

6. ACIDS AND BASES

PREVIOUS EAMCET BITS

1. pH of a buffer solution decreases by 0.02 units when 0.12g of acetic acid is added to 250ml of a buffer solution of acetic acid and Potassium acetate at 27°C. The buffer capacity of the solution is **(2009 E)**
- 1) 0.1 2) 10 3) 1 4) 0.4

Ans : 4

Sol: To 250 ml. Of buffer solution 0.12g of acetic acid is added
To 1000ml of buffer solution $4 \times 0.12 = 0.48$ g of acid is added

∴ NO. of moles of acetic acid added

$$= \frac{0.48}{60} = 8 \times 10^{-3} \text{ moles}$$

No. of moles of acid added to 1lit. solution

Buffer capacity = $\frac{\text{change in PH}}{\text{change in PH}}$

$$= \frac{8 \times 10^{-3}}{0.02} = 0.4$$

2. Assertion (A) : the aqueous solution of CH₃COONa is alkaline in nature.

Reason (R) : Acetate ion undergoes anionic hydrolysis

The correct answer is

(2009 M)

- 1) both A and R are true and R is the correct explanation of A
2) both A and R are true and R is not the correct explanation of A
3) A is true and R is not true 4) A is not true but R is true

Ans : 1

Sol: $CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^-_{(aq)}$

Anion Weak acid

CH_3COO^- undergoes anionic hydrolysis

∴ Aq. Solution of CH₃COONa is Alkaline

3. When 0.1 moles of an acid is added to 2 litres of a buffer solution, the pH of the buffer decreases by 0.5. The buffer capacity of the solution is **(2008 E)**

- 1) 0.6 2) 0.4 3) 0.2 4) 0.1

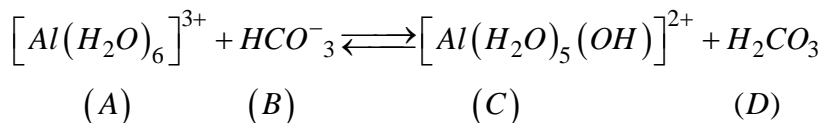
Ans : 4

$$\phi = \frac{\text{No. of moles of acid or base added to 1lit. of the solution}}{\text{Change in pH}}$$

Sol: Buffer capacity

$$= \frac{0.05}{0.5} = 0.1$$

4. Identify Bronsted –Lowry acids in the reaction given



[2008 M]

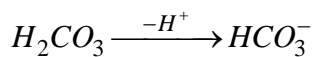
The correct answer is

1. (A), (C) 2. (B), (D) 3. (A), (D) 4. (B), (C)

Ans : 3

Sol: $\left[Al(H_2O)_6 \right]^{3+} \xrightarrow{-H^+} \left[Al(H_2O)_5(OH) \right]^{2+}$

Acid



Acid

5. Which of the following is not a conjugate acid-base pair?
- (2007 E)

- 1) HPO_3^{2-} , PO_3^{3-} 2) $H_2PO_4^-$, HPO_4^{2-}
 3) $H_2PO_4^-$, H_3PO_4 4) $H_2PO_4^-$, PO_3^{3-}

Ans: 4

Sol: Conjugate acid and its base must differ by one proton

 $H_2PO_4^-$, PO_3^{3-} not a conjugate acid base pair.

6. 100 mL of 0.1 M
- H_2SO_4
- is added to 200 mL of 0.1 M NaOH. What is the pH of the resulting mixture?

(2007 M)

- 1) 2 2) 7 3) 10 4) 12

Ans : 2

Sol : 0.1 M H_2SO_4 means 0.2N H_2SO_4

0.1 M NaOH means 0.1N NaOH

100ml 0.2N H_2SO_4 exactly neutralizes 200ml 0.1 N NaOH

Resulting solution is neutral

 $\therefore pH = 7$

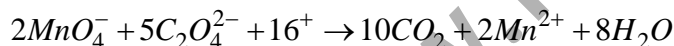
7. The concentration of oxalic acid is 'x' mol lit
- ⁻¹
- . 40 ml of this solution reacts with 16ml of 0.05 M acidified
- $KMnO_4$
- . What is the pH of 'x' M oxalic acid solution? (Assume that oxalic acid dissociates completely)

(2006 E)

- 1) 1.3 2) 1.699 3) 1 4) 2

Ans : 3

Sol: Reaction



2 moles 5 moles

Number of moles of $MnO_4^- = 16 \times 0.05 \times 10^{-3} = 0.8 \times 10^{-3}$

$$\text{Number of moles of oxalic acid} = \frac{0.8 \times 10^{-3} \times 5}{2} = 2 \times 10^{-3}$$

$$\text{Oxalic acid conc.} = \frac{2 \times 10^{-3} \times 1000}{40}$$

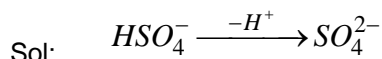
$$\therefore [H^+] = 2 \times 0.05 = 0.1M$$

pH = 1

8. What is the conjugate base of
- HSO_4^-
- ?
- (2006 M)

- 1) H_2SO_4 2) HSO_4^- 3) SO_4^{2-} 4) H^+

Ans : 3



Acid Conjugate base

9. Assertion (A): The
- P_H
- of a buffer solution containing equal moles of acetic acid and sodium acetate is 4.8 (
- P_{K_a}
- of acetic acid is 4.8).

Reason (R): The ionic product of water at 25°C is 10^{-14} mol².lit⁻².

(2005 E)

The correct answer is

- Both (A) and (R) are true and (R) is the correct explanation of (A).
- Both (A) and (R) are true and (R) is not the correct explanation of (A).
- (A) is true but (R) is not true.
- (A) is not true but (R) is true.

(2006 E)

Ans : 2

$$\text{Sol: } \text{pH of Buffer Solution} = \text{p}K_a + \log \frac{\{\text{salt}\}}{\{\text{Acid}\}}$$

$$= 4.8 \log \frac{1}{1} = 4.8 + 0 = 4.8$$

$$K_w = [H^+][OH^-]$$

$$= 1 \times 10^{-4} \text{ mol}^2 \text{ lit}^{-2} \text{ at } 25^\circ\text{C}$$

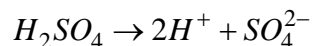
10. Which of the following is correct?

(2005 M)

- The pH of one litre solution containing 0.49g of H_2SO_4 is 2.0
- The conjugate base of H_2S is S^{2-}
- BF_3 is a Lewis Base.
- Phenolphthalein is colorless in basic medium.

Ans : 1

$$\text{Sol: } \text{Molarity of } \text{H}_2\text{SO}_4 = \frac{0.49}{98 \times 1} = 0.005 \text{ M}$$



$$\therefore [H^+] = 2 \times 0.005 = 0.01 \text{ M}$$

$$\text{pH} = -\log(0.01) = +2$$

11. Study the following table

Buffer solution	Volume (in ml) of 0.1M weak acid	Volume (in ml) of 0.1M sodium salt of weak acid
I	4.0	4.0
II	4.0	40.0
III	40.0	4.0
IV	0.1	10.0

Which of the two sets of buffer solutions have the least pH

(2004 E)

- I and II
- I and III
- II and III
- II and IV

Ans : 2

Sol: pH of an acid buffer is least when the concentration of an acid is highest. The buffer I and III have highest acid concentration and least pH .

12. 100ml of 0.015M HCl is mixed with 100 ml of 0.005M HCl, what is the pH of the resulting solution.

(2004 M)

- 1.2.5
- 1.5
- 2
- 1

Ans : 3

$$\text{Sol: } [H^+] = \frac{(100 \times 0.015) + (100 \times 0.005)}{200}$$

$$[H^+] = \frac{1.5 + 0.5}{200} = \frac{2}{200} = 0.01$$

$$\text{pH} = 2$$

13. If the ionic product of water is (K_w) 1.96×10^{-14} at 35°C . What is its value at 100°C ?

(2003 E)

- 1.96×10^{-14}
- 2.392×10^{-14}
- 3.295×10^{-15}
- 1.96×10^{-13}

Ans : 3

Sol: With decrease in temp. the value of (K_w) decreases 10°C $K_w = 2.95 \times 10^{-15}$

14. Which one of the following statements is correct? **(2002 E)**

1. Bronsted Lowry theory could not explain the acidic nature of BCl_3
2. The pH of 0.01 M NaOH solution is 2
3. The ionic product of water at 25°C is 10^{-10} mole²/lit²
4. The pH of a solution can be calculated using the equation $\text{pH} = \log. (\text{H}^+)$

Ans : 1

Sol: Bronsted Theory : An acid is a proton donor. But BCl_3 is not a proton donor. BCl_3 is an acid as per Lewis Theory.

15. What is the hybridization state of the central atom in the conjugate base of NH_4^+ ion ? **(2002 E)**

- 1) sp
- 2) sp^3
- 3) sp^2
- 4) dsp^2

Ans : 2

Sol: $\text{NH}_4^+ \rightarrow \text{NH}_3 + \text{H}^+$

NH_3 has sp^3 hybridisation

16. Which one of the following statements is not correct ? **(2002 M)**

- 1) Cl^- is a Lewis acid
- 2) The pH of 10^{-8} M HCl solution is less than 7
- 3) The ionic product of water at 25°C is 10^{-14} mol². lit⁻²
- 4) Bronsted – Lowry theory could not explain the acidic character of AlCl_3

Ans : 1

Sol: Cl^- is a Lewis base not Lewis acid.

This is wrong statement

All others correct

17. The P^{Ka} of weak acid is 4.8. What should be the ratio of (acid/salt) if buffer of $\text{pH} = 5.8$ is required **(2001 E)**

- 1) 0.1 M
- 2) 10
- 3) 1
- 4) 2

Ans : 1

Sol: Henderson equation

$$\text{pH of Buffer} = \text{P}^{\text{Ka}} + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

$$5.8 = \left[4.8 + \log \frac{[\text{Salt}]}{[\text{Acid}]} \right]$$

$$\therefore \log \frac{[\text{Salt}]}{[\text{Acid}]} = 5.8 - 4.8 = 1$$

We know $\log 10 = 1$

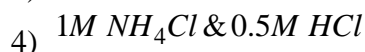
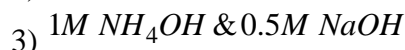
$$\therefore \frac{[\text{Salt}]}{[\text{Acid}]} = 10$$

$$\therefore \frac{[\text{Acid}]}{[\text{Salt}]} = \frac{1}{10} = 0.1$$

18. Which of the following would produce a buffer solution when mixed in equal volumes

(2001 E)

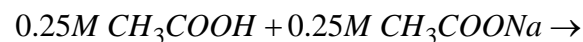
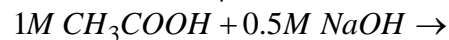
- 1) 1 M CH_3COOH & 0.5M NaOH



Ans : 1

Sol: A buffer should be an aqueous solution containing a weak acid and its conjugate base in the form of salt.

When mixed in equal volumes,



Buffer solution

All others are not buffers

19. The pH of a 0.1M aqueous solution of a weak acid (HA) is 3. What is its degree of dissociation (2001 M)

1) 1%

2) 10%

3) 50%

4) 25%

Ans : 1

Sol: $pH = 3 \quad \therefore [H^+] = 1 \times 10^{-3} M$

$[H^+] = \text{degree of dissociation} \times \text{Concentration of solution}$

degree of dissociation, $\alpha = \frac{[H^+]}{\text{conc. of solution}}$

$$= \frac{1 \times 10^{-3}}{0.1} = 1 \times 10^{-2} = 1\%$$

20. Which of the following is correct for acid buffer? (salt = S, acid = A) (2000 E)

1. $pK_a = pH + \log \frac{[S]}{[A]}$

2. $pH = pK_a + \log \frac{[S]}{[A]}$

3. $pK_a = pH - \log \frac{[A]}{[S]}$

4. $pH = pK_a + \log \frac{[A]}{[S]}$

Ans : 2

21. The pH of an aqueous solution of a salt is 10. The salt is **(2000 E)**

1. NaCl 2. NH₄Cl 3. CH₃COONa 4. (NH₄)₂SO₄

Ans : 3

Sol : Salt whose pH value "10"
Is Basic Salt i.e., CH₃COONa

22. The P^{ka} of a weak acid is 4.8. What is the ratio of [salt] to [acid], if a buffer of pH = 5.8 is to be prepared **(2000 M)**

1. 1:1 2. 10:1 3. 2:1 4. 1:10

Ans: 2

Sol:
$$\text{pH} = \text{Pka} + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

$$5.8 = 4.8 + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

$$5.8 - 4.8 + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

$$1 = \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

$$\log_{10} = \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

$$\frac{[\text{Salt}]}{[\text{Acid}]} = 10 = \frac{10}{1}$$

$$\therefore \frac{[\text{Salt}]}{[\text{Acid}]} = 10:1$$

23. Which of the following is a Lewis Acid? **(2000 M)**

1. HCOO⁻ 2. H₂SO₄ 3. SiF₄ 4. H₂S

Ans: 3

Sol: In Si atom due to presence vacant d-orbitals, it can accept a pair of electrons.
