GRAFTER JA
ANALYTICAL CHEMISTRY

1. Which of the following is not a chelating agent?

a) Ethylenediaminetetraacetic acid (EDTA)
b) Nitrilotriacetic acid (NTA)
c) Dimethylglyoxime (DMG)
d) Ethylenediamine (en)

Answer: c) Dimethylglyoxime (DMG)

Explanation: Dimethylglyoxime (DMG) is a specific reagent for nickel(II) ions, forming a red precipitate. It is not a chelating agent in the sense that it does not form multiple bonds with the metal ion. The other options are all chelating agents that form multiple bonds with metal ions.

2. Which of the following is a primary standard for acid-base titrations?

a) Sodium hydroxide (NaOH)
b) Potassium permanganate ($KMnO_4$)
c) Sodium carbonate (Na_2CO_3)
d) Hydrochloric acid (HCl)

Answer: c) Sodium carbonate (Na_2CO_3)

Explanation: Sodium carbonate (Na_2CO_3) is a primary standard for acid-base titrations because it is stable, pure, and has a known composition. The other options are not primary standards for acid-base titrations. Sodium hydroxide (NaOH) is a secondary standard, potassium permanganate ($KMnO_4$) is used in redox titrations, and hydrochloric acid (HCl) is a titrant.

3. The pH of a solution with a hydrogen ion concentration of 1×10^{-3} M is:

a) 3
b) 11
c) 7
d) 1

Answer: a) 3

Explanation: The pH is calculated using the formula: $pH = -\log[H^+]$. For $[H^+] = 1 \times 10^{-3}$ M, $pH = -\log(1 \times 10^{-3}) = 3$. The other options are incorrect calculations.

4. Which of the following is a strong base?

a) Ammonia (NH_3)
b) Sodium hydroxide (NaOH)
c) Acetic acid (CH_3COOH)
d) Hydrochloric acid (HCl)

Answer: b) Sodium hydroxide (NaOH)

Explanation: Sodium hydroxide (NaOH) is a strong base because it completely dissociates in water to form Na^+ and OH^- ions. Ammonia (NH_3) is a weak base, acetic acid (CH_3COOH) is a weak acid, and hydrochloric acid (HCl) is a strong acid.

5. The buffer capacity is maximum when the pH of the buffer is equal to the pKa of the weak acid.

a) True
b) False

Answer: a) True

Explanation: The buffer capacity is maximum when the pH of the buffer is equal to the pKa of the weak acid. This is because the buffer can effectively neutralize both added acid and added base when the pH is equal to the pKa.

6. Which of the following is a primary standard for redox titrations?

a) Potassium permanganate ($KMnO_4$)
b) Sodium thiosulfate ($Na_2S_2O_3$)
c) Potassium dichromate ($K_2Cr_2O_7$)
d) Iodine (I_2)

Answer: c) Potassium dichromate ($K_2Cr_2O_7$)

Explanation: Potassium dichromate ($K_2Cr_2O_7$) is a primary standard for redox titrations because it is stable, pure, and has a known composition. The other options are not primary standards for redox titrations. Potassium permanganate ($KMnO_4$) is a secondary standard, sodium thiosulfate ($Na_2S_2O_3$) is used in iodometric titrations, and iodine (I_2) is a titrant.

7. Which of the following is a chelating agent?

a) Ethylenediaminetetraacetic acid (EDTA)
b) Nitrilotriacetic acid (NTA)
c) Dimethylglyoxime (DMG)
d) Ethylenediamine (en)

Answer: a) Ethylenediaminetetraacetic acid (EDTA)

Explanation: Ethylenediaminetetraacetic acid (EDTA) is a chelating agent because it forms multiple bonds with metal ions, forming a stable complex. The other options are not chelating agents. Nitrilotriacetic acid (NTA) is a weak chelating agent, dimethylglyoxime (DMG) is a specific reagent for nickel(II) ions, and ethylenediamine (en) is a ligand but not a chelating agent.

8. The pH of a solution with a hydrogen ion concentration of 1×10^{-4} M is:

a) 4
b) 10
c) 7
d) 1

Answer: a) 4

Explanation: The pH is calculated using the formula: $pH = -\log[H^+]$. For $[H^+] = 1 \times 10^{-4}$ M, $pH = -\log(1 \times 10^{-4}) = 4$. The other options are incorrect calculations.

9. Which of the following is a strong acid?

a) Acetic acid (CH_3COOH)
b) Hydrochloric acid (HCl)
c) Ammonia (NH_3)
d) Sodium hydroxide (NaOH)

Answer: b) Hydrochloric acid (HCl)

Explanation: Hydrochloric acid (HCl) is a strong acid because it completely dissociates in water to form H^+ and Cl^- ions. Acetic acid (CH_3COOH) is a weak acid, ammonia (NH_3) is a weak base, and sodium hydroxide (NaOH) is a strong base.

10. The buffer capacity is maximum when the pH of the buffer is equal to the pKa of the weak base.

a) False
b) True

Answer: a) False

Explanation: The buffer capacity is maximum when the pH of the buffer is equal to the pKa of the weak acid. This is because the buffer can effectively neutralize both added acid and added base when the pH is equal to the pKa.

11. Which of the following is a primary standard for precipitation titrations?

a) Silver nitrate ($AgNO_3$)
b) Potassium chromate (K_2CrO_4)
c) Sodium chloride (NaCl)
d) Potassium iodide (KI)

Answer: c) Sodium chloride (NaCl)

Explanation: Sodium chloride (NaCl) is a primary standard for precipitation titrations because it is stable, pure, and has a known composition. The other options are not primary standards for precipitation titrations. Silver nitrate ($AgNO_3$) is a secondary standard, potassium chromate (K_2CrO_4) is used in Mohr's method, and potassium iodide (KI) is used in iodometric titrations.

12. Which of the following is a weak base?

a) Ammonia (NH_3)
b) Sodium hydroxide (NaOH)
c) Acetic acid (CH_3COOH)
d) Hydrochloric acid (HCl)

Answer: a) Ammonia (NH_3)

Explanation: Ammonia (NH_3) is a weak base because it partially dissociates in water to form NH_4^+ and OH^- ions. Sodium hydroxide (NaOH) is a strong base, acetic acid (CH_3COOH) is a weak acid, and hydrochloric acid (HCl) is a strong acid.

13. The pH of a solution with a hydrogen ion concentration of 1×10^{-5} M is:

a) 5
b) 9
c) 7
d) 1

Answer: a) 5

Explanation: The pH is calculated using the formula: $pH = -\log[H^+]$. For $[H^+] = 1 \times 10^{-5}$ M, $pH = -\log(1 \times 10^{-5}) = 5$. The other options are incorrect calculations.

14. Which of the following is a primary standard for complexometric titrations?

a) Ethylenediaminetetraacetic acid (EDTA)
b) Nitrilotriacetic acid (NTA)
c) Dimethylglyoxime (DMG)
d) Ethylenediamine (en)

Answer: a) Ethylenediaminetetraacetic acid (EDTA)

Explanation: Ethylenediaminetetraacetic acid (EDTA) is a primary standard for complexometric titrations because it is stable, pure, and has a known composition. The other options are not primary standards for complexometric titrations. Nitrilotriacetic acid (NTA) is a weak chelating agent, dimethylglyoxime (DMG) is a specific reagent for nickel(II) ions, and ethylenediamine (en) is a ligand but not a chelating agent.

15. The buffer capacity is maximum when the pH of the buffer is equal to the pKa of the weak acid.

a) True
b) False

Answer: a) True

Explanation: The buffer capacity is maximum when the pH of the buffer is equal to the pKa of the weak acid. This is because the buffer can effectively neutralize both added acid and added base when the pH is equal to the pKa.

16. Which of the following is a strong acid?

a) Acetic acid (CH_3COOH)
b) Hydrochloric acid (HCl)
c) Ammonia (NH_3)
d) Sodium hydroxide (NaOH)

Answer: b) Hydrochloric acid (HCl)

Explanation: Hydrochloric acid (HCl) is a strong acid because it completely dissociates in water to form H^+ and Cl^- ions. Acetic acid (CH_3COOH) is a weak acid, ammonia (NH_3) is a weak base, and sodium hydroxide (NaOH) is a strong base.

17. The pH of a solution with a hydrogen ion concentration of 1×10^{-6} M is:

a) 6
b) 8
c) 7
d) 1

Answer: a) 6

Explanation: The pH is calculated using the formula: $pH = -\log[H^+]$. For $[H^+] = 1 \times 10^{-6}$ M, $pH = -\log(1 \times 10^{-6}) = 6$. The other options are incorrect calculations.

18. Which of the following is a primary standard for gravimetric analysis?

a) Silver nitrate ($AgNO_3$)
b) Potassium chromate (K_2CrO_4)
c) Sodium chloride (NaCl)
d) Potassium iodide (KI)

Answer: c) Sodium chloride (NaCl)

Explanation: Sodium chloride (NaCl) is a primary standard for gravimetric analysis because it is stable, pure, and has a known composition. The other options are not primary standards for gravimetric analysis. Silver nitrate ($AgNO_3$) is a secondary standard, potassium chromate (K_2CrO_4) is used in Mohr's method, and potassium iodide (KI) is used in iodometric titrations.

19. Which of the following is a weak acid?

a) Acetic acid (CH_3COOH)
b) Hydrochloric acid (HCl)
c) Ammonia (NH_3)
d) Sodium hydroxide (NaOH)

Answer: a) Acetic acid (CH_3COOH)

Explanation: Acetic acid (CH_3COOH) is a weak acid because it partially dissociates in water to form H^+ and CH_3COO^- ions. Hydrochloric acid (HCl) is a strong acid, ammonia (NH_3) is a weak base, and sodium hydroxide (NaOH) is a strong base.

20. The buffer capacity is maximum when the pH of the buffer is equal to the pKa of the weak base.

a) False
b) True

Answer: a) False

Explanation: The buffer capacity is maximum when the pH of the buffer is equal to the pKa of the weak acid. This is because the buffer can effectively neutralize both added acid and added base when the pH is equal to the pKa.

21. Which of the following is a primary standard for iodometric titrations?

a) Potassium iodate (KIO_3)
b) Sodium thiosulfate ($Na_2S_2O_3$)
c) Potassium dichromate ($K_2Cr_2O_7$)
d) Iodine (I_2)

Answer: a) Potassium iodate (KIO_3)

Explanation: Potassium iodate (KIO_3) is a primary standard for iodometric titrations because it is stable, pure, and has a known composition. The other options are not primary standards for iodometric titrations. Sodium thiosulfate ($Na_2S_2O_3$) is used in iodometric titrations, potassium dichromate ($K_2Cr_2O_7$) is a primary standard for redox titrations, and iodine (I_2) is a titrant.

22. Which of the following is a strong base?

a) Ammonia (NH_3)
b) Sodium hydroxide (NaOH)
c) Acetic acid (CH_3COOH)
d) Hydrochloric acid (HCl)

Answer: b) Sodium hydroxide (NaOH)

Explanation: Sodium hydroxide (NaOH) is a strong base because it completely dissociates in water to form Na^+ and OH^- ions. Ammonia (NH_3) is a weak base, acetic acid (CH_3COOH) is a weak acid, and hydrochloric acid (HCl) is a strong acid.

23. The pH of a solution with a hydrogen ion concentration of 1×10^{-7} M is:

a) 7
b) 11
c) 3
d) 1

Answer: a) 7

Explanation: The pH is calculated using the formula: $pH = -\log[H^+]$. For $[H^+] = 1 \times 10^{-7}$ M, $pH = -\log(1 \times 10^{-7}) = 7$. The other options are incorrect calculations.

24. Which of the following is a primary standard for gravimetric analysis?

a) Silver nitrate ($AgNO_3$)
b) Potassium chromate (K_2CrO_4)
c) Sodium chloride (NaCl)
d) Potassium iodide (KI)

Answer: c) Sodium chloride (NaCl)

Explanation: Sodium chloride (NaCl) is a primary standard for gravimetric analysis because it is stable, pure, and has a known composition. The other options are not primary standards for gravimetric analysis. Silver nitrate ($AgNO_3$) is a secondary standard, potassium chromate (K_2CrO_4) is used in Mohr's method, and potassium iodide (KI) is used in iodometric titrations.

25. Which of the following is a weak base?

a) Ammonia (NH_3)
b) Sodium hydroxide (NaOH)
c) Acetic acid (CH_3COOH)
d) Hydrochloric acid (HCl)

Answer: a) Ammonia (NH_3)

Explanation: Ammonia (NH_3) is a weak base because it partially dissociates in water to form NH_4^+ and OH^- ions. Sodium hydroxide (NaOH) is a strong base, acetic acid (CH_3COOH) is a weak acid, and hydrochloric acid (HCl) is a strong acid.

26. The buffer capacity is maximum when the pH of the buffer is equal to the pKa of the weak acid.

a) True
b) False

Answer: a) True

Explanation: The buffer capacity is maximum when the pH of the buffer is equal to the pKa of the weak acid. This is because the buffer can effectively neutralize both added acid and added base when the pH is equal to the pKa.

27. Which of the following is a primary standard for redox titrations?

a) Potassium permanganate ($KMnO_4$)
b) Sodium thiosulfate ($Na_2S_2O_3$)
c) Potassium dichromate ($K_2Cr_2O_7$)
d) Iodine (I_2)

Answer: c) Potassium dichromate ($K_2Cr_2O_7$)

Explanation: Potassium dichromate ($K_2Cr_2O_7$) is a primary standard for redox titrations because it is stable, pure, and has a known composition. The other options are not primary standards for redox titrations. Potassium permanganate ($KMnO_4$) is a secondary standard, sodium thiosulfate ($Na_2S_2O_3$) is used in iodometric titrations, and iodine (I_2) is a titrant.

28. Which of the following is a chelating agent?

a) Ethylenediaminetetraacetic acid (EDTA)
b) Nitrilotriacetic acid (NTA)
c) Dimethylglyoxime (DMG)
d) Ethylenediamine (en)

Answer: a) Ethylenediaminetetraacetic acid (EDTA)

Explanation: Ethylenediaminetetraacetic acid (EDTA) is a chelating agent because it forms multiple bonds with metal ions, forming a stable complex. The other options are not chelating agents. Nitrilotriacetic acid (NTA) is a weak chelating agent, dimethylglyoxime (DMG) is a specific reagent for nickel(II) ions, and ethylenediamine (en) is a ligand but not a chelating agent.

29. The pH of a solution with a hydrogen ion concentration of 1×10^{-8} M is:

a) 8
b) 12
c) 7
d) 1

Answer: a) 8

Explanation: The pH is calculated using the formula: $pH = -\log[H^+]$. For $[H^+] = 1 \times 10^{-8}$ M, $pH = -\log(1 \times 10^{-8}) = 8$. The other options are incorrect calculations.

30. Which of the following is a strong acid?

a) Acetic acid (CH_3COOH)
b) Hydrochloric acid (HCl)
c) Ammonia (NH_3)
d) Sodium hydroxide (NaOH)

Answer: b) Hydrochloric acid (HCl)

Explanation: Hydrochloric acid (HCl) is a strong acid because it completely dissociates in water to form H^+ and Cl^- ions. Acetic acid (CH_3COOH) is a weak acid, ammonia (NH_3) is a weak base, and sodium hydroxide (NaOH) is a strong base.

31. The buffer capacity is maximum when the pH of the buffer is equal to the pKa of the weak base.

a) False
b) True

Answer: a) False

Explanation: The buffer capacity is maximum when the pH of the buffer is equal to the pKa of the weak acid. This is because the buffer can effectively neutralize both added acid and added base when the pH is equal to the pKa.

32. Which of the following is a primary standard for iodometric titrations?

a) Potassium iodate (KIO_3)
b) Sodium thiosulfate ($Na_2S_2O_3$)
c) Potassium dichromate ($K_2Cr_2O_7$)
d) Iodine (I_2)

Answer: a) Potassium iodate (KIO_3)

Explanation: Potassium iodate (KIO_3) is a primary standard for iodometric titrations because it is stable, pure, and has a known composition. The other options are not primary standards for iodometric titrations. Sodium thiosulfate ($Na_2S_2O_3$) is used in iodometric titrations, potassium dichromate ($K_2Cr_2O_7$) is a primary standard for redox titrations, and iodine (I_2) is a titrant.

33. Which of the following is a strong base?

a) Ammonia (NH_3)
b) Sodium hydroxide (NaOH)
c) Acetic acid (CH_3COOH)
d) Hydrochloric acid (HCl)

Answer: b) Sodium hydroxide (NaOH)

Explanation: Sodium hydroxide (NaOH) is a strong base because it completely dissociates in water to form Na^+ and OH^- ions. Ammonia (NH_3) is a weak base, acetic acid (CH_3COOH) is a weak acid, and hydrochloric acid (HCl) is a strong acid.

34. The pH of a solution with a hydrogen ion concentration of 1×10^{-9} M is:

a) 9
b) 13
c) 7
d) 1

Answer: a) 9

Explanation: The pH is calculated using the formula: $pH = -\log[H^+]$. For $[H^+] = 1 \times 10^{-9}$ M, $pH = -\log(1 \times 10^{-9}) = 9$. The other options are incorrect calculations.

35. Which of the following is a primary standard for gravimetric analysis?

a) Silver nitrate ($AgNO_3$)
b) Potassium chromate (K_2CrO_4)
c) Sodium chloride (NaCl)
d) Potassium iodide (KI)

Answer: c) Sodium chloride (NaCl)

Explanation: Sodium chloride (NaCl) is a primary standard for gravimetric analysis because it is stable, pure, and has a known composition. The other options are not primary standards for gravimetric analysis. Silver nitrate ($AgNO_3$) is a secondary standard, potassium chromate (K_2CrO_4) is used in Mohr's method, and potassium iodide (KI) is used in iodometric titrations.

36. Which of the following is a weak acid?

a) Acetic acid (CH_3COOH)
b) Hydrochloric acid (HCl)
c) Ammonia (NH_3)
d) Sodium hydroxide (NaOH)

Answer: a) Acetic acid (CH_3COOH)

Explanation: Acetic acid (CH_3COOH) is a weak acid because it partially dissociates in water to form H^+ and CH_3COO^- ions. Hydrochloric acid (HCl) is a strong acid, ammonia (NH_3) is a weak base, and sodium hydroxide (NaOH) is a strong base.

37. The buffer capacity is maximum when the pH of the buffer is equal to the pKa of the weak acid.

a) True
b) False

Answer: a) True

Explanation: The buffer capacity is maximum when the pH of the buffer is equal to the pKa of the weak acid. This is because the buffer can effectively neutralize both added acid and added base when the pH is equal to the pKa.

38. Which of the following is a primary standard for redox titrations?

a) Potassium permanganate ($KMnO_4$)
b) Sodium thiosulfate ($Na_2S_2O_3$)
c) Potassium dichromate ($K_2Cr_2O_7$)
d) Iodine (I_2)

Answer: c) Potassium dichromate ($K_2Cr_2O_7$)

Explanation: Potassium dichromate ($K_2Cr_2O_7$) is a primary standard for redox titrations because it is stable, pure, and has a known composition. The other options are not primary standards for redox titrations. Potassium permanganate ($KMnO_4$) is a secondary standard, sodium thiosulfate ($Na_2S_2O_3$) is used in iodometric titrations, and iodine (I_2) is a titrant.

39. Which of the following is a chelating agent?

a) Ethylenediaminetetraacetic acid (EDTA)
b) Nitrilotriacetic acid (NTA)
c) Dimethylglyoxime (DMG)
d) Ethylenediamine (en)

Answer: a) Ethylenediaminetetraacetic acid (EDTA)

Explanation: Ethylenediaminetetraacetic acid (EDTA) is a chelating agent because it forms multiple bonds with metal ions, forming a stable complex. The other options are not chelating agents. Nitrilotriacetic acid (NTA) is a weak chelating agent, dimethylglyoxime (DMG) is a specific reagent for nickel(II) ions, and ethylenediamine (en) is a ligand but not a chelating agent.

40. The pH of a solution with a hydrogen ion concentration of 1×10^{-10} M is:

a) 10
b) 14
c) 7
d) 1

Answer: a) 10

Explanation: The pH is calculated using the formula: $pH = -\log[H^+]$. For $[H^+] = 1 \times 10^{-10}$ M, $pH = -\log(1 \times 10^{-10}) = 10$. The other options are incorrect calculations.

41. Which of the following is a strong acid?

a) Acetic acid (CH_3COOH)
b) Hydrochloric acid (HCl)
c) Ammonia (NH_3)
d) Sodium hydroxide (NaOH)

Answer: b) Hydrochloric acid (HCl)

Explanation: Hydrochloric acid (HCl) is a strong acid because it completely dissociates in water to form H^+ and Cl^- ions. Acetic acid (CH_3COOH) is a weak acid, ammonia (NH_3) is a weak base, and sodium hydroxide (NaOH) is a strong base.

42. The buffer capacity is maximum when the pH of the buffer is equal to the pKa of the weak base.

a) False
b) True

Answer: a) False

Explanation: The buffer capacity is maximum when the pH of the buffer is equal to the pKa of the weak acid. This is because the buffer can effectively neutralize both added acid and added base when the pH is equal to the pKa.

43. Which of the following is a primary standard for iodometric titrations?

a) Potassium iodate (KIO_3)
b) Sodium thiosulfate ($Na_2S_2O_3$)
c) Potassium dichromate ($K_2Cr_2O_7$)
d) Iodine (I_2)

Answer: a) Potassium iodate (KIO_3)

Explanation: Potassium iodate (KIO_3) is a primary standard for iodometric titrations because it is stable, pure, and has a known composition. The other options are not primary standards for iodometric titrations. Sodium thiosulfate ($Na_2S_2O_3$) is used in iodometric titrations, potassium dichromate ($K_2Cr_2O_7$) is a primary standard for redox titrations, and iodine (I_2) is a titrant.

44. Which of the following is a weak base?

a) Ammonia (NH_3)
b) Sodium hydroxide (NaOH)
c) Acetic acid (CH_3COOH)
d) Hydrochloric acid (HCl)

Answer: a) Ammonia (NH_3)

Explanation: Ammonia (NH_3) is a weak base because it partially dissociates in water to form NH_4^+ and OH^- ions. Sodium hydroxide (NaOH) is a strong base, acetic acid (CH_3COOH) is a weak acid, and hydrochloric acid (HCl) is a strong acid.

45. The pH of a solution with a hydrogen ion concentration of 1×10^{-11} M is:

a) 11
b) 15
c) 7
d) 1

Answer: a) 11

Explanation: The pH is calculated using the formula: $pH = -\log[H^+]$. For $[H^+] = 1 \times 10^{-11}$ M, $pH = -\log(1 \times 10^{-11}) = 11$. The other options are incorrect calculations.

46. Which of the following is a primary standard for gravimetric analysis?

a) Silver nitrate ($AgNO_3$)
b) Potassium chromate (K_2CrO_4)
c) Sodium chloride (NaCl)
d) Potassium iodide (KI)

Answer: c) Sodium chloride (NaCl)

Explanation: Sodium chloride (NaCl) is a primary standard for gravimetric analysis because it is stable, pure, and has a known composition. The other options are not primary standards for gravimetric analysis. Silver nitrate ($AgNO_3$) is a secondary standard, potassium chromate (K_2CrO_4) is used in Mohr's method, and potassium iodide (KI) is used in iodometric titrations.

47. Which of the following is a weak acid?

a) Acetic acid (CH_3COOH)
b) Hydrochloric acid (HCl)
c) Ammonia (NH_3)
d) Sodium hydroxide (NaOH)

Answer: a) Acetic acid (CH_3COOH)

Explanation: Acetic acid (CH_3COOH) is a weak acid because it partially dissociates in water to form H^+ and CH_3COO^- ions. Hydrochloric acid (HCl) is a strong acid, ammonia (NH_3) is a weak base, and sodium hydroxide (NaOH) is a strong base.

48. The buffer capacity is maximum when the pH of the buffer is equal to the pKa of the weak acid.

a) True
b) False

Answer: a) True

Explanation: The buffer capacity is maximum when the pH of the buffer is equal to the pKa of the weak acid. This is because the buffer can effectively neutralize both added acid and added base when the pH is equal to the pKa.

49. Which of the following is a primary standard for redox titrations?

a) Potassium permanganate ($KMnO_4$)
b) Sodium thiosulfate ($Na_2S_2O_3$)
c) Potassium dichromate ($K_2Cr_2O_7$)
d) Iodine (I_2)

Answer: c) Potassium dichromate ($K_2Cr_2O_7$)

Explanation: Potassium dichromate ($K_2Cr_2O_7$) is a primary standard for redox titrations because it is stable, pure, and has a known composition. The other options are not primary standards for redox titrations. Potassium permanganate ($KMnO_4$) is a secondary standard, sodium thiosulfate ($Na_2S_2O_3$) is used in iodometric titrations, and iodine (I_2) is a titrant.

50. Which of the following is a chelating agent?

a) Ethylenediaminetetraacetic acid (EDTA)
b) Nitrilotriacetic acid (NTA)
c) Dimethylglyoxime (DMG)
d) Ethylenediamine (en)

Answer: a) Ethylenediaminetetraacetic acid (EDTA)

Explanation: Ethylenediaminetetraacetic acid (EDTA) is a chelating agent because it forms multiple bonds with metal ions, forming a stable complex. The other options are not chelating agents. Nitrilotriacetic acid (NTA) is a weak chelating agent, dimethylglyoxime (DMG) is a specific reagent for nickel(II) ions, and ethylenediamine (en) is a ligand but not a chelating agent.

EXERCISE

Q1. Select the right answer from the choices given with each question.

1. Which of the following technique does not involve electromagnetic radiation?
a) Infrared spectroscopy
b) Mass spectrometry
c) Atomic spectroscopy
d) All of these involve electromagnetic radiations

2. Which region of the electromagnetic spectrum is involved in the electronic transitions?
a) Ultraviolet
b) Visible
c) Both of these
d) None of these

3. Which of the following techniques is different from the others in regards the basic principle?
a) Mass spectrometry
b) Visible spectroscopy
c) Electronic spectroscopy
d) None of these

4. Which of the following is used as a source of visible radiation?
a) Tungsten filament lamp
b) Hydrogen discharge lamp
c) Deuterium discharge lamp
d) All of these

5. What is the wavelength range of the ultraviolet infrared region?

a) 0.8-2.5μm
b) 0.2-0.8μm
c) 2.5-15.1μm
d) 1000-1000nm

6. The position of an infrared absorption band is commonly expressed by:
a) Wavenumber
b) Frequency
c) Both of these
d) None of these

7. Which of the following is not used as a source of infrared radiation?
a) Nernst glower
b) Tungsten filament lamp
c) Globar
d) Nichrome wire

8. Which region of the electromagnetic spectrum is involved in mass spectrometry?
a) Visible
b) Ultraviolet
c) Infrared
d) None of these

9. Mass spectroscopy is an analytical technique which involves:
a) Production of gaseous ions from the sample
b) Separation of the gaseous ions
c) Measurement of the relative abundance of the gaseous ions
d) All of these

10. Mass spectrometry can be used to determine:
a) Molecular weight
b) Molecular formula
c) Molecular structure
d) All of these

11. Which of the following spectra is detected in the mass spectrometer?
a) Positively charged particles
b) Protons
c) Neutral molecules
d) All of these

12. Which of the following process is produced in the ionization chamber of a mass spectrometer?
a) Positively charged species
b) Radicals
c) Neutral molecules
d) All of these

13. Which kind of information about a positively charged species obtained from a mass spectrum?
a) Molecular weight
b) Relative abundance
c) Both of these
d) None of these

14. What kind of sample can be studied in a mass spectrometer?
a) Solid
b) Liquid
c) Gas
d) All of these

15. Mass ultraviolet region of these electromagnetic spectrum generally lies between:
a) 10-200 nm
b) 200-400 nm
c) 400-750 nm
d) 350-700 nm

16. The ultraviolet or visible region of the electromagnetic spectrum generally lies between:
a) 10-200 nm
b) 200-400 nm
c) 400-750 nm
d) 350-700 nm

17. The infrared region of the electromagnetic radiation generally lies between:
a) 10-200 nm
b) 200-400 nm
c) 400-750 nm
d) 1000-1000 nm

Answers

1	a	2	a	3	a	4	d	5	b
6	c	7	d	8	a	9	d	10	d
11	a	12	a	13	c	14	d	15	b
16	c	17	c						

Q2. Give brief answer for the following questions.

Q1. What is spectroscopy? Underline its principle.

Answer

Spectroscopy

Spectroscopy involves using instruments to examine the isolation emitted or absorbed by chemical species therefore reveal their molecular structure.

Principle

When electromagnetic radiation, such as light or infrared, shines on a chemical the chemical may interact with the radiation in some. The commonest example is light. Colors are produced when chemicals absorb or absorb visible light of a particular frequency.

Q2. What is meant by wavelength and frequency?

Answer

Wavelength

The distance between two consecutive nodes and therefore is called wavelength.

Frequency

Number of waves pass through an area in one second is called frequency.

Q3. What is spectrometer? Briefly discuss its working?

Answer

Spectrometer

Spectrometer is used to measure the amount of electromagnetic radiations absorbed by an organic molecule.

Working

Spectrometer produces a spectrum on chart recorder from where we can see which bonds have strange peaks which have deeded values.

Q4. How will you distinguish between (i) 1,3-Pentadiene and 1,4-Pentadiene (ii) Benzene and anthracene by UV spectroscopy?

Answer

Q5. Two isomeric dienes (C5 and C7), having the molecular formula C_5H_8, shrink at 32mm and 64mm, H_2 respectively. Write the structures of the two isomers.

Answer

$CH_2 = CH - CH_2 - CH_2 = CH$ (pentene)

$CH_2 = CH - CH_2 - CH_2 - CH_2$ (1-pentene)

Q6. Give significant application of Atomic Absorption Spectroscopy (AAS).

Answer

Significant of Atomic Absorption Spectroscopy:

1. A 5 mmol is highly specific. Hence analysis of a mixture from a complex mixture is possible and a high accuracy made on the analyzed.
2. Well suited for the analysis of substances at low concentrations.

A highly specific, finely established in analytical chemistry, carcinoma, mineralogy, biochemistry, metallurgy etc.,

Q7. How will you distinguish between 2-Pentanone and 3-Pentanone by using mass spectrum?

Answer

2 – Pentanone: The major peak at m/z.

3 – Pentanone: The major peak at m/z 71.

The molecular ion is 86.

The molecular ion is 86.

Q8. Give detailed answer of the following questions.

Q1. What is combustion analysis? Describe its element steps.

Answer

Empirical and molecular formulas for compounds that contain only carbon and hydrogen or carbon, hydrogen and oxygen can be determine with a sample burned with a special called combustion analysis. The side products will be CO_2 and H_2O and the combustion tube can absorbs these products.

Steps

1. Weight a sample of the compound to be analyzed and place it in the apparatus.
2. Burn the sample completely. The only products of the combustion of a compound contain only carbon and hydrogen is CO_2.
3. The + CO and CO are oxidized through two tubes. One tube contains a substance that absorbs carbon dioxide.

Weight each of these tubes before and after the combustion. The increase in mass in the first tube is the mass of CO_2 that formed in the combustion, and the increase in the mass, for the second tube is the mass of CO formed.

Suppose that the mass of the first tube increases by 0.1320 grams converted to CO_2 and suppose the second tube. Calculate the mass of carbon in the compound and the mass of oxygen in the measured mass of CO.

Suppose that all of the hydrogen in the compound has been converted to HO and trapped in the first tube. Calculate the mass of hydrogen in the compound and the mass of oxygen in the compound.

If the compound contains oxygen as well as carbon and hydrogen from the total mass of the original sample of compound.

Q2. An organic compound contains carbon and hydrogen and oxygen was subjected to combustion analysis 0.6879g of the compound gave 1.374g of CO_2 0.4187g of HO. Determine the empirical formula of the compound.

Answer

Mass of compound = 0.6879 g

Mass of CO_2 = 1.374 g

Mass of H_2O = 0.4187 g

$$\%\ C = \frac{\text{Mass of } CO_2}{\text{Mass of compound}} \times \frac{\text{Atomic mass of C}}{\text{Molecular mass of } CO_2} \times 100$$

$$= \frac{1.374}{0.6879} \times \frac{12}{44} \times 100$$

$$= 54\%$$

$$\%\ H = \frac{\text{Mass of } H_2O}{\text{Mass of compound}} \times \frac{\text{Atomic mass of H}}{\text{Molecular mass of } H_2O} \times 100$$

$$= \frac{0.4187}{0.6879} \times \frac{2}{18} \times 100$$

$$= 6\%$$

$$\%\ O = 100 - (54 + 6)$$

$$= 40\%$$

% of C = 54%

% of H = 6%

% of O = 40%

Now we determine Empirical formula of compound

1. Percentage compounds C : H : O

= 54 : 6 : 40

2. Percentage no. of moles

(dividing by atomic mass) $\frac{54}{12} : \frac{6}{1} : \frac{40}{16}$

= 4.5 : 6.0 : 2.5

3. Percentage no. of moles

(dividing by least value) $\frac{4.5}{2.5} : \frac{6.0}{2.5} : \frac{2.5}{2.5}$

= 1.8 : 2.4 : 1

4. Rounding off mole 1.8 : 2.4 : 1

= Empirical formula of compound = $C_9H_{12}O$

Q3. The combustion analysis shows that organic compounds contain 40.68% carbon 5.08% hydrogen and 54.24% of oxygen. What is empirical formula? If the molecular mass of the compound is 118 figurate it then calculate molecular formula of given organic compound.

(Ans. $C_4H_6O_3$ $C_8H_{12}O_6$)

Answer

1. Percentage compounds C : H : O

= 40.68 : 5.08 : 54.24

2. No. of moles

$\frac{40.68}{12} : \frac{5.08}{1} : \frac{54.24}{16}$

= 3.39 : 5.08 : 3.39

3. Mole ratio

(dividing by least value) $\frac{3.39}{3.39} : \frac{5.08}{3.39} : \frac{3.39}{3.39}$

= 1 : 1.5 : 1.5

= 2 : 3 : 3

= Empirical formula of compound

(on rounding off moles) = $C_2H_3O_3$

Empirical formula mass of $C_2H_3O_3$ = 75 + 3 + 48

= 118.00

Molecular mass of compound = 118.00

$$n = \frac{\text{Molecular mass}}{\text{Empirical formula mass}}$$

$$= \frac{118}{118}$$

$$= 1$$

So Molecular Formula = $C_2H_3O_3 \times 1$

= $C_2H_3O_3$

Q4. What is meant by the term chemical shift of a particular proton in NMR spectroscopy? Also draw the splitting pattern of protons in NMR spectrum of ethyl alcohol.

Answer

Chemical Shift of Proton in NMR

The technique of NMR is used in identifying the number and types of hydrogen atoms in a molecule. The largest peak (τ) corresponds to 3H atoms in CH_3. The intermediate peak (τ) corresponds to 2H atoms in CH_2 and the smallest peak (τ) is for group 1H. Hence in particular a type of environment have another protons in the NMR spectrum normally the position is measured in a chemical shift. The chemical shift of a particular proton is the difference in the field strength of absorption of a substance compared to that the chemical shift of chemical shift of TMS is set at zero.

Fig 10.1 propyl alcohol NMR spectrum in chloroform
τ
Δτ
τ
Δτ
τ
Δτ
τ
τ
τ

Objective type Questions & Answers

Multiple Choice Questions

1) The branch of chemistry which deals with the separation and analysis of a sample to indentified its components is called:
   a) Organic chemistry b) Inorganic chemistry
   c) Analytical chemistry d) Physical chemistry
2) Empirical and molecular formulas contains:
   a) Carbon b) Hydrogen c) Oxygen d) All of these
3) The frequency range of ultraviolet radiation is:
   a) $10^{13} - 10^{17}$ b) 10^{10-18} c) 10^{12-16} d) 10^{18-19}
4) The frequency range visible light is:
   a) 10^{15-16} b) 10^{14-16} c) $10^{18} - 10^{19}$ d) $10^{20} - 10^{22}$
5) The frequency range of infrared is:
   a) $10^{11} - 10^{12}$ b) $10^{14} - 10^{18}$ c) $10^{19} - 10^{20}$ d) $10^{10} - 10^{14}$
6) The frequency range of radio waves:
   a) $10^{9} - 10^{8}$ b) $10^{10} - 10^{12}$ c) $10^{11} - 10^{12}$ d) $10^{14} - 10^{19}$
7) The wavelength of IR infrared lies between:
   a) 2100nm – 2400nm b) 2500nm – 25000nm
   c) 2000 – 20000nm d) 2200 – 24000nm
8) The instrument which allows the radiation in interact with a sample of chemical and analyses the changes:
   a) Photometer b) Hydrometer c) Spectroscope d) None of these
9) The spectrum is produced by an instrument called as:
   a) spectrometer b) Spectroscope c) Photometer d) Hydrometer
10) The stronger peak at about 1720cm^{-1} corresponds to the:
   a) C – H bond b) C = O bond c) C = H bond d) C ≡ H bond
11) The weaker absorptions at about 3000cm^{-1} corresponds to the:
   a) C – H bond b) C – O bond c) C = O bond d) C – X bond
12) The peak at about 3400cm^{-1} corresponds:
   a) O – H bond b) C – O bond c) C – H bond d) C – X bond
13) The colour of transition elements related to incompletely filled:
   a) π – orbital b) d – orbitals c) s – orbitals d) p – orbitals
14) The wavelength of infrared lies above:
   a) 700 b) 600 c) 500 d) 400
15) The wavelength of ultraviolet lies below:
   a) 500 b) 400 c) 300 d) 200
16) The wavelength of violet lies between:

   a) 400 – 420nm b) 500 – 520nm c) 600 – 660nm d) 300 – 320nm
17) The wavelength of indigo lies between:
   a) 400 – 420nm b) 420 – 440nm c) 500 – 800nm d) 400 – 500nm
18) The wavelength of orange lies between:
   a) 600 – 620nm b) 500 – 540nm c) 420 – 660nm d) 400 – 600nm
19) The wavelength of red lies between:
   a) 400 – 420nm b) 620 – 700nm c) 700 – 800nm d) 500 – 600nm
20) The wavelength of yellow lies between:
   a) 400 – 440nm b) 500 – 520nm c) 600 – 640nm d) 580 – 600nm
21) In NMR the largest peak corresponds to the:
   a) C_6H_5 b) CH_3 c) CH_2 d) CH_4
22) In NMR the second peak which is second largest corresponds to:
   a) C_6H_5 b) CH_3 c) CH_2 d) CH_4
23) In NMR, the third peak corresponds to the:
   a) C_6H_5 b) CH_3 c) CH_2 d) CH_4
24) The number of signals in the NMR spectrum corresponds to the number of different types of:
   a) Protons b) Electrons c) Neutrons d) All of these
25) Absorption of infrared radiation causes covalent bonds with in the molecule to be promoted from one vibrational energy level to a:
   a) Lower vibrational level b) Same level
   c) Higher vibrational level d) None of these
26) If an organic compound absorbs UV–Vis radiation it means it contains:
   a) Carbonyl group b) Conjugated double bond
   c) Both a & b d) Aldehyde group
27) If an organic compound does not absorbs UV–Vis radiation it means the compound does not contains:
   a) Conjugated double bounds b) Hydroxyl group
   c) Alkynes group d) Ketone group
28) Which spectroscopy is concerned with the characteristic radiation produced when atoms are exited:
   a) Absorption Spectroscopy b) Emission Spectroscopy
   c) Both a & b d) Nuclear Spectroscopy
29) Which spectroscopy involves the absorption of radiant energy by neutral atoms in the gaseous states:
   a) Atomic Absorption Spectroscopy b) Emission Spectroscopy
   c) Nuclear Spectroscopy d) None of these
30) The instrument which turns atoms and molecules into ions and measure their masses:
   a) Photometer b) Mass spectrometer
   c) Spectrometer d) Electrometer

31) The first step in the mass spectrometer is:
   a) Vaporization b) Ionization c) Acceleration d) Detection
32) Blue zone of a flame is characterize by:
   a) No combustion b) Partial combustion
   c) Complete combustion d) Incomplete combustion
33) Dark zone of flame is characterize by:
   a) Complete combustion b) No combustion
   c) Incomplete combustion d) None of these
34) Luminous zone of flam is characterize by:
   a) Incomplete combustion b) No combustion
   c) Complete combustion d) All of these
35) Non–luminous zone is characterize by:
   a) Complete combustion b) No combustion
   c) Incomplete combustion d) None of these
36) Mass spectroscopy is used to measure the:
   a) Atomic number b) Masses c) Volume d) Density
37) The temperature of the Non–luminous zone lies between:
   a) 2000°C b) 3000°C c) 4000°C d) 1000°C
38) The flame temperature of candle is:
   a) 1,500°C b) 1,400°C c) 1,000°C d) 1,800°C
39) The application of chemistry to criminal investigation is called:
   a) Bio chemistry b) Physical chemistry
   c) Organic chemistry d) Forensic chemistry
40) Which method combines the feature of gas–liquid chromatography and mass spectrometry:
   a) GC – MS b) LC – MS c) HPLC – MS d) MS
41) Which method combines the physical separation capabilities of liquid chromatography with the mass analysis capabilities of mass spectrometry:
   a) GE – MS b) LC – MS c) MS d) NMS

Answers

1)	c	2)	d	3)	A	4)	b
5)	a	6)	a	7)	b	8)	C
9)	a	10)	b	11)	a	12)	a
13)	b	14)	a	15)	b	16)	a
17)	b	18)	a	19)	b	20)	d
21)	a	22)	b	23)	c	24)	a
25)	c	26)	c	27)	a	28)	b
29)	a	30)	b	31)	a	32)	c
33)	b	34)	a	35)	a	36)	b

37)	a	38)	b	39)	d	40)	a
41)	b						

Short Answers and Questions

Q1: Define analytical chemistry:

Answer

Analytical chemistry is the branch of chemistry which deals with the separation and analysis of a sample to identified its components.

Q2: What is Qualitative analysis?

Answer

The analysis which provides the identity of a substance i.e chemical composition of the substance is called qualitative analysis.

Q3: What is Quantitative analysis?

Answer

The analysis which determines the amount of each component present in the sample is called quantitative analysis.

Q4: Why formaldehyde dissolve in water?

Answer

Formaldehyde CH_2O, is unstable as a pure gas, readily forming a mixture of substance called trioxane and a polymer called paraformaldehyde, that is why it is dissolve in water.

Q5: What is spectroscopy?

Answer

Spectroscopy involved using instruments to examine the radiation emitted or absorbed by chemicals giving information about their molecular structure.

Q6: What is Infrared spectroscopy?

Answer

Infrared spectroscopy is the spectroscopy which measures the bonds and have wavelength longer than visible light i.e 2500nm and 25000nm.

Q7: Which bond give rise to the peak just below 3000cm^{-1}?

Answer

The weaker absorption at 3000cm^{-1} corresponds to the C–H bond.

Q8: Which bond give rise to the peak at about 3400 cm^{-1}?

Answer

The peak at about 3400cm^{-1} is from the O–H bond.

Q9: Which bond give rise to the peak at about 1720cm^{-1}?

Answer

The strong peak at about 1720cm^{-1} corresponds to the c = 0 bond.

Q10: What do you mean by visible and ultraviolet spectroscopy?

Answer

It is an example of H C visible emission spectrum, where a substance emite certain visible frequencies when its electrons have been excited by heating or by an electrical

Short Answers and Questions

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Answer

The peak at about 3400cm is from the bond.

Q9: Which bond give rise to the peak at about 1720cm - 1 ?

Answer

The strong peak at about 1720cm^{-1} corresponds to the c = O bond.

Q10: What do you mean by visible and ultraviolet spectroscopy?

Answer

It is an example of H C visible emission spectrum, where a substance emit certain visible frequencies when its electrons have been excited by heating or by an electrical discharge these radiations may be in the visible as well as in ultraviolet and visible spectroscopy.

Q 11 : What does the colour of the transition element shows?

Answer

The colour of transition elements shows incompletely filled d— orbitals in the transition metal ion.

Q12: What is TMS?

Answer

TMS is tetramethyl stane, Si (CH4) and a unreactive substance because its proton gives a single peak.

Q 3: What is Spin-Spin coupling?

Answer

The splitting of protons on neighboring carbon atoms due to spin coupling is called spin-spin coupling.

Q 14: What are quartet peaks?

Answer

When external magnetic field is applied CH2 protons give four different peaks very close to one another. These are called quartet peaks.

Q 15: What are triplet peaks?

Answer

When external magnetic field is applied CH3 protons gives slightly three different peaks close to one another is called triplet peak.

Q16: What is the general rule splitting?

Answer

A group containg m protons lll cause the protons on a neighboring group to split into m + 1 peaks.

Q 7: What is atomic emission spectroscopy?

Answer

Atomic emission spectroscopy pertains to electronic transitions in atoms which use and an excitation course like flames sparks.

Q18: What is principal of atomic emission spectroscopy?

Answer

The course vaporizes the sample causes electronic excitation of elementary particles in the gas. Exited molecules in the gas phase emit band spectra. Thus a molecule in an exited state of energy E2 undergoes a transition state of lower energy E1 and a photon of energy hv is aomitted

$$E2 - E1 = hv$$

Q19: Enlist major advantages of emission spectroscopy?

Answer

i) Metalloids have been identified with this technique.
ii) Perform either in solid or liquid state.
iii) Just require 30sec to one minute.

Q20: Give disadvantages of Emission spectroscopy:

Answer

i) Excitation intensities are not always be reproducible.
ii) Relative error exceeds l to 2%.
iii) The accuracy and precision are not high.

Q21 : Give some applications of emission spectroscopy.

Answer

i) Alloys of Zn, Cu, Pb, Al, Mg and Sn have been analyzed.

i) In petroleum industry oil is analysed for V, Ni, Fe in the presence which make fuel poor.
ii) Traces of Co, Ni, MO and V in Graphite mas be synthesize.

Q22: What is atomic absorption spectroscopy?

Answer

Atomic absorption spectroscopy involves the study of the absorption of radiant energy usually visible by natural atoms in the gaseous states.

Q23: What is mass spectroscopy?

Answer

The mass spectroscopy is an instrument which n_{ions} atoms and molecules into ions and measure their mass and its study is mass spectroscopy.

Q24: Why does the magnet have the same attraction for all the balls?

Answer

Wooden balls of different sizes but with identical iron cores, roll down a sloping plain. At the bottom of the slope a powerful magnet attracts the iron cores and the moving balls are deflected. All balls have identical iron cores, they are all attracted equally by the magnet.

Q25: Which size ball will be deflected the most? Why?

Answer

The smaller balls are lighter the balls collect in different compartments depends on their mass.

Q26: Name the five main stages of mass spectrometer.

Answer

i) Vaporization ii) Ionization
iii) Acceleration iv) Deflection
v) Detection

Q27: Name the four different zones of a flame?

Answer

i) Blue zone ii) Dark zone
iii) Luminous zone iv) Non luminous zone

Q28: What is luminous zone?

Answer

In luminous zone incomplete combustion takes place has the temperature of 600 — 800OC.

Q29: What is non - luminous zone?

Answer

None—luminous zone is the zone where complete combustion takes place has the temperature of about 2000°C.

Q30: Red colour of a flame explains what?

Answer

In line then the red colour is most. It suggests that the lack of oxygen is there where the flame is burned and the flame temperature is from 600 — 800°C. As a result, lot of carbon non-oxide is formed and cause greater risk of backdraft.

Q31: What is forensic chemistry?

Answer

Forensic chemistry is the application of chemistry to criminal investigation and involves the examination of physical traces such as body fluids, bones, fibres and drugs.

Q32: What is the market value of global life science and chemical instrumentation?

Answer

The global life science and chemical instrumentation market was estimated to be $30, 2 billion in the year 2011 and is expected to grow at a CAGR of 8.4% from 2011 to 2016 to reach $45,2 billion.

Q33: What is chromatography?

Answer

Chromatography is the collective term for a set of laboratory techniques for the separation of mixtures and for the detection of small amounts of material present in those mixtures.

Q34: What is mass spectrometry?

Answer

It is a analytical technique that measure the mass to charge ratio of charged particles.s used for determining masses of the particles, elemental composition of molecule and elucidation the chemical structure of the molecules such as peptides.

Q35: What is gas chromatography-mass spectrometry (GC-MS)?

Answer

(GC-MS) is the method that combines the features of gas-liquid chromatography and mass-spectrometry to identify different ...t substances even present in small amounts with in a test sample.

Q36: What is Liquid-chromatography-mass spectrometry (LC-MS) or (HPLC-MS)?

Answer

(LC-MS) is a technique that combine the physical separation capabilities of liquid chromatography with the mass analysis capabilities of mass spectroscopy. Used for very high sensitivity and selectivity.