

1. What should be added to a solution of sodium acetate to prepare a buffer:

- a. NaOH
- b.  $\text{Na}_2\text{CO}_3$
- c. NaCl
- d.  $\text{CH}_3\text{COOH}$
- e.  $\text{NH}_3 \cdot \text{H}_2\text{O}$

2. What is the name of the reaction and reagents that can be used to identify this ion in the presence of others:

- a. Specific
- b. Selective
- c. Characteristic
- d. Group
- e. General

3. Weak electrolytes - substances that have:

- a. The low value of the constant of ionization
- b. The low value of the solubility product constant
- c. The low value of the hydrolysis constant
- d. The low value of oxidation number
- e. A small value of the constant of instability

4. The drug contains a  $[\text{Co}(\text{NH}_3)_6] \text{Cl}_2$ . Indicate the central ion, which forms a complex:

- a. Chlorine, charge 0
- b. Cobalt charge of +2
- c. Cobalt, a charge +3
- d. Chloride, charge -1
- e. Ammonia, the charge 0

5. The 0,1 M solution of which substance has the smallest ion concentration?

- a.  $\text{NaNO}_3$
- b. HCl
- c.  $\text{H}_2\text{SO}_4$
- d.  $\text{CH}_3\text{COOH}$
- e.  $\text{CaCl}_2$

6. What salt does the expression for hydrolysis constant correspond with?

- a.  $(\text{NH}_4)_3\text{PO}_4$
- b.  $(\text{NH}_4)_2\text{SO}_4$
- c. NaCN
- d.  $\text{CH}_3\text{COONH}_4$
- e.  $\text{Na}_2\text{SO}_4$

7. Buffer solutions are used in analysis for:

- a. solution coloration
- b. precipitate analytical group cations completeness
- c. solution pH change
- d. pH control
- e. complex compounds formation

8. There are  $\text{NH}_4^+$  in aqueous solution. What will happen, if we add Nessler's reagent to this solution?

- a. Brownish-red solution
- b. Pink precipitate
- c. White precipitate
- d. Blue solution
- e. Brownish-red precipitate

9. What cation of group I forms a white precipitate with tartaric acid with presence sodium acetate?

- a.  $\text{Na}^+$  and  $\text{Ag}^+$

b.  $\text{Na}^+$  and  $\text{NH}_4^+$

c.  $\text{K}^+$  and  $\text{NH}_4^+$

d.  $\text{K}^+$  and  $\text{Na}^+$

e.  $\text{NH}_4^+$  and  $\text{Zn}^{2+}$

10. There is  $\text{K}^+$  in aqueous solution ( $\text{pH} > 7$ ). What will happen, if we add hexanitrocobaltate sodium to this solution:

a. White precipitate

b. Colorless solution

c. Yellow solution

d. Brown precipitate

e. Yellow precipitate

11. There are  $\text{Na}^+$  in aqueous solution ( $\text{pH} = 7$ ). What will happen, if we add hexahydroxoantimonate (V) potassium to this solution:

a. Yellow precipitate

b. Yellow solution

c. Brown precipitate

d. White precipitate

e. Colorless solution

12. What cations of group I do not interfere with the identification of each other in solution by characteristic reactions:

a.  $\text{NH}_4^+$  and  $\text{Ag}^+$

b.  $\text{K}^+$  and  $\text{Na}^+$

c.  $\text{K}^+$  and  $\text{NH}_4^+$

d.  $\text{Na}^+$  and  $\text{NH}_4^+$

e.  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{NH}_4^+$

13. Choose the solution with group I cations:

a.  $\text{NH}_4^+$ ,  $\text{Cu}^{2+}$ ,  $\text{Hg}_2^{2+}$

b.  $\text{K}^+$ ,  $\text{Ag}^+$ ,  $\text{Al}^{3+}$

c.  $\text{K}^+$ ,  $\text{NH}_4^+$ ,  $\text{Zn}^{2+}$

d.  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{NH}_4^+$

e.  $\text{Na}^+$ ,  $\text{Fe}^{2+}$ ,  $\text{Fe}^{3+}$

14. Why there is no precipitating agent for group I cations?

a. Most of salt solutions are colorless

b. Cations of group I are weak complexing agents

c. Most of group I cations' compounds can dissolve in water

d. Weak acids salts of these cations undergo hydrolysis

e. Salts of group I cations impart a characteristic color to a flame

15. Unknown solution was hitting with the base. There was foxiness gas. What cations are contained in the solution?

a. Silver (I)

b. Lead (II)

c. Mercury (II)

d. Mercury (I)

e. Ammonium

16. What cation forms a white precipitate with hydrochloric acid and which can soluble in hot water and in excess of sodium hydroxide.:

a. Lead (II)

b. Mercury (I)

c. Calcium

d. Silver (I)

e. Barium

17. What cation forms a white precipitate with sodium hydroxide and which can soluble in excess of sodium hydroxide?

- a. Barium (II)
- b. Mercury (II)
- c. Lead (II)**
- d. Silver (I)
- e. Mercury (I)

18. What cation forms a yellow precipitate with potassium chromate and which can dissolve in hot acetic acid?

- a. Barium
- b. Lead**
- c. Magnesium
- d. Calcium
- e. Strontium

19. Hydrochloric acid solution was added to a solution containing cations of the second analytical group. It resulted in generation of white precipitate that was soluble in ammonium solution. What cations are contained in the solution?

- a. Mercury (II) ions
- b. Mercury (I)
- c. Lead and mercury (I) ions
- d. Silver ions**
- e. Lead ions

20. Adding of a chlorohydrogen acid diluted solution to a solution under examination resulted in white caseous sediment formation. It is the evidence the following ions presence:

- a. Iron (II)
- b. Ammonium
- c. Barium
- d. Silver**
- e. Iodine

21. Hydrochloric acid solution was added to a solution containing cations of the second analytical group. It resulted in generation of white precipitate that was partly soluble in ammonium solution and was black. What cations are contained in the solution?

- a. Silver and lead ions
- b. Silver and mercury (II) ions
- c. Mercury (II) and mercury (I) ions
- d. Silver and barium ions
- e. Silver and mercury (I) ions**

22. Potassium dichromate was added to the filtrate which was prepared after adding hot distilled water to the white precipitate of chlorides. It resulted in generation of yellow precipitate that was soluble in basic solution and insoluble in acetic acid. What cations are contained in the solution?

- a. Barium (II)
- b. Mercury (II)
- c. Lead (II)**
- d. Silver (I)
- e. Calcium (II)

23. Sodium hydroxide solution was added to a solution containing cations of the first, second and third analytical group. It resulted in generation of the precipitate that was soluble in excess of sodium hydroxide. What cations are contained in the solution?

- a. Barium
- b. Silver (I)
- c. Calcium
- d. Lead (II)**

e. Mercury (I)

24. There are  $\text{Pb}^{2+}$ ,  $\text{Ag}^{+}$  and  $\text{Hg}_2^{2+}$  of group II cations (acid – base classification). Choose group reagent for these cations:

- a. Acetic acid
- b. Oxalic acid
- c. Sulfuric acid + alcohol
- d. Nitric acid
- e. Hydrochloric acid**

25. Choose reagents for detection of strontium-ions in a solution:

- a. Ammonium oxalate
- b. Hydrochloric acid
- c. Gypsum water**
- d. Sodium hydroxide
- e. Ammonium hydroxide

26. There are  $\text{Ba}^{2+}$  and  $\text{Ca}^{2+}$  in aqueous solution. What will happen, if we add acetic acid and potassium chromate to this solution?

- a. Black precipitate
- b. Yellow precipitate**
- c. Yellow solution
- d. White precipitate
- e. Colorless solution

27. What cations of group III cations (acid – base classification) form a white precipitate with precipitating agent and which soluble in saturated solution of ammonium sulfate?

- a. Lead
- b. Strontium
- c. Barium
- d. Calcium**
- e. Magnesium

28. Choose reagents that can be used to identify the  $\text{Ba}^{2+}$  cations in the presence of  $\text{Ca}^{2+}$  and  $\text{Sr}^{2+}$  cations:

- a. Sulfuric acid + alcohol
- b. Potassium chromate solution + nitric acid
- c. Potassium chromate solution + acetic acid**
- d. Ammonium oxalate + hydrochloric acid
- e. Ammonium oxalate + acetic acid

29. There are  $\text{Ca}^{2+}$ ,  $\text{Sr}^{2+}$  and  $\text{Ba}^{2+}$  of group III cations (acid – base classification). Choose group reagent for these cations:

- a. Sulfuric acid + alcohol**
- b. Hydrochloric acid
- c. Oxalic acid
- d. Acetic acid
- e. Nitric acid

30. Calcium sulfate saturated solution was added to a solution containing cations of the third analytical group and heated. It resulted in generation of white precipitate. What cation is contained in the solution?

- a. Calcium
- b. Lead
- c. Strontium**
- d. Magnesium
- e. Mercury (II)

31. Choose reagents for detection of calcium-ions in a solution:

a. Ammonium oxalate

b. Potassium iodide

c. Ammonium hydroxide

d. Sodium hydroxide

e. Hydrochloric acid

32. There are  $Al^{3+}$ ,  $As^{(III)}$  in aqueous solution. What will happen, if we add silver nitrate to this solution?

a. White precipitate

b. Colorless solution

c. Black precipitate

d. Yellow precipitate

e. Yellow solution

33. What cations of group IV cations (acid – base classification) form a red precipitate with Aluminon reagent in presence of ammonium hydroxide?

a. Chromium (III)

b. Tin (II)

c. Aluminum

d. Tin (IV)

e. Zinc

34. What cations of group IV cations (acid – base classification) are form a gray-green precipitate with sodium hydroxide that soluble in excess of sodium hydroxide and in strong acids?

a. Chromium (III)

b. Tin (IV)

c. Aluminum

d. Tin (II)

e. Zinc

35. A medicinal preparation solution under examination contains magnesium (II) and aluminum (III) cations. What reagent will help to separate these cations during this preparation analysis?

a. Argentum nitrate solution

b. Chloride acid solution

c. Alkali solution

d. Hydrogen peroxide in acidic medium

e. Hydrogen peroxide in ammoniac medium

36. A medicinal preparation solution under examination with precipitating agent contains cations of group IV. Choose reagent for zinc ions detection in presence of aluminum ions contained in a pharmaceutical:

a. Excess of 6M sodium hydroxide in hydrogen peroxide presence

b. Borax solution

c. Sodium hydroxide

d. Cobalt (II) nitrate

e. Potassium hexacyanoferrate (II)

37. Potassium hexacyanoferrate (II) solution was added to a solution containing IV – VI group cations. It resulted in generation of the white precipitate that was insoluble in dilute hydrochloric acid. What cations are contained in the solution?

a. Zinc

b. Cadmium

c. Mercury (II)

d. Aluminum

e. Manganese

38. Potassium hydroxide solution in presence of  $H_2O_2$  was added to a solution containing IV group cations. It resulted in generation of the precipitate that was soluble in excess of potassium hydroxide

to form yellow solution. What cations are contained in the solution?

- a. Aluminum
- b. Chromium (III)**
- c. Tin (IV)
- d. Tin (II)
- e. Zinc

39. There are  $\text{Al}^{3+}$ ,  $\text{Sn}^{2+}$ ,  $\text{Sn}^{(IV)}$ ,  $\text{As}^{(V)}$ ,  $\text{As}^{(III)}$ ,  $\text{Zn}^{2+}$  and  $\text{Cr}^{3+}$  of group IV cations (acid – base classification). Choose group reagent for these cations:

- a. Nitric acid
- b. Sulfuric acid + alcohol
- c. Sodium hydroxide +  $\text{H}_2\text{O}_2$**
- d. Acetic acid
- e. Ammonium hydroxide

40. What cation with potassium thiocyanate forms a water-soluble red complex compound?

- a. Antimony (III)
- b. Iron (III)**
- c. Bismuth
- d. Manganese
- e. Iron (II)

41. Magnesium can be precipitated from aqueous solution by addition of the reagent  $\text{Na}_2\text{HPO}_4$  in presence of ammonium chloride – ammonium hydroxide buffer system: What is the colour of the precipitate?

- a. Brown
- b. Blue
- c. Red
- d. Black
- e. White**

42. Choose reagents for detection cations  $\text{Fe}^{2+}$  in aqueous solution:

- a.  $\text{Na}[\text{Sb}(\text{OH})_4]$
- b.  $\text{K}_3[\text{Fe}(\text{CN})_6]$**
- c.  $\text{Na}_2\text{HPO}_4$
- d.  $\text{K}_4[\text{Fe}(\text{CN})_6]$
- e.  $(\text{NH}_4)_2\text{S}_2\text{O}_8$

43. Iron (II) cations can react with salicyl – sulfonic acid to formation colouring complex's compounds. What is the colour of the complex's compound if the  $\text{pH} = 9 - 11$ ?

- a. Violet
- b. Red
- c. Blue
- d. Yellow**
- e. Black

44. What cations of group V cations can be identified by the reaction of hydrolysis?

- a. Iron (III); iron (II)
- b. Bismuth; antimony (III), (V)**
- c. Magnesium; iron (II)
- d. Manganese; bismuth
- e. Iron (III); antimony (III), (V)

45. Name the type of reaction with potassium KCN aqueous solution applied for  $\text{Fe}^{3+}$  cation detection:

- a. Complexing**
- b. Hydrolysis
- c. Precipitation

- d. Neutralization
- e. Renewing

46. Under certain conditions of qualitative analysis  $K_4[Fe(CN)_6]$  is a specific reagent to  $Fe^{3+}$  cations. What is the colour of the precipitate?

- a. White
- b. Brown
- c. Red
- d. Black
- e. Blue**

47. Tin chloride was added to the basic solution containing V group cations. It resulted in generation of the black precipitate. What cations are contained in the solution?

- a. Iron (II)
- b. Iron (III)
- c. Antimony (III)
- d. Manganese (II)
- e. Bismuth**

48. There are iron (III) and copper (II) cations in aqueous solution. What reagent can we use to separate these cations:

- a. Sodium hydroxide and hydrogen peroxide aqueous solution
- b. Sodium hydroxide aqueous solution
- c. Sulfuric acid aqueous solution
- d. Ammonium hydroxide concentrated solution**
- e. Hydrochloric acid aqueous solution

49. There are iron (III) and copper (II) cations in aqueous solution. What reagent can we use to separate these cations:

- a. Ammonium hydroxide concentrated solution**
- b. Hydrochloric acid aqueous solution
- c. Sulfuric acid aqueous solution
- d. Sodium hydroxide aqueous solution
- e. Sodium hydroxide and hydrogen peroxide aqueous solution

50. What cations of group VI form a blue organic layer with ammonium thiocyanate:

- a.  $Cd^{2+}$
- b.  $Co^{2+}$**
- c.  $Cu^{2+}$
- d.  $Hg^{2+}$
- e.  $Ni^{2+}$

51. There are  $Co^{2+}$  cations in aqueous solution. What would be seen if we add to the solution group reagent of group VI cations?

- a. Brownish-yellow solution
- b. Pink precipitate**
- c. Blue solution
- d. Red precipitate
- e. Brownish-yellow precipitate

52. What cations of group VI form a green precipitate with ammonium hydroxide which dissolves in excess of ammonium hydroxide to form a dark blue solution?

- a.  $Co^{2+}$
- b.  $Ni^{2+}$
- c.  $Cu^{2+}$**
- d.  $Hg^{2+}$
- e.  $Cd^{2+}$

53. What cations of group VI form a green precipitate with sodium hydroxide which dissolves in strong

acids?

- a. Copper (II)
- b. Cadmium (II)
- c. Cobalt (II)
- d. Mercury (II)
- e. Nickel (II)**

54. Potassium iodide solution was added to the basic solution containing VI group cations. It resulted in generation of the red precipitate which dissolves in excess of potassium iodide. What cations are contained in the solution?

- a.  $\text{Cu}^{2+}$
- b.  $\text{Cd}^{2+}$
- c.  $\text{Ni}^{2+}$
- d.  $\text{Co}^{2+}$
- e.  $\text{Hg}_2^{2+}$**

55. What cations of group VI form a yellow precipitate with sodium hydroxide?

- a. Nickel (II)
- b. Copper (II)
- c. Cadmium (II)
- d. Mercury (II)**
- e. Cobalt (II)

56. Nickel (II) cations can be precipitated from aqueous solution by addition of the reagent dimethylglyoxime in presence of ammonium chloride – ammonium hydroxide buffer system. What is the color of the precipitate?

- a. Reddish-brown
- b. White
- c. Dark blue
- d. Strawberry red**
- e. Black

57. What anion forms colorless gas with strong acid, which can react with lime water to form white precipitate?

- a. Sulfite-ions
- b. Arsenite-ions
- c. Carbonate-ions
- d. Iodide-ions
- e. Sulfate-ions**

58. Silver nitrate solution was added to a solution containing anions of the second analytical group. It resulted in generation of light yellow precipitate that was insoluble in nitric acid and partly soluble in ammonium solution. What anions are contained in the solution?

- a. Phosphate -ions
- b. Bromide-ions**
- c. Iodide-ions
- d. Chloride ions
- e. Sulfide-ions

59. Choose reagents for nitrite ions detection in presence of nitrate ions contained in a pharmaceutical under examination:

- a. Iron (II) sulfate (diluted) and potassium iodide
- b. Iron (II) chloride
- c. Iron (III) sulfate (concentrated) and potassium bromide
- d. Antipyrin and chlorohydrogen acid (diluted)**
- e. Iron (III) chloride

60. What anion can react with magnesium sulfate to form white precipitate? Write the chemical



## reactions

a. Oxalate -ions

**b. Phosphate -ions**

c. Carbonate-ions

d. Sulfate-ions

e. Sulfite-ions

61. Potassium iodide solution was added to a solution containing colorless oxidizing – agent-anions. What analytical effect will be observed?

a. Appearance of precipitate and dissolving in excess of reagent

**b. Brown iodine solution**

c. Change of aggregate state

d. White precipitate formation

e. Gas evolution

62. What anion forms a blue color of solution after adding diphenilamin?

a. Carbonate-ions

b. Sulfide-ions

**c. Nitrate-ions**

d. Acetate -ions

e. Oxalate -ions

63. What anions of group I anions forms a yellow precipitate with precipitating agent?

a. Sulfate-ions

b. Sulfite-ions

c. Oxalate -ions

**d. Chromate-ions**

e. Phosphate -ions

64. Iodine solution was added to a solution containing reducing – agent – anions. What analytical effect will be observed?

a. Formation of precipitate

**b. Solution colour appearance**

c. Gas evolution

d. Precipitate dissolving

e. Discoloration iodine solution

65. Choose reagents for nitrate ions contained in a pharmaceutical under examination:

a. Iron (II) chloride

b. Iron (III) chloride

**c. Iron (II) sulfate (diluted) and concentrated H<sub>2</sub>SO<sub>4</sub>**

d. Iron (III) sulfate (concentrated) and potassium bromide

e. Antipyrin and chlorohydrogen acid (diluted)

66. There is PO<sub>4</sub><sup>3-</sup> anions in aqueous solution. What will happen, if we add the ammonium molybdate?

a. Solution color appearance

b. Formation of white precipitate

c. Precipitate dissolving

d. Gas evolution

**e. Formation of yellow precipitate**

67. What anions can react with silver nitrate in presence of nitric acid to form white precipitate that soluble in 12% ammonium carbonate solution?

a. Iodine – ions

**b. Chloride – ions**

c. Bromine – ions

d. Thiocyanate – ions

e. Sulfide – ions

68. What anion forms a green color of solution after adding antipyrin and chlorohydrogen acid (diluted)?

a. Acetate -ions

b. Sulfide-ions

c. Nitrite -ions

d. Nitrate-ions

e. Oxalate -ions

69. There is  $\text{SO}_4^{2-}$  anions in aqueous solution. What will happen, if we add lead (II) cations and strong base?

a. Formation of white precipitate

b. Formation of yellow precipitate

c. Gas evolution

d. Precipitate dissolving

e. Solution color appearance

70. What anion forms a yellow-brown color of organic layer after adding chlorine water?

a. Iodine – ions

b. Thiocyanate – ions

c. Sulfide – ions

d. Bromine – ions

e. Chloride – ions

71. What anion forms a blue color of solution after adding diphenylamin?

a. Iodine -ions

b. Nitrate-ions

c. Carbonate-ions

d. Acetate -ions

e. Sulfide -ions

72. There is  $\text{CO}_3^{2-}$  anions in aqueous solution. What will happen, if we add the precipitating reagent of group I anions and then strong acid?

a. Solution color appearance

b. Gas evolution

c. Discoloration solution

d. Precipitate dissolving

e. Formation of yellow precipitate

73. Potassium bromide solution was added to a solution containing colorless oxidizing – agent-anions. What analytical effect will be observed?

a. Gas evolution

b. Appearance of precipitate and dissolving in excess of reagent

c. White precipitate formation

d. Violet solution

e. Brownish-yellow solution

74. There is  $\text{NO}_2^-$  anions in aqueous solution. What will happen, if we add potassium iodide?

a. Gas evolution

b. Precipitate dissolving

c. Solution color appearance

d. Formation of yellow precipitate

e. Formation of precipitate

75. Choose reagents for sulphate-ions detection in a solution that contains carbonate-, sulfate-, sulfite-, phosphate-anions:

a.  $\text{CaCl}_2$ ,  $\text{NH}_4\text{OH}$

b.  $\text{AgNO}_3$ ,  $\text{HNO}_3$

c.  $\text{Ba}(\text{NO}_3)_2$ ,  $\text{HCl}$

d.  $\text{BaCl}_2$ ,  $\text{H}_2\text{O}$

e.  $\text{Ba}(\text{NO}_3)_2$ ,  $\text{NaOH}$

76. What anions can react with silver nitrate in presence of nitric acid to form light – yellow precipitate that insoluble in 12% ammonium carbonate solution, but partly dissolve in aqueous ammonium?

a. Thiocyanate – ions

b. Sulfide – ions

c. Iodine – ions

d. Chloride – ions

e. Bromine – ions

77. Choose reagents for acetate ions contained in a pharmaceutical under examination:

a. Iron (III) sulfate (concentrated) and potassium bromide

b. Iron (II) sulfate (diluted) and concentrated  $\text{H}_2\text{SO}_4$

c. Antipyrin and chlorohydrogen acid (diluted)

d. Iron (II) chloride

e. Iron (III) chloride

78. There is  $\text{SO}_3^{2-}$  anions in aqueous solution. What will happen, if we add the  $\text{KMnO}_4$  in acidic solution?

a. Discoloration the  $\text{KMnO}_4$  solution

b. Precipitate dissolving

c. Gas evolution

d. Formation of precipitate

e. Solution color appearance

79. What anion forms a violet color of organic layer after adding chlorine water?

a. Iodine – ions

b. Sulfide – ions

c. Chloride – ions

d. Bromine – ions

e. Thiocyanate – ions

80. What anion of group III anions forms a red-brown precipitate with iron (III) chloride?

a. Iodine -ions

b. Acetate -ions

c. Carbonate-ions

d. Nitrate -ions

e. Sulfide -ions