Public Library · FBISE / NBF

# Chemistry Grade 12 — Chapter 4

Acid-base Chemistry

by Public Library

*Independent practice MCQs from the supplied Class 12 Chemistry notes pack. Total: 50 questions.*

## A. Important / Main Topics

**1. The pH of a solution is defined as:**

(A) -log[H□]
(B) log[H□]
(C) 1/[H□]
(D) 10[H^□]

**Correct Answer: A**

*Explanation: The notes state that pH = -log[H□], i.e., the negative logarithm of the hydrogen ion concentration.*

**2. At 25°C, a neutral solution has a pH of:**

(A) 0
(B) 7
(C) 14
(D) 1

**Correct Answer: B**

*Explanation: At 25°C, a neutral solution has a pH of 7.*

**3. The ionic product of water (K_w) at 25°C is:**

(A) 1.0 × 10□⁷
(B) 1.0 × 10□¹⁰
(C) 1.0 × 10□¹⁴
(D) 1.0 × 10□⁴

**Correct Answer: C**

*Explanation: The notes state that K_w = [H□][OH□] = 1.0 × 10□¹⁴ at 25°C.*

**4. The pH scale typically ranges from:**

(A) 0 to 7
(B) 7 to 14
(C) 1 to 14
(D) 0 to 14

**Correct Answer: D**

*Explanation: The notes state that the values on the pH scale go from 0 to 14.*

**5. The relationship between pH and pOH at 25°C is:**

(A) pH + pOH = 14
(B) pH + pOH = 7
(C) pH - pOH = 14
(D) pH × pOH = 14

**Correct Answer: A**

*Explanation: The relationship between pH and pOH at 25°C is pH + pOH = 14.*

**6. In a titration of a strong acid with a strong base, the pH at the equivalence point is:**

(A) Less than 7
(B) 7
(C) Greater than 7
(D) Always 14

**Correct Answer: B**

*Explanation: The equivalence point of a strong acid–strong base titration is neutral, with a pH of 7.*

**7. The pH titration curve of a weak acid with a strong base has an equivalence point that is:**

(A) Acidic
(B) Neutral
(C) Basic
(D) Always 7

**Correct Answer: C**

*Explanation: The notes state that for a weak acid–strong base titration, the equivalence point is basic (pH about 9).*

**8. The pH titration curve of a strong acid with a weak base has an equivalence point that is:**

(A) Neutral
(B) Basic
(C) Always 7
(D) Acidic

**Correct Answer: D**

*Explanation: The notes state that for a strong acid–weak base titration, the equivalence point is acidic (pH about 5.5).*

**9. The pH scale was introduced by:**

(A) Sorensen
(B) Arrhenius
(C) Lewis
(D) Lowry

**Correct Answer: A**

*Explanation: The notes state that the pH scale was introduced by the Danish biochemist S.P.L. Sorensen in 1909.*

**10. A change of one pH unit represents a change in [H□] by a factor of:**

(A) 1
(B) 10
(C) 100
(D) 1000

**Correct Answer: B**

*Explanation: The notes state that a change of one pH unit corresponds to a ten-fold change in the hydrogen ion concentration.*

**11. Which titration curve has no steep vertical region?**

(A) Strong acid + strong base
(B) Strong acid + weak base
(C) Weak acid + weak base
(D) Weak acid + strong base

**Correct Answer: C**

*Explanation: The notes state that in a weak acid–weak base titration, there is no vertical region; only a gradual change in pH occurs.*

**12. A solution with a pH of 5 is:**

(A) Basic
(B) Neutral
(C) A strong base
(D) Acidic

**Correct Answer: D**

*Explanation: A pH of 5 is less than 7, so the solution is acidic.*

**13. The pH of a solution with [H□] = 1 × 10□³ M is:**

(A) 3
(B) -3

(C) 11
(D) 1

**Correct Answer: A**

*Explanation: The pH of a solution with [H□] = 1 × 10□³ M is 3.*

**14. The pOH of a solution with a pH of 10 at 25°C is:**

(A) 7
(B) 4
(C) 10
(D) 14

**Correct Answer: B**

*Explanation: The pOH of a solution with a pH of 10 at 25°C is 4.*

**15. Which of the following solutions is the most acidic?**

(A) pH 5
(B) pH 7
(C) pH 2
(D) pH 10

**Correct Answer: C**

*Explanation: The lower the pH, the more acidic the solution. pH 2 is the lowest value among the options.*

**16. If the concentration of H□ in a solution is 1 × 10□⁵ M, the pH is:**

(A) -5
(B) 9
(C) 1
(D) 5

**Correct Answer: D**

*Explanation: If the concentration of H□ in a solution is 1 × 10□⁵ M, the pH is 5.*

**17. If the pH of a solution is 3, the concentration of H□ is:**

(A) 1 × 10□³ M
(B) 3 × 10□¹ M
(C) 1 × 10□¹¹ M
(D) 3 × 10□³ M

**Correct Answer: A**

*Explanation: If the pH of a solution is 3, the concentration of H□ is 1 × 10□³ M.*

**18. If the concentration of NaOH in a solution is 2.5 × 10□⁴ M, the concentration of H□O□ at 25°C is:**

(A) 2.5 × 10□⁴ M
(B) 4.0 × 10□¹¹ M
(C) 1.0 × 10□⁷ M
(D) 1.0 × 10□¹⁴ M

**Correct Answer: B**

*Explanation: If the concentration of NaOH in a solution is 2.5 × 10□⁴ M, the concentration of H□O□ at 25°C is 4.0 × 10□¹¹ M.*

**19. A solution has a pH of 7.84. The hydrogen ion concentration is approximately:**

(A) 7.84 × 10□⁸ M
(B) 1.45 × 10□⁷ M
(C) 1.45 × 10□⁸ M
(D) 7.84 × 10□⁷ M

**Correct Answer: C**

*Explanation: A solution has a pH of 7.84. The hydrogen ion concentration is approximately 1.45 × 10□⁸ M.*

**20. At 25°C, the pKw value is:**

(A) 7

(B) 10
(C) 1
(D) 14

**Correct Answer: D**

*Explanation: At 25°C, the pKw value is 14.*

**21. If the pH of a solution is 5, its pOH at 25°C is:**

(A) 9
(B) 5
(C) 14
(D) 7

**Correct Answer: A**

*Explanation: If the pH of a solution is 5, its pOH at 25°C is 9.*

**22. A solution with a pH of 11 is:**

(A) Acidic
(B) Basic
(C) Neutral
(D) A strong acid

**Correct Answer: B**

*Explanation: A pH of 11 is greater than 7, so the solution is basic.*

**23. Which of the following indicators is suitable for a strong acid–strong base titration?**

(A) An indicator with a pH range of 3–5
(B) An indicator with a pH range of 9–11
(C) An indicator with a pH range of 6–8
(D) An indicator with a pH range of 12–14

**Correct Answer: C**

*Explanation: The equivalence point is at pH 7, so an indicator that changes colour near pH 7 (range 6–8) is sui.*

**24. The equivalence point of a titration is the point where:**

(A) The indicator changes colour
(B) The pH is always 7
(C) The titration begins
(D) Moles of acid equal moles of base

**Correct Answer: D**

*Explanation: The equivalence point is the theoretical point where neutralization is complete.*

**25. In the titration of a weak acid with a strong base, the pH at the equivalence point is greater than 7 because:**

(A) The conjugate base of the weak acid hydrolyzes to produce OH□
(B) The strong base is in excess
(C) The acid is fully ionized
(D) Water is neutral

**Correct Answer: A**

*Explanation: At the equivalence point, the solution contains the conjugate base of the weak acid, which reacts with water to produce OH□, making the solution basic.*

## B. Less Important / Secondary Topics

**26. Why is the equivalence point of a strong acid–weak base titration acidic?**

(A) Because the conjugate acid of the weak base hydrolyzes to produce H□
(B) Because the acid is fully ionized
(C) Because the base is in excess
(D) Because water is neutral

**Correct Answer: A**

*Explanation: At the equivalence point, the solution contains the conjugate acid of the weak base, which donates protons to water, making the solution acidic.*

**27. A weak acid–weak base titration cannot be used with an indicator because:**

(A) The pH change is too sudden
(B) There is no sharp vertical region, making the endpoint difficult to detect
(C) The reaction is too fast
(D) The reaction is too exothermic

**Correct Answer: B**

*Explanation: The notes state that a weak acid–weak base titration has no steep vertical region; the pH changes gradually, so the endpoint is difficult to detect with an indicator.*

**28. If the [OH□] of a solution is 1.0 × 10□³ M, the pOH is:**

(A) 11
(B) 7
(C) 3
(D) 14

**Correct Answer: C**

*Explanation: If the [OH□] of a solution is 1.0 × 10□³ M, the pOH is 3.*

**29. Which solution has the highest pH?**

(A) 0.1 M HCl
(B) Pure water
(C) 0.1 M acetic acid
(D) 0.1 M NaOH

**Correct Answer: D**

*Explanation: NaOH is a strong base, giving the highest pH among the options.*

**30. The pH of a 0.001 M HCl solution is:**

(A) 3
(B) -3
(C) 11
(D) 1

**Correct Answer: A**

*Explanation: HCl is a strong acid, so [H□] = 10□³ M, and pH = 3.*

**31. Which of the following statements about the pH scale is correct?**

(A) A pH of 0 means the solution is neutral.
(B) A pH of 7 means the solution is neutral.
(C) A pH of 14 means the solution is extremely acidic.
(D) A pH of 1 is more basic than a pH of 2.

**Correct Answer: B**

*Explanation: A pH of 7 is neutral at 25°C. A pH of 0 is extremely acidic, and a pH of 14 is extremely basic.*

**32. The relationship between pH, pOH, and pK_w at 25°C is:**

(A) pH - pOH = 14
(B) pH × pOH = 14
(C) pH + pOH = pK_w = 14
(D) pH = pOH

**Correct Answer: C**

*Explanation: The relationship between pH, pOH, and pK_w at 25°C is pH + pOH = pK_w = 14.*

**33. Which of the following is a strong base?**

(A) Ammonia
(B) Water

(C) Acetic acid
(D) Sodium hydroxide

**Correct Answer: D**

*Explanation: Sodium hydroxide (NaOH) is a strong base that dissociates completely in water.*

**34. The concentration of OH□ in a solution with a pH of 3 at 25°C is:**

(A) 1.0 × 10□¹¹ M
(B) 1.0 × 10□³ M
(C) 1.0 × 10□⁷ M
(D) 1.0 × 10□¹⁴ M

**Correct Answer: A**

*Explanation: The concentration of OH□ in a solution with a pH of 3 at 25°C is 1.0 × 10□¹¹ M.*

**35. The pH of a solution with [H□] = 1 × 10□⁷ M is:**

(A) 14
(B) 7
(C) 1
(D) 0

**Correct Answer: B**

*Explanation: The pH of a solution with [H□] = 1 × 10□⁷ M is 7.*

**36. A 0.01 M solution of a weak acid has a pH of 4. The K_a of the acid is approximately:**

(A) 1 × 10□⁴
(B) 1 × 10□⁸
(C) 1 × 10□⁶
(D) 1 × 10□²

**Correct Answer: C**

*Explanation: pH = 4 Rightarrow [H□] = 10□⁴ M. For a weak acid, K_a ≈ [H□]²/[HA] = (10□⁴)²/0.01 = 10□⁸/10□² = 10□⁶.*

**37. A buffer solution is prepared from 0.1 M acetic acid and 0.2 M sodium acetate. If pK_a of acetic acid is 4.74, the pH is:**

(A) 4.44
(B) 4.74
(C) 7.00
(D) 5.04

**Correct Answer: D**

*Explanation: A buffer solution is prepared from 0.1 M acetic acid and 0.2 M sodium acetate. If pK_a of acetic acid is 4.74, the pH is 5.04.*

**38. A buffer solution is prepared from 0.2 M acetic acid and 0.1 M sodium acetate. If pK_a of acetic acid is 4.74, the pH is:**

(A) 4.44
(B) 4.74
(C) 5.04
(D) 7.00

**Correct Answer: A**

*Explanation: A buffer solution is prepared from 0.2 M acetic acid and 0.1 M sodium acetate. If pK_a of acetic acid is 4.74, the pH is 4.44.*

**39. Two solutions have pH values of 2 and 5. The ratio of their hydrogen ion concentrations, [H□]pH □ : [H□]pH □, is:**

(A) 1 : 3
(B) 1000 : 1
(C) 3 : 1
(D) 1 : 1000

**Correct Answer: B**

*Explanation: Two solutions have pH values of 2 and 5. The ratio of their hydrogen ion concentrations, [H□]pH □ : [H□]pH □, is 1000 : 1.*

**40. In a titration of a weak acid with a strong base, the pH at the equivalence point is about 9. This is because:**

(A) The strong base is in excess
(B) The acid is fully ionized
(C) The conjugate base of the weak acid hydrolyzes to produce OH□
(D) Water is neutral

**Correct Answer: C**

*Explanation: The conjugate base of the weak acid reacts with water to produce OH□, making the solution basic at the equivalence point.*

**41. A titration curve with a long, steep vertical region centred at pH 7 corresponds to:**

(A) Strong acid + weak base
(B) Weak acid + strong base
(C) Weak acid + weak base
(D) Strong acid + strong base

**Correct Answer: D**

*Explanation: A titration curve with a long, steep vertical region centred at pH 7 corresponds to Strong acid + strong base.*

**42. A buffer solution is prepared from a weak acid and its conjugate base. If the pH of the buffer is 5 and the pK_a of the acid is 5, the ratio [A□]/[HA] is:**

(A) 1
(B) 10
(C) 0.1
(D) 100

**Correct Answer: A**

*Explanation: pH = pK_a + log([A□]/[HA]), so 5 = 5 + log(ratio), giving log(ratio) = 0, so the ratio is 1.*

**43. The pH of a solution with [H□] = 2 × 10□³ M is approximately:**

(A) 3.00
(B) 2.70
(C) 3.30
(D) 2.00

**Correct Answer: B**

*Explanation: The pH of a solution with [H□] = 2 × 10□³ M is approximately 2.70.*

**44. A solution has a pOH of 4. The concentration of H□ at 25°C is:**

(A) 1 × 10□⁴ M
(B) 1 × 10□⁷ M
(C) 1 × 10□¹⁰ M
(D) 1 × 10□¹⁴ M

**Correct Answer: C**

*Explanation: pOH = 4 means [OH□] = 10□⁴ M. Using K_w, [H□] = 10□¹⁴/10□⁴ = 10□¹⁰ M.*

**45. The pH of a solution with [H□] = 1 × 10□⁸ M at 25°C is:**

(A) 6
(B) 7
(C) 14
(D) 8

**Correct Answer: D**

*Explanation: pH = -log(1 × 10□⁸) = 8. The solution is basic.*

**46. A buffer solution containing a weak acid and its conjugate base is made such that the concentration of the conjugate base is 10 times that of the acid. If the pK_a of the acid is 4, the pH of the buffer is:**

(A) 5
(B) 4
(C) 3
(D) 7

**Correct Answer: A**

*Explanation: A buffer solution containing a weak acid and its conjugate base is made such that the concentration of the conjugate base is 10 times that of the acid. If the pK_a of the acid is 4, the pH of the buffer is 5.*

**47. A solution has a pH of 6. The hydrogen ion concentration is:**

(A) 6 × 10□¹ M
(B) 1 × 10□⁶ M
(C) 1 × 10□⁸ M
(D) 6 × 10□⁶ M

**Correct Answer: B**

*Explanation: A solution has a pH of 6. The hydrogen ion concentration is 1 × 10□⁶ M.*

**48. Which of the following is true about the equivalence point in a titration?**

(A) It always occurs at pH 7.
(B) It is the point where the indicator changes colour.
(C) It is the point where moles of acid equal moles of base.
(D) It is the point where the titration begins.

**Correct Answer: C**

*Explanation: The equivalence point is the theoretical point where neutralization is complete; the pH depends on the acid and base strengths.*

**49. The pH of a 0.1 M solution of a strong acid is:**

(A) 2
(B) 7
(C) 13
(D) 1

**Correct Answer: D**

*Explanation: A strong acid dissociates completely, so [H□] = 0.1 M = 10□¹ M, and pH = 1.*

**50. The pH of a 0.01 M solution of a strong base is approximately:**

(A) 12
(B) 2
(C) 7
(D) 14

**Correct Answer: A**

*Explanation: A strong base dissociates completely, so [OH□] = 0.01 M = 10□² M, pOH = 2, and pH = 14 - 2 = 12.*