TOPIC: GROUP OF SUBSTANCES ISOLATED FROM THE BIOLOGICAL MATERIAL BY MINERALIZATION (METALLIC POISONS)

Toxicity and antidotes in metal compound poisonings

1. What is the toxicological value of arsenic compounds based on? On their application in:
   A. Pyrotechnics
   B. Food industry
   C. Light industry
   D. Medicine
   E. Manufacture of fusible alloys

2. Poisoning by a metallic poison happened. What is the reason of toxic action of metallic poisons?
   A. Binding with lipids
   B. Binding with amino acids, proteins and polypeptides
   C. Binding with carbohydrates
   D. Binding with hydrochloric acid
   E. Binding with cholesterol

3. Barium salt was taken by mistake. What barium salt is not toxic for a living organism?
   A. Barium nitrate
   B. Barium carbonate
   C. Barium sulphate
   D. Barium acetate
   E. Barium chloride

4. Mercury (II) chloride and ethyl mercuric chloride are highly toxic substances. Ethyl mercuric chloride is more toxic than mercury (II) chloride because of the presence in its structure of:
   A. Ethyl radical
   B. Mercury (II) cation
   C. Chloride ion
   D. Carbon atoms
E. Ionic bond

5. Mercury compounds are toxic substances. The toxicity rate of compounds depends on their chemical structure. What substance is the most toxic?
   A. Hg₂Cl₂
   B. C₂H₅HgCl
   C. HgCl₂
   D. HgO
   E. Hg₂O

6. When performing toxicological examination dark blue-green stomach content was observed. Which substance should the toxicological examination be carried out for?
   A. Ammonium oxalate
   B. Barium chloride
   C. Potassium nitrate
   D. Sodium chloride
   E. Copper sulphate

7. In the case of heavy metal or arsenic compound poisoning the following antidote is used:
   A. Glucagon
   B. Vitamin B₆
   C. Lipoic acid
   D. Methyl blue
   E. Unithiol

8. What medicine as antidote must be present for the first aid at an industrial enterprise where acute poisoning by arsenic, mercury, chromium or bismuth compounds is possible?
   A. Adrenalin
   B. Unithiol
   C. Atropine
   D. Droperidol
   E. Morphine

9. At barium salt poisoning such specific chemical antidote is used:
   A. Potassium iodide
B. Sodium chloride  
C. Sodium sulphate  
D. Sodium carbonate  
E. Copper acetate

**10. What specific antidote is used at poisoning by iron preparations?**  
A. Penicillamine  
B. Bemegride  
C. Atropine sulphate  
D. Deferoxamine  
E. Protamine sulphate

**11. The toxic substances are divided into groups according to the isolation method from the biological material. What method is used for isolation of the metallic poisons:**  
A. Infusion with acidified ethanol or acidified water  
B. Steam distillation  
C. Mineralization of the biological material  
D. Infusion with water  
E. Infusion with lipophilic solvent

**12. Mineralization is the isolation method of the metallic poisons from the biological material. Mineralization of the biological samples when heating in the crucible to high temperature at free air is named:**  
A. Distillation  
B. Alloying  
C. Wet ashing  
D. Extraction  
E. Dry ashing

**13. At research of the biological material for the presence of a metallic poison the mineralization by the mixture of nitric and sulphuric acids is carried out. The first stage of the mineralization is:**  
A. Oxidization  
B. Denitration  
C. Sulphurization and nitration  
D. Ashing
14. When performing the mineralization by the mixture of sulphuric and nitric acids the end of this process is determined by:
   A. Yellow colour of liquid in the reaction flask
   B. Orange colour of liquid in the reaction flask
   C. The absence of black inclusions at heating to heavy white steam liberation and when nitric acid addition is discontinued
   D. The absence of colour changes of liquid when nitric acid is added
   E. After expiration of the set time

15. Which scientist was the first to suggest the idea of the necessity of the mineralization in the study of the biological material for the presence of heavy metal compounds?
   A. Nelyubin A. P.
   B. Ravdanikis P. K.
   C. Krilova A. N.
   D. Zaykovskiy F. V.
   E. Shvaykova M. D.

16. What oxidizers are used for the mineralization destruction of the biological material by the Kaan method?
   A. Hydrogen peroxide and sulphuric acid
   B. Nitric acid
   C. Sulphuric and nitric acids
   D. Sulphuric, nitric and perchloric acids
   E. Hydrogen peroxide and hydrochloric acid

**NB!** Inorganic mercury compounds are isolated from the biological material by the special method which is called destruction because mercury and its compounds are volatile

17. The biological sample contains mercury. What method is used for isolation of mercury compounds from the biological material?
   A. Mineralization
   B. Destruction
   C. Steam distillation
   D. Extraction with organic solvent
E. Extraction with acidified ethanol

18. Various poisons are isolated from the biological material using different methods. Inorganic mercury compounds are isolated from the biological material by the following method:
   A. Infusion with ethanol acidified by oxalic acid
   B. Mineralization
   C. Steam distillation
   D. Infusion with by water acidified by sulphuric acid
   E. Destruction

19. Which metallic poison is isolated from the biological material by the mineralization destruction?
   A. Silver
   B. Mercury
   C. Thallium
   D. Cadmium
   E. Antimony

20. Using the mineralization destruction for isolation of mercury compounds from the biological material allows:
   A. To mask the interfering cations
   B. To decrease the duration of the biological material destruction
   C. To warn the severe losses of mercury compounds in the conditions of the hard thermal mode
   D. To increase the method sensitivity for mercury detection in the biological material
   E. To decrease the method sensitivity for mercury detection in the biological material

21. Some metallic poison is separated from the biological material by the destruction method. What metallic poison is separated by this method?
   A. Antimony
   B. Mercury
   C. Cadmium
   D. Silver
   E. Arsenic

22. For the prevention of mercury loss during forensic-toxicological study
of the biological material some special isolation method is used. This method is named:

A. Destruction  
B. Denaturation  
C. Degradation  
D. Disintegration  
E. Mineralization

NB! Denitration is the process of removing nitric, nitrogenous, nitrososulphuric acids and nitrogen oxides from the mineralizate. These substances are oxidizers, which prevent the analysis for metallic poisons. Denitration is performed by adding to the mineralizate various reductants. The most effective reductant is formalin.

23. After the metallic poisons isolation using mineralization the denitration is carried out. What method of the denitration is the most widespread and fast?

A. Distillation  
B. Hydrolysis  
C. By urea  
D. By sodium sulphate  
E. By formalin

24. For denitration of the mineralizate different reductants can be used. What reagent is the most effective for denitration?

A. Sodium sulphate  
B. Thiourea  
C. Formaldehyde solution  
D. Urea  
E. Sodium thiosulphate

25. For the mineralizate denitration different reductants were proposed. What reagent is used for denitration?

A. Thiourea  
B. Solution of formaldehyde  
C. Sodium sulphite  
D. Urea  
E. Sodium of thiosulphate
26. Poisoning by inorganic mercury compounds happened. After destruction of the biological sample the denitration is carried out with the help of:

A. Urea  
B. Formalin  
C. Sodium sulphate  
D. Sodium thiosulphate  
E. Sodium sulphide

27. After the biological material mineralization the denitrification is carried out. Which reagent is used for verification of the denitrification completeness?

A. Diphenylamine  
B. Urea  
C. Diphenylldithiocarbazone  
D. Diethylldithiocarbamate  
E. Glycerol

28. Forensic toxicologists examines the mineralize obtained from the biological material. For verification of the denitrification completeness the following reagent is used:

A. Aniline solution  
B. Diphenylbenzidine solution  
C. Diphenylamine in concentrated sulphuric acid  
D. Dithizone solution  
E. α-Naphthol solution

29. Which scientist suggested the method of the mineralize denitration using formaldehyde?

A. Krylova A. N.  
B. Nelyubin A. P.  
C. Kramarenko V. F.  
D. Zaykovskiy F. V.  
E. Shvaykova M. D.

Detection and identification of metallic poisons in the mineralize

NB! In the chemical toxicological analysis of metallic poisons the fractional method is used. The fractional method is based on using the reactions, which allow to detect
metallic cations in separate small portions of the solution examined. Tananaev N. A. was the founder of the fractional analysis method.

30. Which scientist was the founder of the fractional analysis method?
A. Tananaev N. A.
B. Krylova A. N.
C. Kaan
D. Sherbak A.
E. Nelyubin A. P.

NB! Masking the interference ions is one of the main approaches used in the fractional method. Complexation, the binding the interference ions into colourless stable complexes, is widely used for this purpose. Cyanide, fluoride, phosphate are used for masking many trace metals.

31. In the fractional analysis method masking is one of the main methods of eliminating the interference ion influence. The basic masking method is:
A. Oxidation
B. Evaporation
C. Complexation
D. Extraction
E. Destruction

32. To mask which cation when detecting cobalt cation in the mineralizate by the reaction with ammonium rhodanide according to the fractional analysis method is fluoride used?
A. Copper (II) cation
B. Ferric (III) cation
C. Cadmium cation
D. Lead cation
E. Bismuth cation

33. To mask which cation when studying the mineralizate in accordance with the fractional analysis method is phosphate used?
A. Zinc (II)
B. Copper (II)
C. Iron (III)
D. Cadmium (II)
34. To mask which cation when studying the mineralizate in accordance with the fractional analysis method is phosphate used?
   A. Cuprum (II)
   B. Zinc (II)
   C. Plumbum (II)
   D. Cadmium (II)
   E. Ferrum (III)

35. For masking the interference ions in the fractional method of the metallic poisons analysis various reagents are used. Usage of fluoride for this purpose is based on its ability to form colourless stable complexes with the following cation:
   A. Mg$^{2+}$
   B. Fe$^{2+}$
   C. Ba$^{2+}$
   D. Fe$^{3+}$
   E. Ag$^+$

36. In chemicotoxicological analysis of heavy metal compounds the masking copper (II) cations when performing the fractional method following reagent is used:
   A. Fluoride
   B. Glycerol
   C. Thiourea
   D. Cyanide
   E. Phosphate

37. In the fractional analysis method various chelating agents are used for elimination of the interference ions. Follow-up destruction of the complexes obtained is named:
   A. Masking
   B. Dismasking
   C. Denitration
   D. Mineralization
   E. Extraction
NB! Separation of PbSO₄ and BaSO₄. To separate barium and lead sulphates obtained after mineralization the precipitate is washed by a hot solution of ammonium acetate which results in dissolving PbSO₄.

38. The mineralizate studied contains sediments of barium sulphate and lead sulphate. These salts may be separated with the use of:
   A. Acetic acid
   B. Sulphuric acid
   C. Ammonium acetate solution
   D. Sodium acetate solution
   E. Ammonium nitrate solution

39. The mineralizate contained white precipitate of lead sulphate, barium sulphate and strontium sulphate. What procedure should be used to separate lead sulphate?
   A. Transformation into arsine
   B. Dissolution in concentrated sulphuric acid
   C. Transformation into carbonate
   D. Transformation into diethyldithiocarbamate
   E. Dissolution in ammonium acetate

NB! Dithizone is often used as a reagent in the qualitative analysis of metallic poisons. Dithizonates can be coloured. Dithizonates are dissolved in organic solvents and destroyed by acids, and this fact is used for separating some heavy metal cations from the mineralizate.

40. Some complexation reactions are used as preliminary tests. Which reaction is used for detection of thallium cations in the mineralizate?
   A. With thiourea
   B. Sodium rhodizonate
   C. With dithizone
   D. With diphenylcarbazide
   E. With sulphuric acid

41. It is necessary to detect and determine mercury ions in the mineralizate. Which reaction is used for this purpose?
   A. With sodium rhodizonate
   B. With dithizone
C. With diphenylcarbazide
D. With thiourea
E. With ammonium persulphate

42. Metal poisoning happened. During the reaction with dithizone chloroform layer is turned in pink. Which metallic poisons is it necessary to carry out the confirmative reactions for?
   A. Manganese and chromium
   B. Thallium and antimony
   C. Copper and bismuth
   D. Lead and zinc
   E. Silver and arsenic

43. Poisoning by heavy metals happened. Which metal detection is the preliminary test with dithizone used for?
   A. Copper and cadmium
   B. Zinc and silver
   C. Arsenic and antimony
   D. Manganese and chromium
   E. Bismuth and copper

44. At the mineralizate study for the presence of zinc the following reaction is used as the preliminary test:
   A. With dithizone
   B. With diphenylcarbazide
   C. With sodium rhodanide
   D. With thiourea
   E. With diethyldithiocarbamate

45. Heavy metal poisoning happened. The reaction with dithizone is carried out when studying the mineralizate. Which heavy metal does not react with this reagent:
   A. Thallium
   B. Silver
   C. Mercury
   D. Lead
   E. Barium
46. What is dithizone by the chemical structure?
   A. Diphenylcarbazone
   B. Diphenyldithiocarbazone
   C. Diphenylthiocarbazone
   D. Dithiocarbazone
   E. Dithiophenylcarbazone

Detection of Lead compounds

47. For the metallic poison isolation from the biological material the mineralization by the mixture of sulphuric and nitric acids was carried out. In the process the white precipitate was obtained. It testifies to the possible presence of:
   A. Lead
   B. Thallium
   C. Zinc
   D. Copper
   E. Antimony

48. What metallic poison is detected with KI by the reaction of “gold rain formation”?
   A. Mn$^{2+}$
   B. Cu$^{2+}$
   C. Pb$^{2+}$
   D. Ag$^+$
   E. Ba$^{2+}$

Detection of Barium compounds

49. For the mineralization of the biological material the mixture of nitric and sulphuric acids is used. What metal cation forms insoluble sulphate:
   A. Copper
   B. Barium
   C. Silver
   D. Manganese
   E. Zinc

50. When studying the mineralizate for the presence of barium cations
the reaction with sodium rhodizonate is used. What colour is the product of this reaction?

A. Red  
B. Yellow  
C. Brown  
D. Violet  
E. Dark blue

51. What is barium rhodizonate in appearance?
A. Prismatic crystals  
B. Red solution  
C. Yellow solution  
D. Blue-violet sediment  
E. Red-brown sediment

Detection of Manganese compounds

NB! For detection of Manganese compounds the reactions of Mn$^{2+}$ oxidization by means of potassium periodate or ammonium persulphate to permanganate-ion are carried out.

52. The preliminary test of the mineralizate for the presence of manganese compounds is carried out. What reagent is used?
A. Thiourea  
B. Potassium periodate  
C. Copper acetate  
D. Sulphuric acid  
E. Dithizone

53. A man was poisoned by manganese salt. The manganese (II) cations are detected in the mineralizate. What reactions are in the base of chemical method of manganese detection?
A. Dissociation reactions  
B. Hydrolysis reaction;  
C. Oxidation-reduction  
D. Neutralization reactions  
E. Exchange reactions

54. When carrying out the reaction with potassium periodate a violet
colour is appeared. It testifies the presence in the mineralizate the following metallic poison:

A. Zinc  
B. Manganese  
C. Cadmium  
D. Arsenic  
E. Antimony

Detection of Chromium compounds

55. What reaction is used for detection of chromium (III) cations?

A. With malachite green  
B. With dithizone  
C. With sodium rhodizonate  
D. With diphenylcarbazide  
E. With thiourea