CHEMISTRY SECTION-I: (i) Only One option correct Type This section contains 9 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE is correct. Q.1 How many moles of HCl must be removed from 1 litre of aqueous HCl solution to change its pH from 2 to 3 :-(A) 1 (B) 0.02 (C) 0.009 (D) 0.01 Q.2 Which of the following is most soluble in water? (A) MnS ($K_{sp} = 8 \times 10^{-37}$) (B) ZnS ($K_{sp} = 7 \times 10^{-16}$) (C) $Bi_2S_3 (K_{sp} = 1 \times 10^{-72})$ (D) $Ag_3(PO_4)$ (K_{sp} = 1.8×10⁻¹⁸) Q.3 Solubility of AgBr will be minimum in :-(B) 0.1 M CaBr₂ (C) 0.1 M NaBr (A) Pure water (D) 0.1 M AgNO₃ Q.4 pH of solution at first $1/4^{th}$ equivalence point of Na_2CO_3 when titrated with HCl will be (for $H_2CO_3 K_{a_1} = 10^{-7}$; $K_{a_2} = 10^{-11}$) (A) $7 + \log 3$ (C) $11 + \log 3$ (B) $7 - \log 3$ (D) $11 - \log 3$ Q.5 Statement-1: On dilution of a concentrated solution of CH₃COOH, the concentration of [H⁺] decreases. Statement-2: Increase in volume is more than the increase in degree of ionisation. (A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1. (B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1. (C) Statement-1 is true, statement-2 is false. (D) Statement-1 is false, statement-2 is true. Q.6 An acid HA ionises as $HA \implies H^+ + A^-$ The pH of 1.0 M solution is 5. Its dissociation constant would be :-[AIEEE-2011] (A) 1×10^{-10} (C) 5×10^{-8} (B) 5 (D) 1×10^{-5} Q.7 Which one of the following arrangements represents the correct order of solubilities of sparingly soluble salts Hg₂Cl₂, Cr₂(SO₄)₃, BaSO₄ and CrCl₃ respectively ? [JEE-MAIN(Online)-2013] (A) $\left(\frac{K_{sp}}{4}\right)^{\frac{1}{3}}, \left(\frac{K_{sp}}{108}\right)^{\frac{1}{5}}, \left(K_{sp}\right)^{\frac{1}{2}}, \left(\frac{K_{sp}}{27}\right)^{\frac{1}{4}}$ (B) $\left(K_{sp}\right)^{\frac{1}{2}}, \left(\frac{K_{sp}}{4}\right)^{\frac{1}{3}}, \left(\frac{K_{sp}}{27}\right)^{\frac{1}{4}}, \left(\frac{K_{sp}}{108}\right)^{\frac{1}{5}}$ (C) $\left(K_{sp}\right)^{\frac{1}{2}}, \left(\frac{K_{sp}}{108}\right)^{\frac{1}{5}}, \left(\frac{K_{sp}}{27}\right)^{\frac{1}{4}}, \left(\frac{K_{sp}}{4}\right)^{\frac{1}{3}}$ (D) $\left(\frac{K_{sp}}{108}\right)^{\frac{1}{5}}, \left(\frac{K_{sp}}{27}\right)^{\frac{1}{4}}, \left(K_{sp}\right)^{\frac{1}{2}}, \left(\frac{K_{sp}}{4}\right)^{\frac{1}{3}}$ Q.8 What would be the pH of a solution obtained by mixing 5 g of acetic acid and 7.5 g of sodium acetate and making the volume equal to 500 mL? [JEE-MAIN(Online)-2013] $(Ka = 1.75 \times 10^{-5}, pKa = 4.76)$ (A) 4.76 < pH < 5.0(B) pH < 4.70

- (C) pH of solution will be equal to pH of acetic acid
- (D) pH = 4.70

IONIC-EQUILIBRIUM

PHYSICAL CHEMISTRY

- Q.9 pK_a of a weak acid (HA) and pK_b of a weak base (BOH) are 3.2 and 3.4, respectively. The pH of their salt (AB) solution is [JEE-MAIN(Offine)-2017]
 - (1) 7.2 (2) 6.9 (3) 7.0 (4) 1.0

SECTION-II: (Integer Second Decimal) : 4(0)

- This section contains 5 questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places; e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30, if answer is 11.36777.... then both 11.36 and 11.37 will be correct) by darken the corresponding bubbles in the ORS.

For Example : If answer is -77.25, 5.2 then fill the bubbles as follows.

(\pm)	
2222••2	222.
3 3 3 3 3 3	3 3 3 3 3 3
4 4 4 4 4	44444
5 5 5 5 5	5555
666666	666666
$\bigcirc \bigcirc $	$\bigcirc \bigcirc $
88888	88888
999999	999999

• Answer to each question will be evaluated according to the following marking scheme: *Full Marks* : +4 If ONLY the correct numerical value is entered as answer.

Zero Marks: 0 In all other cases.

- Q.1 Calculate pH of a solution containing 0.1M HA (Ka = 10^{-5}) & 0.1 M HCl.
- Q.2 What is the pH of 0.1M NaHCO₃? $K_1 = 5 \times 10^{-7}$, $K_2 = 5 \times 10^{-11}$ for carbonic acids. [log 2= 0.3]
- Q.3 Calculate the pH of solution containing 0.2 M NH₄OH and 0.1 M NH₄Cl. K_b of NH₄OH = 1.8×10^{-5} . (log2 = 0.3, log 1.8 = 0.26)
- Q.4 A buffer of pH 9.26 is made by dissolving x moles of ammonium sulphate and 0.1 mole of ammonia into 100 mL solution. If pK_b of ammonia is 4.74, calculate value of x.
- Q.5 Calculate the pH of a solution containing 0.2 M HCO_3^- and 0.1 M CO_3^{2-} [log 2= 0.3]

 $[K_1(H_2CO_3) = 4 \times 10^{-7}; K_2(HCO_3^-) = 4 \times 10^{-11}]$

SECTION-III : (SUBJECTIVE)

Q.1 Calculate the extent of hydrolysis & the pH of 0.02 M CH₃COONH₄.

 $[K_{h} (NH_{3})= 1.8 \times 10^{-5}, K_{a} (CH_{3}COOH)=1.8 \times 10^{-5}]$

- Q.2 (i) K_w for H₂O is 9 × 10⁻¹⁴ at 60°C. What is pH of water at 60°C. (log 3 = 0.47)
 - (ii) What is the nature of solution at 60°C whose
 - (a) pH = 6.7 (b) pH = 6.35

Q.3 Calculate pH of following solutions :

- (a) 0.1 M HCl
- (b) 0.1 M CH₃COOH (K_a= 1.8×10^{-5}) (log $\sqrt{1.8} = 0.13$)
- (c) 0.1 M NH₄OH ($K_b = 1.8 \times 10^{-5}$)
- (d) 10^{-8} M HCl $\sqrt{401} = (20.02)$ [log 1.051 = 0.03]
- (e) 10⁻¹⁰ M NaOH
- (f) 10^{-6} M CH₃COOH (K_a = 1.8×10^{-5})
- (g) 10^{-8} M CH₃COOH (K_a= 1.8×10^{-5}) [$\sqrt{401} = (20.02)$] [log 1.051 = 0.03]
- (h) Decimolar solution of Baryta $(Ba(OH)_2)$, diluted 100 times. (log 2 = 0.3)
- (i) 10^{-3} mole of KOH dissolved in 100 L of water.
- (j) Equal volume of HCl solution (PH = 4) + 0.0019 N HCl solution

Q.4 Calculate:

- (a) K_a for a monobasic acid whose 0.10 M solution has pH of 4.50.
- (b) K_{b} for a monoacidic base whose 0.10 M solution has a pH of 10.50.
- Q.5 Calculate pH of following solutions : $[\log 0.3 = -0.522]$
 - (a) $0.1 \text{ M H}_2\text{SO}_4 (50 \text{ ml}) + 0.4 \text{ M HCl} 50 (\text{ml})$
 - (b) 0.1 M HA + 0.1 M HB [K_a (HA) = 5 × 10⁻⁵ ; K_a (HB) = 4 × 10⁻⁵]
- Q.6 What are the concentration of H⁺, $H_2C_2O_4$, $HC_2O_4^-$ and $C_2O_4^{2-}$ in a 0.1 M solution of oxalic acid ?

 $[K_1 = 10^{-2} \text{ M and } K_2 = 10^{-5} \text{ M}] \left[\sqrt{41} = 6.4\right]$

- Q.7 0.25 M solution of pyridinium chloride $C_5H_6N^+Cl^-$ was found to have a pH of 2.699. What is K_b for pyridine, C_5H_5N ? (log2 = 0.3010)
- Q.8 The acid ionization (hydrolysis) constant of Zn^{2+} is 1.0×10^{-9}
 - (a) Calculate the pH of a 0.001 M solution of ZnCl₂
 - (b) What is the basic dissociation constant of $Zn(OH)^+$?
- Q.9 An aqueous solution contains 0.01 M RNH₂ ($K_b = 2 \times 10^{-6}$) & 10⁻⁴ M NaOH. The concentration of OH⁻ is nearly :
- Q.10 Determine [OH⁻] of a 0.050 M solution of ammonia to which sufficient NH₄Cl has been added to make the total [NH₄⁺] equal to 0.100.[K_{b(NH₃)}=1.8 × 10⁻⁵, pK_b = 4.74]

Q.11 In 1 L saturated solution of AgCl $[K_{sp}(AgCl) = 1.6 \times 10^{-10}]$, 0.1 mol of CuCl

 $[K_{sp}(CuCl) = 1.0 \times 10^{-6}]$ is added. The resultant concentration of Ag⁺ in the solution is 1.6×10^{-x} . The value of 'x' is. [JEE -2011]