K_a(CH_3COOH)$= 1.8 x 10^{-5}
   (A) 10.57 (B) 9.89 (C) 12.56 (D) 9.17
4. Calculate amount of ammonium chloride required to dissolve in 500 ml water to make pH = 4.5 (K_b for NH_3 = 1.8 x 10^{-5}).

Exercise - 2

1. Calculate pH of mixture containing 50 ml 0.1 (M) NaOH and 50 ml of 0.1 (M) CH_3CO_2H.
   (A) 8.86 (B) 7.45 (C) 9.89 (D) 10.11
2. Calculate pH of mixture containing 50 ml 0.05 (M) NH_3 and 50 ml 0.05 (M) CH_3CO_2H
   (A) 9 (B) 10 (C) 8 (D) 7
3. Calculate for 0.01 (N) solution of CH_3CO_2Na
   (A) hydrolysis constant,
   (B) degree of hydrolysis,
   (C) pH (K_a for CH_3CO_2H = 1.8 x 10^{-5}, K_b for NH_3 = 1.8 x 10^{-5})

Buffer Solutions

1. Write expression of pH of (i) Acid Buffer (ii) Basic Buffer
2. What is pH of
   (i) 50 ml 0.05 (M) NaOH and 50 ml 0.1 (N) CH_3CO_2H
   (ii) 50 ml 0.1 (M) NH_4OH and 50 ml 0.05 (M) HCl

3. Suppose it is required to make a buffer solution of pH = 4, using acetic acid and sodium acetate. How many grams of sodium acetate is to be added to on litre of $\frac{N}{10}$ acetic acid?
$K_a = 1.8 \times 10^{-5}$.

(A) 2.567 (B) 1.476 (C) 3.257 (D) 4.235

4. How many g moles of HCl will be required to prepare one litre of buffer solution (containing NaCN and HCN) of pH = 8.5 using 0.01 gm formula mass of NaCN.
$K_a(HCN) = 4.1 \times 10^{-10}$.

Exercise 3

1. what type of solution blood is? What is pH of blood steam?
2. Calculate the amount of $(NH_4)_2SO_4$ which must be added to 500 ml of 0.2 (M) NH_3 to yield a solution of pH = 9.35 $pK_{b(NH_4OH)} = 4.74$
3. What is buffer capacity? When it is maximum.
4. The pH of a buffer is 4.745. When 0.01 mole of NaOH is added to one litre of it, then pH changes to 4.832. Calculate its buffer capacity?

Solubility and Solubility Product

5. What is value of solubility product (K_{sp}) of the salt of (i) AB type, (ii) AB_2 type, (iii) AB_2 type, (iv) A_2B_3/A_3B_2type. Given solubility of salt is S mole / lit (A = Cationic Part, B = anionic part)
6. The solubility of AgCl in water at 25° C is 1.79×10^{-3}g/lit. Calculate (K_{sp}) AgCl at 25° C.

(A) 3.45×10^{-10} (B) 4.5×10^{-10} (C) 1.55×10^{-10} (D) 9.7×10^{-10}

7. $(K_{sp})_{AgCl}$ is 2.8×10^{-10} at 25° C. Calculate solubility of AgCl in

(a) 0.1 (M) $AgNO_3$ (b) 0.1 (M) NaCl

8. 20 ml of 0.001 M $AgNO_3$ solution is added to one litre of 0.002 M K_2CrO_4 solution. Will there be any precipitation? $K_{sp}Ag_2CrO_4 = 2.4 \times 10^{-12}$.

Exercise 4

1. The solubility of $PbSO_4$ in H_2O is 0.038 g/L at 25° C. Calculate K_{sp} of $PbSO_4$ at same temperature/
2. Calculate simultaneous solubility of AgCNS and AgBr in a solution of water.
3. K_{sp} ($BaSO_4$) $= 1.5 \times 10^{-9}$. Find solubility in (a) pure water and (B) 0.1 M $BaCl_2$ solution.
4. The solubility product of SrF_2 in water is 8×10^{-10}. Calculate its solubility in 0.1 (M) NaFsolution.

(A) 8×10^{-8} (B) 9×10^{-8} (C) 11×10^{-8} (D) 13×10^{-8}

Problems

1. 0.1 solution of NH_4OH is 1.344 % dissociated at equilibrium, calculate

(i) K_b (ii) $[NH_4^+]$, $[OH^-]$, $[NH_4OH]$.

2. Calculate the amount of NH_{-3} and NH_4Cl required to prepare a buffer solution of pH 9.0 when total concentration of buffering reagents is 0.6 mol L^{-1}. pK_b for $NH_3 = 4.7$, log 2 = 0.30
3. Calculate pH of an aqueous solution of 1 M $HCOONH_4$ assuming complete dissociation.
$pK_a(HCOOH) = 3.8$ and $pK_b(NH_3) = 4.8$
4. What is the maximum pH of a 0.1 M Mg^{2+}, solution from which $Mg(OH)_2$ will not be precipitated [$K_{sp} = 1.2 \times 10^{-11}$].

5. The solubility product of $Ca(OH)_2$ at 25° is 4.42×10^{-5}. A 500ml of saturated solution of $Ca(OH)_2$ is mixed with equal volume of 0.4 M NaOH solution. How much $Ca(OH)_2$ in milligrams is precipitated.
6. Two weak monobasic organic acids HA and HB have dissociation constants as 1.5×10^{-5} and 1.8×10^{-5} respectively at 25° C. If 500 ml of 1 M solutions of each of these two acids are mixed to produce 1 litre of mixed solution, what is the pH of the resulting solution?

7. How much AgBr could dissolve in 1.0 L of 0.4 NH_3? Assume that $[Ag(NH_3)_2]^+$ is the only complex formed given, $K_f[Ag(NH_3)_2]^+ = 1.0 \times 10^8$, Ksp (AgBr) $= 5.0 \times 10^{-13}$.

8.Calculate change in pH of 1 litre buffer solution containg 0.10 mole each of NH_3 and NH_4Cl upon addition of (a) 0.02 mole of dissolved gaseous HCl. (b) 0.02 mole of dissolved NaOH. (Assuming volume to be constant), K_b $[NH_3] = 1.8 \times 10^{-5}$

9. Saccharin ($K_a = 2 \times 10^{-12}$) is a weak acid represented by formula HSaC. 4×10^{-4} moles of saccharin are dissolved in 200 cc buffer of pH 3. Assuming no chage in volume, calculate the concertration of SaC^{-1} ions in the resulting solution at equilibrium. (Assume pH of buffer is maintained.)

10. calcium lactate $Ca(Lac)_2$ is salt of weak organic aci. A saturated solution of $Ca(Lac)_2$ contains 0.13 mole of this salt in 0.5 litre solution. The pOH of this solution is 5.60. Assuming a complete dissociation of salt, calculate K_a lactic acid.

Objective

1. if the H^+ion concentration of a solution is increased to ten times its initial value, its pH will
   (A) increase by one
   (B) remains changed
   (C) decrease by one
   (D) increase by ten

2. when a solution of benzonic acid was titrated with NaOH the pH of the solution when half the acid neutarilized was 4.2. dissociation constant of the acid is
   (A) 6.31×10^{-5} (B) 3.2×10^{-5} (C) 8.7×10^{-8}
   (D) 6.42×10^{-4}

3. 10^{-2} mole of NaOh was added to 10 litre of water the pH will chang by
   (A) 4 (B) 3 (C) 11 (D) 7

4. For an aqueous solution to be neutral if must have
   (A) pH = 7 (B) $[H^+] = [OH^-]$ (C) $[H^+] > \sqrt{k_w}$
   (D) $[H^+] < [OH^-]$

5. if an aqueous solution at 25^o c has twice as many OH^- as pure water its pOH will be
   (A) 6.699 (B) 7.307 (C) 7 (D) 6.98

6. If an acidic indicator Hln ionises as $Hln \rightleftharpoons H^+ + ln^-$. To which maximum pH value its solution has distinct colour characteristic of Hln.

7. Solubility of AgCl in water 0.01 M $CaCl_2$, 0.01 M NaCl and 0.05 M $AgNO_3$ are S_1, S_2, S_3 and S_4 respectively then. ($K_{sp}AgCl = 10^{-10} M^2$)
   (A) $S_1 > S_2 > S_3 > S_4$ (B) $S_1 > S_3 > S_2 > S_4$
   (C) $S_1 > S_2 = S_3 > S_4$ (D) $S_1 > S_3 > S_4 < S_2$

8. What would be the pH of an ammonia solution if that of an acetic acid solution of equal strength is 3.2? Assume dissociation constant for NH_3& acetic acid are equal
   (A) 3.2 (B) 6.4 (C) 9.6 (D) 10.8

9. pH of $Ba(OH)_2$ solution is 12. Its solubility product is
   (A) 10^{-6} (B) 4×10^{-6} (C) 0.5×10^{-7} (D) 5×10^{-7}

10. The hydrolysis constant for $ZnCl_2$ for complete hydrolysis of Zn^{+2} will be
   (A) $K_n = \frac{K_q}{K_b}$ (B) $K_n = \frac{K_w^2}{K_b}$ (C) $K_h = \frac{K_w^2}{K_b^2}$
   (D) $K_h = \frac{K_b}{K_w^2}$

11. 0.1 M CH_3COOH is titrated with 0.1 M NaOH solution. What would be the difference in pH between ¼ and ¾ stages of neutralization of acid.
   (A) $2\log\frac{3}{4}$ (B) $2\log\frac{1}{4}$
   (C) $\log\frac{1}{3}$ (D) $2\log^3$

12. Which of the following is a buffer solution?

(A) $CH_3COOH + CH_3COONA$ (B) NaCl + NaOH

(C) $HCl + NH_4Cl$ (D) $CH_3COOH + HCl$

13. In a buffer solution consisting of a weak acid and its salt, the ratio of concentration of salt to acid is increased ten fold, then pH of the solution will

(A) increase by one (B) Increase ten fold

(C) decrease by one (D) decreases ten fold

14. A certain weak acid has $K_a = 1 \times 10^{-4}$. K_{eq} for its reaction with NaOH is

(A) 1×10^{-4} (B) 1×10^{-10}

(C) 1×10^{10} (D) $1 \times 10^{-14=}$

15. Which of following solution will have pH close to 1.0?

(A) 100 ml of $\frac{M}{10}$ HCl + 100 ml of $\frac{M}{10}$ NaOH

(B) 55 ml of $\frac{M}{10}$ HCl + 45ml of $\frac{M}{10}$ NaOH

(C) 10 ml of $\frac{M}{10}$ HCl + 90 ml of $\frac{M}{10}$ NaOH

(D) 75 ml of $\frac{M}{10}$ HCl + 25 ml of $\frac{M}{10}$ NaOH

Assignments

Section – 1

Part – A (Level – 1)

1. 10^{-2} mole of NaOH was added to 10 litre of water then calculate the change in pH value.
2. Calculate the pH of an aqueous solution of 0.1 M solution of a weak monoprotic acid which is 1% ionized.
3. Calculate the pH of a 10^{-10} M NaOH.
4. 2 g of NaOH are dissolved in water to make 1 litre solution. What is pH of solution?
5. How to degree of dissociation of weak base related to its molarity?
6. Explain common ion effect and how does it effects degree of dissociation?
7. K_a for a weak acid HA is 2×10^{-5}. What is the value of K_b for A^-?
8. When Ba^{2+} is added to saturated solution of $CaSO_4$, will a precipitate of $BaSO_4$be formed?
9. pH of a mixture of benzoic acid (pKa = 4.20) and 1M C_6H_5COONa is 4, 5. Calculate the moles of benzonic acid in 300 ml buffer.
10. As HCl solution is diluted more and more what happens to its pH?

Level - II

1. At 15^o C, 0.05 N weak mono basic acid is 3.5% ionized. Calculate ionisation constant of acid.
2. Calculate the pH of a solution which contains 100ml of 0.1 M HCl and 9.9 ml of 1M NaOH.
3. 0.1 mole of CH_3NH_2 ($K_b = 5 \times 10^{-10}$) is added to 0 .08 moles of HCl and the solution is diluted to one litre, then calculate resulting hydrogen ion concentration in the solution.
4. (a) Calculate the pH of a 0.001 M solution of benzoic acid, the $K_a$being 7.3×10^{-5}.

(B) 0.2 M solution of $Ba(OH)_2$ is found to be 90% ionized at 25^o C. Find the pH of the solution at that temperature.

5. Calculate the pH and % hydrolysis in a 1 M NaCN solution. $K_a = 4 \times 10^{-10}$.
6. Determine the pOH of a solution after 0.1 moles of NaOH is added to 1L of a solution containing 0.15 M CH_3COOH and 0.2 M CH_3COONa. Assume no change in volume. ($K_a = 1.8 \times 10^{-5}$)
7. The concentration of HCN and NaCN in a solution is 0.01 molar each. Calculate $[H^+]$ and $[OH^-]$ if K_a HCN = 7.2×10^{-10}.
8. A buffer solution is prepared by mixing 6 g. of acetic acid and 13.6 g. of sodium acetate ($CH_3COONa.3H_2O$) and making the total volume to 250 ml. Calculate the pH of the solution. Given $K_a = 1.8 \times 10^{-5}$ for acetic acid.

9. 500 ml of 0.2 M aqueous solution of acetic acid is mixed with 500 mL of 0.2 M HCL at 25^{o} C.

(i) Calculate the degree of dissociation of acetic acid in the resulting solution and pH of the solution.

(ii) if 6 g of NaCH is added to the above solution, determine the final pH. [Assume there is no change in volume on mixing ; K_a of acetic acid is 1.75×10^{-6}mol L^{-1}.

10. The solubility of $Mg(OH)_2$ in pure water is 9.57×10^{-3} g/l. calculate its solubility in 0.02 M $Mg(NO_3)_2$solution.

11. Calculate (i) the percentage of hydrolysis of ammonium acetate. The dissociation constant for NH_4OH is 1.8×10^{-5} and that of CH_3COOH is 1.8×10^{-5} (ii) also calculate its pH value.

12. A 0.01 M solution of $PuO_2 (NO_3)_2$ has found to have a pH of 3.8. what is the hydrolysis constant, K_h for PuO_2^{2+} and what is for $[PuO_2OH]^+$?

13.The solubility product of $PbBr_2$ is 8×10^{-5} . if the salt is 80% dissociated in saturated solution, find the solubility of the salt.

14. and acid type indicator, Hln differs in colour from its conjugate base (in^-). The human eye is sensitive to colour difference only when the ratio $[in^-]/[Hln]$ is greater than 10 or smaller than 0.1. what should be the minimum change in pH of the solution to observe a complete colour chang?

15. For the reaction $[Ag(CN)^-_2] \rightleftharpoons Ag^+ + 2CN^-$

The equilibrium constant at 25^{o} C is 4.0×10^{-19}. Calculate the silver ion concentration in a solution which was originally 0.1 M in KCN and 0.03 M in $AgNO_3$.

PART – B

Multi Choice Questions

1. Let $K_w$at 100^{o} C be 5.5×10^{-13}. If an aqueous solution at this temperature has pOH = 9. Its nature will be

(A) acidic (B) alkaline (C) neutral (D) can't say

2. The pH value for 10^{-7} M HCl solution will be

(A) 7 (B) 6.79 (C) 7.21 (D) 6.98

3. whencation hydrolyses solution becomes

(A) acidic (B) basic (C) neutral (D) H_2 gas evolves

4. Dissociation constant of two acids HA & HB are respectively 4×10^{-10}& 1.8×10^{-5} M whose pH value will be higher. (Assuming initial concentration of HA and HB to be same.)

(A) HA (B) HB (C) Both same (D) can't say

5. which pair will show common ion effect

(A) $BaCl_2 + Ba(NO_3)_2$ (B) NaCl + HCl

(C) $NH_4OH + NH_4Cl$ (D) None of these

6. A given weak acid (0.01 M) had $pK_a = 6$. The pH of the solution is

(A) three (B) four (C) five (D) six

7. if the degree of dissociations are α_1 and α_2 respectively when the concentrations of HCN are 0.1 M and 0.001 M, α_1/α_2 is

(A) 0.1 (B) 10^3 (C) 0.003 (D) 1

8. the value of indicator constant depends upon

(A) temperature (B) pH (C) pOH (D) None of These

9. For all practical purposes, the contribution of H^+ ion form water is negligible if the concentration of H^+ from acid is

(A) equal to 10^{-6} (B) always (C) greater than 10^{-6}

(D) less than 10^{-6}

10. When a solution of acetic acid was titrated with NaOH the pH of the solution when half the acid neutralized was 4.74. Dissociation constant of the acid is

(A) 1.8×10^{-5} (B) 3.2×10^{-5}

(C) 8.7×10^{-6} (D) 6.42×10^{-4}

11. The pK_a of acetylsalicylic acid (aspirin) is 3.5. The pH of gastric juice in the human stomach is about 2 to 3 th pH in small intestine is about 8. Aspirin will be
(A) unionized in the small intestine and in the stomach.
(B) completely ionized in the small intestine and in the stomach
(C) ionized in the stomach and almost unionized in the small intestine.
(D) ionized in the small intestine and almost unionized in the stomach.

12. The following equilibrium is established when hydrogen chloride is dissolved in acetic acid;
$HCl + CH_3COOH \rightleftharpoons Cl^- + CH_3COOH_2^+$
The set that characterises the conjugate acid- base pair is
(A) $[H^+] = [OH^-] = \sqrt{K_w}$ for a neutral solution
(B) $[H^+] > \sqrt{K_w}$ and $[OH^-] < \sqrt{K_w}$ for an alkaline solution
(C) $[H^+] < \sqrt{K_w}$ and $[OH^-] > \sqrt{K_w}$ for an alkaline solution
(D) $[H^+] = [OH^-] = 10^{-7}$ M for a neutral solution at all temperatures

13. 10^{-5} M NaOH solution at 25^o C is diluted 1000 times. The pH of the solution will
(A) be equal to 8
(B) lie between 7 and 8
(C) lie between 6 and 7
(D) remain unchanged

14. Which of the following solutions containing weak acid and salt of its conjugate base has maximum buffer capacity?
(A) [salt] = [acid] (B) [salt] > [acid]
(C) [salt] < [acid] (D) [salt] + [acid] is minimum

15. the pH of pure water is 6.5. its temperature is
(A) more than 25^o C (B) lesst than 25^o C
(C) equal to 25^o C (D) Zero Kelvin

16. The pH of solution formed by mixing 40 ml of 0.1 M HCl with 10 ml 0.45 M of NaOH is
(A) 10 (B) 12 (C) 8 (D) B

17. Choose the incorrect statement.
(A) Ostwald dilution law is applicable for weak electrolytes
(B) Acidic buffer is a mixture of weak acid and its salt with strong base
(C) Basic buffer is a mixture of strong base and its salt with weak acid
(D) Lewis acids are electron pair acceptor and lewis bases are electron pair donor

18. The maximum pH of a solution which is 0.10 M in Mg^{2+} from which $Mg(OH)_2$ is not precipitated is (Given K_{sp} of $Mg(OH)_2$ is 1.12×10^{-11})
(A) 4.96 (B) 6.96 (C) 7.54 (D) 9.04

19. in a saturated solution of calcium phosphate, the concentration of PO_4^{3-} ions is 3.3×10^{-7} M. the K_{sp} of $Ca_3(PO_4)_2$ will be (assuming no hydrolysis)
(A) 1.32×10^{-31} (B) 1.32×10^{-32}
(C) 1.32×10^{-33} (D) 1.32×10^{-35}

Multiple choice Questions (Multiple Options Correct)

1. in which of the following pairs of solutions is there no effect on the pH upon dilution to some extent?
(A) 0.1 M NH_3 and 0.1 M $(NH_4)_2SO_4$
(B) 0.1 M NaH_2PO_4 and 0.1 M Na_2HPO_4
(C) 0.1 M HCl and 0.01 M NaOH

(D) 0.1 M KCl and 0.1 M HCl

2. which of the following will suppress the ionization of phthalic acid in an aqueous solution?

(A) KCL (B) H_2SO_4 (C) HNO_3 (D) NaOH

3. Which of the following buffers have a pH greater than 7, when both components making the buffer are 1 m each.

(A) $NaHCO_3 + Na_2CO_3$ (B) $CH_3COOH + CH_3COONa$

(D) $Na_3PO_4 + NaH_2PO_4$ (C) $NH_3 + NH_4Cl$

4. Which of the following mixtures can act as buffer

(A) $NaOH + CH_3COONa$ (1 : 1 molar ratio)

(B) $CH_3COOH + NaOH$ (2 : 1 molar ratio)

(C) $CH_3COOH + NaOH$ (3 : 1 molar ratio)

(D) $CH_3COOH + NaOH$ (1 : 1 molar ratio)

5. When HC(g) is passed through a saturated solution of common salt, pure NaCl is precipitated because

(A) HCl is highly soluble water

(B) the ionic product $[Na^+][Cl^-]$ exceeds its solubility product (K_{sp})

(C) theK_{sp} of NaCl is lowered by the presence of Cl^- ions

(D) None of These

Numerical Based

1. Aspirin (MW = 180) is a pain reliever with $pK_a = 2$. Two tablets each containing 0.09 g of aspirin are dissolved in 100 mL solution. What will be the pH of solution?

Comprehension Type

Read the paragraph carefully and answer the following question:

Those substance which furnish H^+ ions in water are called Arrthenius acid e.g. HCl while those which furnish OH^- in water are called Arrhenius bases e.g. NaOH, Arrthenius concept is limited upto aqueous medium only while Bronsted-Lowry (protonic) and Lewis (electronics) concepts are applicable in any medium. In water all acids becomes much stronger. It is called levelling effect of water. Glacial acetic acid is used as a differentiating solvent. Bronsted acids and bases exist in pairs, i.e. acids-base conjugate pair. Amphiprotic species are those which can accept as well as donate a proton e.g. H_2O; BF_3, CO_2 etc. are the examples of Lewis acids while NH_3, H_2O etc. Lewis bases.

1. Correct increasing Lewis acid character of BX_3 (X = F ,Cl, Br, I) is:

(A) $BF_3 < BCl_3 < BBr_3 < BI_3$

(B) $BI_3 < BBr_3 < BCl_3 < BF_3$

(C) $BCl_3 < BD_3 < BBr_3 < BI_3$

(D) $BBr_3 < BF_3 < BCl_3 < BI_3$

2. Which of the following is the conjugate acid of HSO_4^- ?

(A) SO_4^{2-} (B) H_2SO_4 (C) H_3SO_4 (D) None of these

3. Match the following

Coloum – 1	Coloum – 2
(a) $H_2PO_4^-$	(p) Conjugated acid
(b) CH_3COOH	(q) Conjugate base
(c) NO_3^-	(r) Arrheneous acid
(d) NO_2^+	(s) Lewis acid
	(t) Amphiprotic ion

(a) a – p, q, r, s, t (b) b – p, q, r

(c) c – q (d) d - s

Match the following

1.

Coloum – 1	Coloum – 2
(A) The solution has a hydronium ion concentration of 0.0001 mol/litre.	(p) solution of weak electrolyte
(B) The solution 0.001 mol/litre NaOH is	(q) pH = 4
(C) The solution to which the Ostwalds' dilution law is applicable	(r) basic in nature
(D) Salt which when dissolved into water gives a basic solution.	(t) potassium succinate

Section - II

1. A solution with pH = 2 is more acidic than the one with pH = 60 by a factor of
   (A) 3 (B) 4 (C) 3000 (D) 10000
2. 50% neutralisation of a solution of formic acid ($K_a = 2 \times 10^{-4}$) with NaOH would result in a solution having a hydrogen ion concentration of
   (A) 2×10^{-4} (B) 3.7 (C) 2.7 (D) 1.85
3. From separate solution of four sodium salts NaW, NaX, NaY, NaZ had pH 7.0, 9.0, 10.0, 11.0 respectively, when each solution was 0.1 m; the strongest acid is
   (A) HW (B) HX (C) HY (D) HZ
4. The total number of different kind of buffers obtained during the titration of H_3PO_3 with NaOH is/are
   (A) 3 (B) 1 (C) 2 (D) 4
5. the solubility of a salt A_2B_3 is 1.0×10^{-3} M. Its solubility product is
   (A) 1.08×10^{-13} (B) 1.08×10^{-15}
   (C) 1.08×10^{-10} (D) 1.08×10^{-17}
6. If pK_b for CN^- at 25^o C is 4.7, the pH of 0.5 M NaCN solution is (Given $10^{-0.17} = 0.67$)
   (A) 12 (B) 10 (C) 11.5 (D) 11
7. A Certain buffer solution contains equal concentration of A^- & HA. The K_b for A^- is 10^{-10}. The pH of the buffer is
   (A) 7 (B) 10 (C) 4 (D) 14
8. If pK_b for fluoride ion at 25^o C is 10.83. The ionisation constant for hydrofluoric acid in H_2O at this temperature is
   (A) 1.74×10^{-5} (B) 3.52×10^{-3}
   (C) 6.75×10^{-4} (D) 5.38×10^{-2}
9. Fear or excitement, generally cause one to breathe rapidly and it results in the decrease in the concentration of CO_2 in blood. In what way it will change the pH of blood.
   (A) pH will increase
   (B) pH will decrease
   (C) No change
   (D) pH will be 7
10. The pH of 0.1 M solution of the following salts increases in the order
   (A) NaCl< NH_4Cl <NaCN<HCl
   (B) HCl< NH_4Cl <NaCl<NaCN
   (C) NaCN< NH_4Cl <NaCl<HCl
   (D) HCl<NaCl<NaCN , NH_4Cl
11. 10 ml of 0.2 M acid is added to 250 ml of a buffer solution with pH = 6.34. The pH of the solution becomes 6.32. The buffer capacity of the solution is
   (A) 0.1 (B) 0.2 (C) 0.3 (D) 0.4
12. if the salts M_2X. QY_2 and PZ_3 have the same solubilities (of 0.8 mole/lit), that K_{SP} values are related as

(A) $K_{sp}(M_2X) = K_{SP}(QY_2) < K_{SP}(PZ_3)$
(B) $K_{sp}(M_2X) > K_{SP}(QY_2) = K_{SP}(PZ_3)$
(C) $K_{sp}(M_2X) = K_{SP}(QY_2) = K_{SP}(PZ_3)$
(D) $K_{sp}(M_2X) > K_{SP}(QY_2) > K_{SP}(PZ_3)$

13. What is the pH of solution which have NH_3 conc. 0.1 M and $(NH_4)_2SO_4$ concentration .05 M. Given that K_b $(NH_3) = 10^{-5}$

(A) 5 (B) 9 (C) 4.74 (D) 8.26

14. an acidic base indicator has $K_a = 3 \times 10^{-5}$. The acid form of the indicator is red and the basic form of the indicator is blue. The $[H^+]$ change required to change the indicator from 75% red to 75% blue is

(A) -8×10^{-5} M (B) 9×10^{-5} M
(C) 1×10^{-5} M (D) 8×10^{-4} M

15. How much water must be added to 300ml of 0.2 M solution of acetic acid for the degree of dissociation of the acid to double
($K_a = 1.8 \times 10^{-5}$)

(A) 600 ml (B) 300 ml (C) 900 ml (D) 1200 ml