Identification of selected cations and anions

Exercise goal:

- pipetting in practise
- identification of selected cations and anions in solutions

Chemical analysis - a set of activities leading to the determination of the chemical, qualitative and quantitative composition of the test substance.

- Qualitative analysis - which determines the chemical elements and compounds consists of the substance; involves the subsequent separation of ion groups using group reagents and detection of individual ions of a given group after the separation of interfering ions

- quantitative analysis - deals with determining the quantitative composition of the substance, i.e. the content of individual components.

Ca^{2+}	Mg^{2+}	NH_4^+	Cu^{2+}	Fe^{3+}	Zn^{2+}	Mn^{2+}	Co^{2+}	Na^+
		Cl^-	CO_3^{2-}	PO_4^{3-}	SO_4^{2-}	NO_3^-		

Cation analysis

Cations are divided into 5 groups. This division is based on the reactions that cations of a given group give with group reagents.

Group I: Ag^{+} (silver (I)), Hg_2^{2+} (mercury (I)), Pb^{2+} (lead (II)). **Group reagent: HCl (hydrochloric acid) concentration 2 mol / dm³.**

Group II: **Group reagent : H_2S (hydrogen sulfide) in acid medium (HCl concentration 2 mol/dm³).** Due to the chemical nature of the respective sulphides, group II cations are divided into two subgroups:

Group IIA: Cu^{2+} (copper(II)), Hg^{2+} (mercury(II)), Pb^{2+} (lead(II)) in diluted solutions, Cd^{2+} (cadium(II)) i Bi^{3+} (bizmuth(III)). Sulphides of these cations are insoluble in $(NH_4)_2S_2$ i KOH. (ammonium sulfide and potassium hydroxide)

Group IIB: Sn^{2+} (tin (II)), Sn^{4+} (tin(IV)), Sb^{3+} (antimony(III)), Sb^{5+} (antimony(V)), As^{3+} (arsenic(III)) i As^{5+} (arsenic(V)). Sulphides of these cations are soluble in $(NH_4)_2S_2$ i KOH. (ammonium sulfide and potassium hydroxide)

Group III: Group III cations were divided into two subgroups.

Group IIIA: Cr^{3+} (chrome(III)), Al $^{3+}$ (aluminium), Fe^{2+} (iron(II)) i Fe^{3+} (iron(III)).

Group reagent : NH_3(aq) (amonia solution) in the presence of NH_4Cl (ammonium chloride) (weakly alkaline ammonium buffer).

Group IIIB: Mn^{2+} (manganese(II)), Zn^{2+} (zinc), Co^{2+} (cobalt(II)) i Ni^{2+} (nickel(II)). **Group reagent :** $(NH_4)_2S$ (ammonium sulfide)in the presence of ammonium buffer.

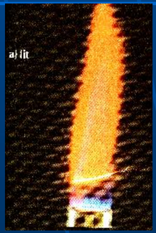
Group IV: Ca^{2+} (calcium), Sr^{2+} (strontium) i Ba^{2+} (barium).
Group reagent : $(NH_4)_2CO_3$ (ammonium carbonate)in the presence of ammonium buffer.

Group V : Mg^{2+} (magnesium), K^+ (potassium), NH_4^+ (ammonium ion) i Na^+ (sodium). This group has no group reagent.

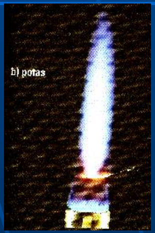
Ion detection Na^+

Measure 1 cm^3 0,5 $mmol/dm^3$ of sodium ion into the tube. In this solution, immerse the previously roasted in the flame of the burner platinum wire embedded in a glass rod. Wetted with sodium ion solution, put wire into flame. The flame turns an intense yellow color.

The intensity of the flame color depends on the ion concentration



Lithium

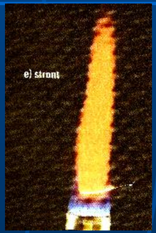


Potasium

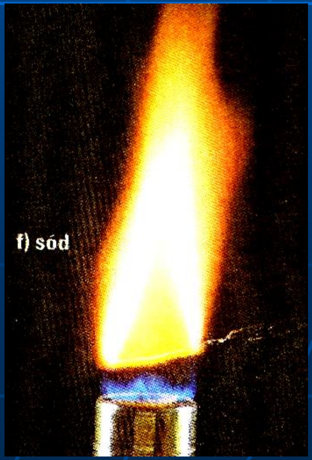
Calcium


Nie zabarwiony płomień

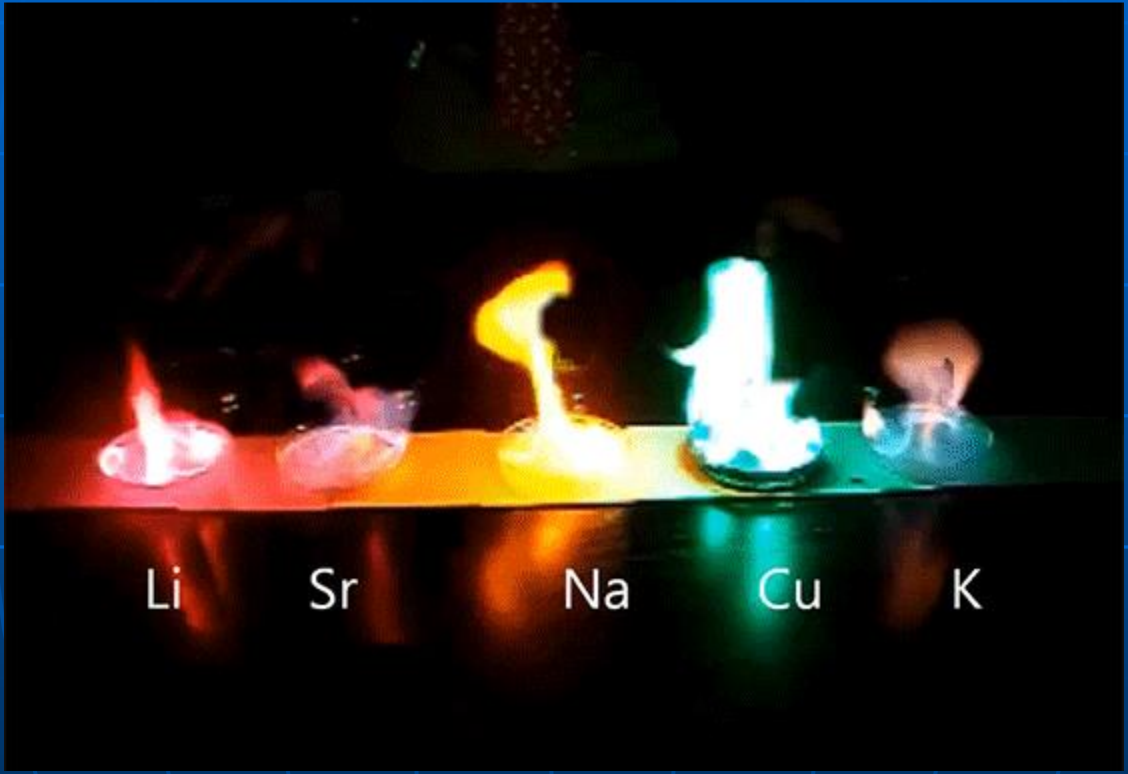
Barium

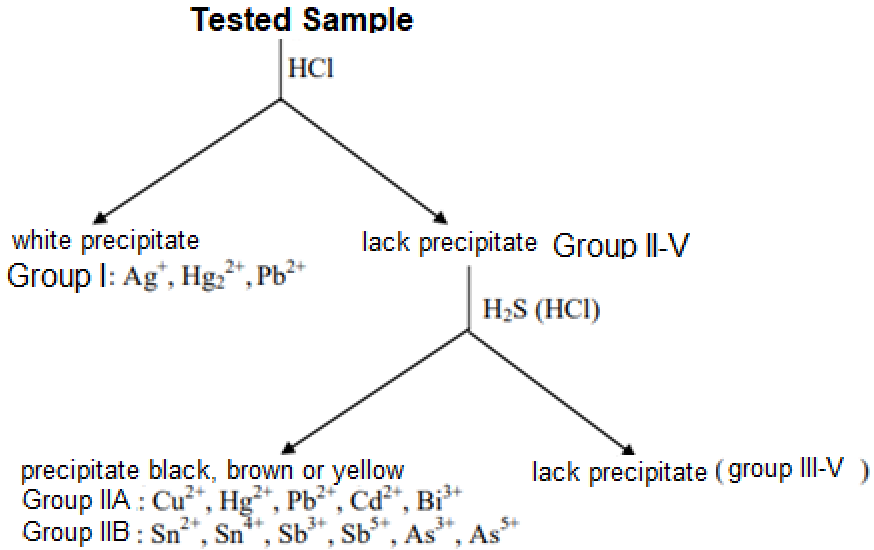


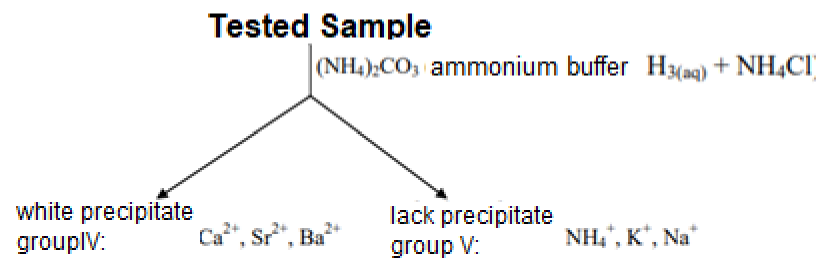
Strontium

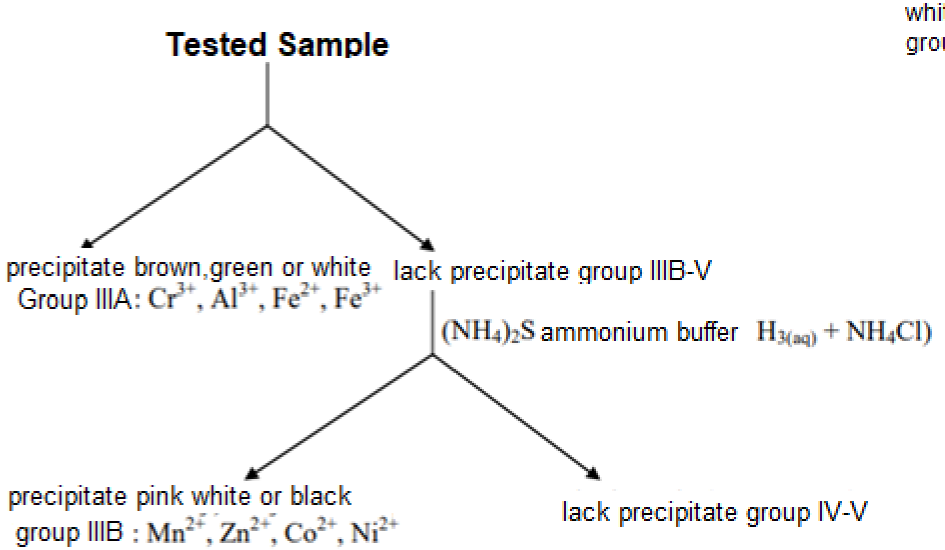


Sodium


Li
Sr
Na
Cu
K


Tested Sample
HCl
white precipitate
Group I: Ag^{+}, Hg_2^{2+}, Pb^{2+}
lack precipitate Group II-V
H_2S (HCl)
precipitate black, brown or yellow
Group IIA : Cu^{2+}, Hg^{2+}, Pb^{2+}, Cd^{2+}, Bi^{3+}
Group IIB : Sn^{2+}, Sn^{4+}, Sb^{3+}, Sb^{5+}, As^{3+}, As^{5+}
lack precipitate (group III-V)


Tested Sample
$(NH_4)_2CO_3$ ammonium buffer $H_{3(aq)}$ + NH_4Cl)
white precipitate
groupIV:
Ca^{2+}, Sr^{2+}, Ba^{2+}
lack precipitate
group V:
NH_4^{+}, K^{+}, Na^{+}


Tested Sample
precipitate brown,green or white
Group IIIA: Cr^{3+}, Al^{3+}, Fe^{2+}, Fe^{3+}
lack precipitate group IIIB-V
$(NH_4)_2S$ ammonium buffer $H_{3(aq)}$ + NH_4Cl)
precipitate pink white or black
group IIIB : Mn^{2+}, Zn^{2+}, Co^{2+}, Ni^{2+}
lack precipitate group IV-V

Anion analysis

In order to facilitate the analysis of anions and standardize analytical procedures, the most common anions were divided into seven analytical groups from I - VII. The division is based on the precipitation of barium and silver salts of individual anions and testing their solubility in water and nitric acid (V)

Group	Solubility, color of precipitate	Detected Ions
I	Ag^+ white or yellow, insoluble in 2M HNO_3 Ba^{2+}- easily soluble in water, no precipitate	Cl^- , Br^- , F^- , CN^- , SCN^- , ClO^- , $[Fe(CN)_6]^{4-}$, $[Fe(CN)_6]^{3-}$
II	Ag^+ - white, soluble in 2M HNO_3 , slightly soluble in water Ba^{2+}- precipitate	S^{2-} , CH_3COO^- , $NO_2{}^-$, $HCOO^-$
III	Ag^+ - colorless, soluble inHNO_3 , insoluble in water Ba^{2+} - white soluble soluble in HNO_3, soluble in wather	$SO_3{}^{2-}$, $CO_3{}^{2-}$, $C_2O_4{}^{2-}$, $HPO_4{}^{2-}$
IV	Ag^+ - yellow, light yellow soluble in HNO_3, insoluble in water Ba^{2+} - white precipitates soluble in HNO_3, hardly soluble in water	$S_2O_4{}^{2-}$, $CrO_4{}^{2-}$, $Cr_2O_7{}^{2-}$, $PO_4{}^{3-}$, $AsO_3{}^{3-}$
V	Ag^+ and barium salts do not precipitate	$NO_3{}^-$, $ClO^{3\,-}$, $ClO^{4\,-}$, $MnO_4{}^-$
VI	Ag^+ - do not precipitate Ba^{2+} - white precipitates, insoluble in water	$SO_4{}^{2-}$, F^-
VII	Ag^+ - precipitate yellow precipitates, soluble in HNO_3 Ba^{2+} - white precipitates, soluble in HNO_3. Gelatinous precipitates of silicic or tungsten acids are formed	$SiO_3{}^{2-}$, $WO_4{}^{2-}$

In the following it belongs perform characteristic reactions that will uniquely identify the anion within the group.

Taking into account the oxidation-reducing properties of the above-mentioned anions, we divide them into four groups.

- Anions with reducing properties. These include : chloride anion (Cl^-), iodine anion (I^-), sulfide anion (S^{2-}), sulfate anion (SO_3^{2-}), oxalate anion ($C_2O_4^{2-}$) i thiosulphate anion ($S_2O_3^{2-}$).

- Anions with oxidizing properties. The anion with strong oxidizing properties is nitrate anion(NO_3^-).

- Anions with both oxidizing and reducing properties. Nitrite anion belongs to this group(NO_2^-).

- Anions that do not show reducing or oxidizing properties in dilute aqueous solutions. We include anions: carbonate anion (CO_3^{2-}), phosphate anion (PO_4^{3-}), sulfate anion (SO_4^{2-}) , silicate anion (SiO_3^{2-}).

Solubility Table

	NH_4^+	Na^+	K^+	Mg^{2+}	Ca^{2+}	Ba^{2+}	Cr^{3+}	Mn^{2+}	Fe^{2+}	Fe^{3+}	Co^{2+}	Ni^{2+}	Cu^{2+}	Ag^+	Au^{3+}	Zn^{2+}	Cd^{2+}	Hg^{2+}	Al^{3+}	Sn^{2+}	Pb^{2+}	Bi^{3+}
OH^-	R	R	R	NR	TR	R	NR	NR	NR	NR	NR	NR	NR	&&	NR	NR	NR	NR	NR	NR	NR	NR
F^-	R	R	R	NR	NR	NR	NR	TR	TR	NR	R	TR	NR	R	R	NR	TR	R	TR	R	NR	R
Cl^-	R	R	R	R	R	R	R	R	R	R	R	R	R	NR	R	R	R	R	R	R	TR	R
Br^-	R	R	R	R	R	R	R	R	R	R	R	R	R	NR	R	R	R	TR	R	R	TR	R
I^-	R	R	R	R	R	R	R	R	R	&&	R	R	&&	NR	TR	R	R	NR	R	TR	NR	NR
S^{2-}	R	R	R	&&	TR	R	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	&&	NR	NR	NR
SO_3^{2-}	R	R	R	R	NR	NR	R	NR	NR	&&	NR	NR	&&	TR	NR	TR	TR	&&	&&	TR	NR	TR
SO_4^{2-}	R	R	R	R	TR	NR	R	R	R	R	R	R	R	TR	R	R	R	R	R	R	NR	R
NO_2^-	R	R	R	R	R	R	R	R	R	NR	R	R	R	TR	&&	R	R	R	R	TR	R	NR
NO_3^-	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
PO_4^{2-}	R	R	R	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
CO_3^{2-}	R	R	R	NR	NR	NR	NR	NR	NR	&&	NR	NR	&&	NR	NR	NR	NR	NR	&&	NR	NR	NR
SiO_3^{2-}	R	R	R	NR	NR	NR	&&	NR	NR	NR	NR	NR	&&	&&	&&	NR	NR	&&	NR	&&	NR	&&
MnO_4^{2-}	R	R	R	R	R	R	R	&&	&&	R	R	R	R	R	&&	R	R	&&	R	&&	R	R
CrO_4^{2-}	R	R	R	R	TR	NR	NR	NR	&&	R	NR	NR	R	NR	&&	TR	NR	TR	NR	NR	NR	NR
octan	R	R	R	R	R	R	R	NR	R	R	R	R	R	R	R	R	R	R	R	R	R	R

Kolor tła odzwierciedla charakterystyczną barwę substancji należy go traktować umownie
R - substancja dobrze rozpuszczalna (rozpuszczalność powyżej 1 g w 100 g wody)
TR - substancja o niewielkiej rozpuszczalności, strąca się przy odpowiednim stężeniu roztworu (rozpuszczalność 0,1 - 1 g w 100 g wody)
NR - substancja praktycznie nierozpuszczalna, strąca się z rozcieńczonych roztworów (rozpuszczalność poniżej 0,1 g w 100 g wody)
&& - zachodzą skomplikowane reakcje, lub substancja nie została otrzymana

Task 1

The aim of the task is to detect Ca^{2+} (calcium) ions

Execution

a. Test with $C_2O_4^{2-}$ (oxalate) ions

Add about 0.5 cm^3 of 0.2 mol/dm^3 ammonium oxalate ($NH_4C_2O_4$) to 0.5 cm^3 of Ca^{2+} solution.

Reaction:

$$Ca^{2+} + C_2O_4^{2-} \Rightarrow \downarrow CaC_2O_4$$

The resulting CaC_2O_4 precipitate is white, crystalline. If you add several drops of ammonia to a test tube, in which the reaction has occurred, the amount of precipitate is greater. Calcium oxalate is soluble in mineral (inorganic) acids, and insoluble in acetic acid.

b. Test with SO_4^{2-} (sulphate) ions

Add several drops of concentrated H_2SO_4 (sulphuric acid) to 0.5 cm^3 of Ca^{2+} solution.

Reaction:

$$Ca^{2+} + SO_4^{2-} \Rightarrow \downarrow CaSO_4$$

Reaction with sulphuric acid results in the precipitation of white $CaSO_4$ (copper sulphate).

Task 2

The aim of the task is to detect NH_4^+ (ammonium) ions

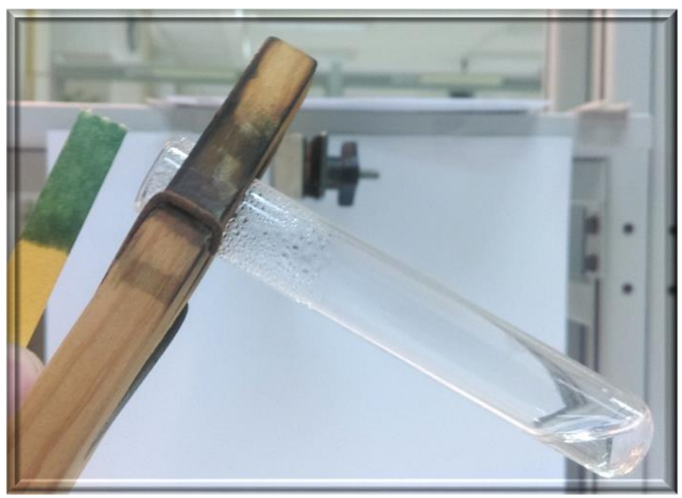
Execution

Add about 0.5 cm^3 of 2mol/dm^3NaOHto 0.5 cm^3 of NH_4^+ solution, and heat the contents of the test tube over a burner.

Reaction:

$$NH_4^+ + 2NaOH \Rightarrow \uparrow NH_3 + 2Na^+ + H_2O$$

Observe the change of litmus paper colour and the characteristic odour of escaping ammonia at the mouth of the test tube.



Task 3

The aim of the task is to detect Cu^{2+} (copper) ions

Execution

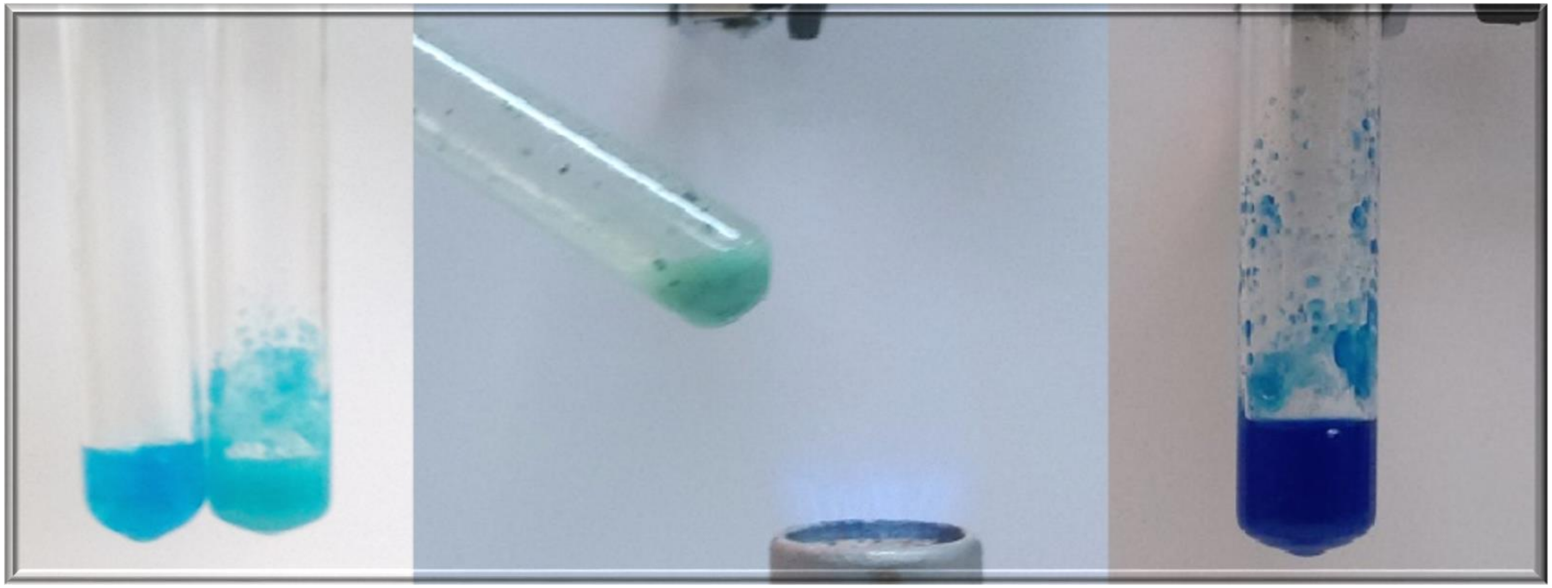
Take two test tubes, pour into each 0.5 cm^3 of Cu^{2+} solution, and then add 0.5 cm^3 of 2 mol/dm^3 NaOH. After the precipitation of $Cu(OH)_2$, heat one test tube over a burner, and add 0.5 cm^3 of concentrated $NH_3 \cdot H_2O$ to the other test tube.

Reactions:

$$Cu^{2+} + 2\ OH^- \Rightarrow \downarrow Cu(OH)_2$$

$$Cu(OH)_2 gel \Rightarrow \downarrow CuO + H_2O$$

$$Cu(OH)_2 + 4NH_3 \Rightarrow [Cu(NH_3)_4]^{2+} + 2OH^-$$



Task 4

The aim of the task is to detect Fe^{3+} (iron) ions

Execution

a. Test with potassium thiocyanate

Add 0.5 cm^3 of 1 mol/dm^3 KSCN (potassium thiocyanate) to 0.5 cm^3 of Fe^{3+} solution.

Reaction:

$$Fe^{3+} + 3\ SCN^- \Rightarrow Fe(SCN)_3$$

Observe the change of solution colour. Fe^{2+} ions do not give this reaction.

b. Test with sodium hydroxide

Add 0.5 cm^3 of 2mol/dm^3 NaOH to 0.5 cm^3 of Fe^{3+} solution.

Reaction:

$$Fe^{3+} + 3\ OH^- \Rightarrow \downarrow Fe(OH)_3$$

Observe the formation of red-brown $Fe(OH)_3$ precipitate, which is insoluble in an excess of the reagent.

Task 5

The aim of the task is to detect Ag^+ (silver) ions

Execution

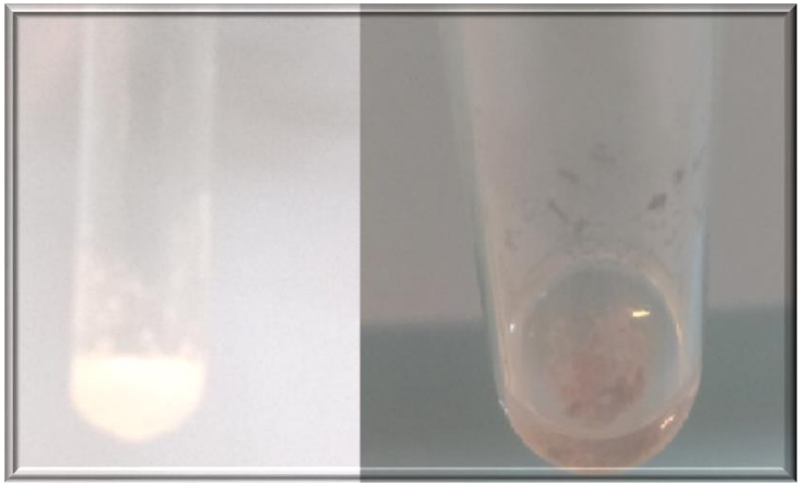
a. Test with Cl^- (chlorine) ions

Take two test tubes, pour into each 0.5 cm^3 of Ag^+ solution, and then several drops of concentrated HCl (hydrochloric acid). One test tube expose to sunlight and after some time observe photochemical reaction occurring in the test tube. Carefully heat the other test tube and observe the precipitate. Cool the test tube, then add drop by drop 2 mol/dm^3 $NH_3 \cdot H_2O$ until the formation of soluble silver diamine chloride ($[Ag(NH_3)_2]Cl$),and next add drop by drop concentrated HNO_3 until the reappearance of AgCl precipitate.

Ag^+ ions, occurring in neutral or acid solutions, react with Cl^- ions forming white, cheese-likeprecipitate of silver chloride (AgCl), which decomposes when exposed to light and darkens due to the precipitation of colloidal silver.

$$Ag^+ + Cl^- \Rightarrow \downarrow AgCl$$

$$2\downarrow AgCl \Rightarrow 2\downarrow Ag + \uparrow Cl_2$$

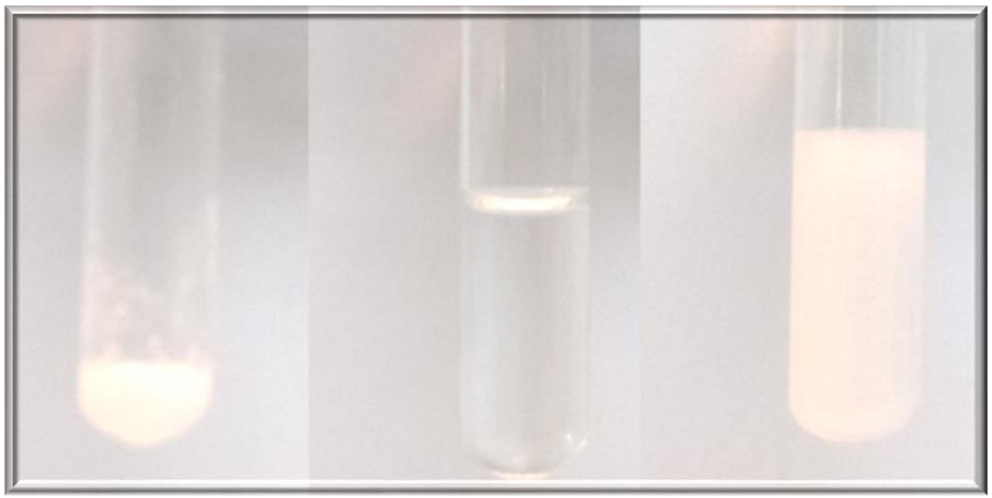


AgCl precipitate is insoluble in both cold and hot pure water but in the presence of ammonium ions it forms soluble, colourless, complex ion $[Ag(NH_3)_2]^+$.

$$2{\downarrow}AgCl \Rightarrow 2{\downarrow}Ag + {\uparrow}Cl_2$$

$${\downarrow}AgCl + 2NH_3{\cdot}H_2O \Rightarrow [Ag(NH_3)_2]Cl + 2H_2O$$

The addition of nitric acid causes the reprecipitation of AgCl.

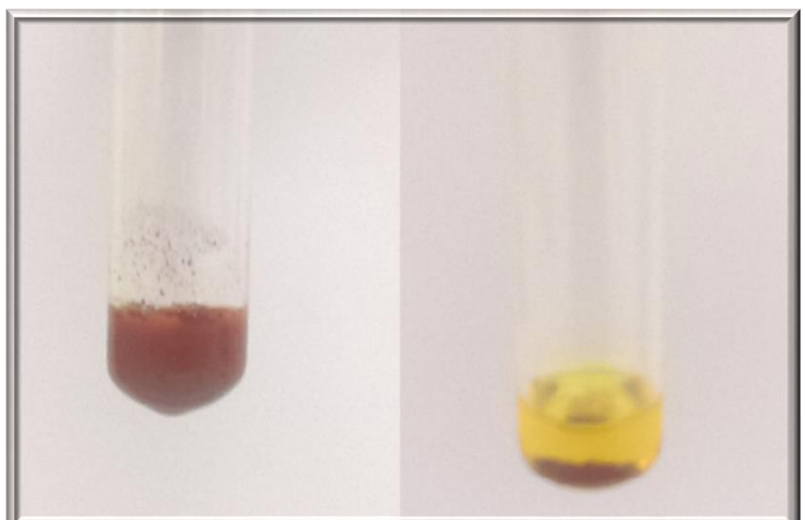


b. Test with CrO_4^{2-} (chromate) ions

Add 0.5 $cm^3$of 0.1 mol/dm^3 K_2CrO_4 to 0.5 cm^3 of Ag^+ solution.After the precipitation of Ag_2CrO_4,add several drops of concentrated nitric acid to the test tube. Observe the course of reaction.

$$2Ag^+ + CrO_4^{2-} \Rightarrow 2 \downarrow Ag_2CrO_4$$

Potassium chromate(K_2CrO_4)causes the precipitation ofred-brown silver chromate (Ag_2CrO_4)from the solutionscontaining Ag^+ ions. This reactionhas found practical application in the quantitative determination of silver in jewellery because the intensity of colour of formed Ag_2CrO_4depends on the amount of silver in the alloy, from which jewellery has been made.



Task 6

The aim of the task is to detect Pb^{2+} (lead) ions

Execution

a. Test with Cl^- (chlorine) ions

Add several drops of concentrated HCl to 0.5 cm^3 of Pb^{2+}solution.

Reaction:

$$Pb^{2+} + 2\ Cl^- \Rightarrow \downarrow PbCl_2$$

The precipitate of lead chloride (II) is formed. Add 2 cm^3 of distilled water to the test tube and heat until the precipitate is dissolved. After cooling, observe the formed crystals.

Cl^- ions, added to the solutions containing Pb^{2+} ions, cause the precipitation of white, crystalline lead chloride (II), which quickly settle on the test tube bottom.

This precipitate dissolves after heating in the test tube, and after cooling it reprecipitates in the form of needle-like crystals.

Test with heating silver and lead chlorides is important because it is used to easily distinguish AgCl from $PbCl_2$ (AgCl is insoluble in hot water).

b. Test with chromate

Add 0.5 $cm^3$of 0.1 mol/dm^3 K_2CrO_4 to 0.5 cm^3 of Pb^{2+} solution. After a few minutes, examine the formed precipitate.

$$Pb^{2+} + CrO_4^{2-} \Rightarrow \downarrow PbCrO_4$$

Potassium chromates($K_2CrO_4$and $K_2Cr_2O_7$), added to the solutions containingPb^{2+} ions, causes the precipitation of yellow lead chromates (II).

Task 7

The aim of the task is to detect Ba^{2+} (barium) ions

Execution

a. Test with SO_4^{2-} (sulphate) ions

Add 0.5 cm^3 of 0.1 mol/dm^3 H_2SO_4 to 0.5 cm^3 of Ba^{2+} solution. Reaction:

$$Ba^{2+} + SO_4^{2-} \Rightarrow \downarrow BaSO_4$$

Sulphuric acid (VI) causes the precipitation of white $BaSO_4$, which is insoluble in water.

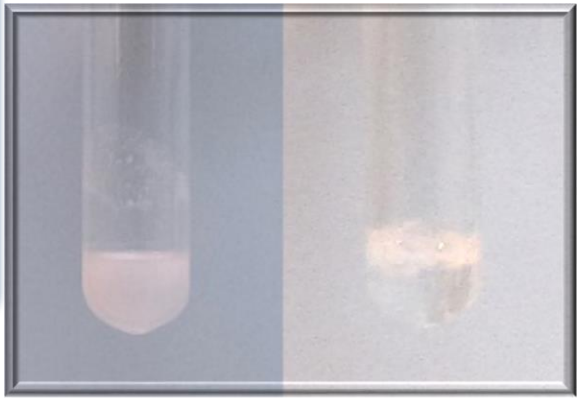
b. Test with CO_3^{2-} (carbonate) ions

Add 0.5 cm^3 of 0.2 mol/dm^3 Na_2CO_3 to 0.5 cm^3 of Ba^{2+} solution. After the precipitation of $BaCO_3$, add 1 cm^3 of concentrated CH_3COOH.

Reactions:

$$Ba^{2+} + CO_3^{2-} \Rightarrow \downarrow BaCO_3$$

$$BaCO_3 + 2\ CH_3COOH \Rightarrow Ba(CH_3COO)_2 + CO_2 + H_2O$$



Carbonate ions, added to the solutions containing Ba^{2+} ions, cause the precipitation of white barium carbonate (II), which is easily soluble in acetic acid. If the precipitate is not dissolved, you can add 1 cm^3 of CH_3COOH more.

Task 8

The aim of the task is to detect Cl^- (chloride) ions

Execution

a. Test with Ag^+ (silver) ions

Add drop by drop about 0.5 cm^3 of 0.1 mol/dm^3 $AgNO_3$ to 0.5 cm^3 of Cl^- solution. Dissolve the resulting precipitate adding 2 mol/dm^3 $NH_3 \cdot H_2O$ drop by drop. Then add several drops of concentrated HNO_3 in order to cause the reprecipitation of AgCl.

Reactions:

$$Ag^+ + Cl^- \Rightarrow \downarrow AgCl$$

$$AgCl + 2NH_3 \cdot H_2O \Rightarrow [Ag(NH_3)_2]Cl + 2H_2O$$

$$[Ag(NH_3)_2]Cl + 2\ H_3O^+ + 2NO_3^- \Rightarrow \downarrow AgCl + 2NH_4NO_3$$

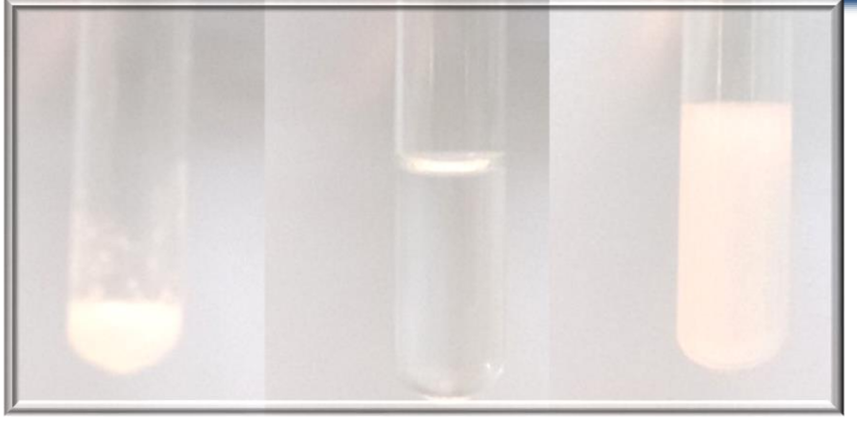
b. Test with potassium premanganate

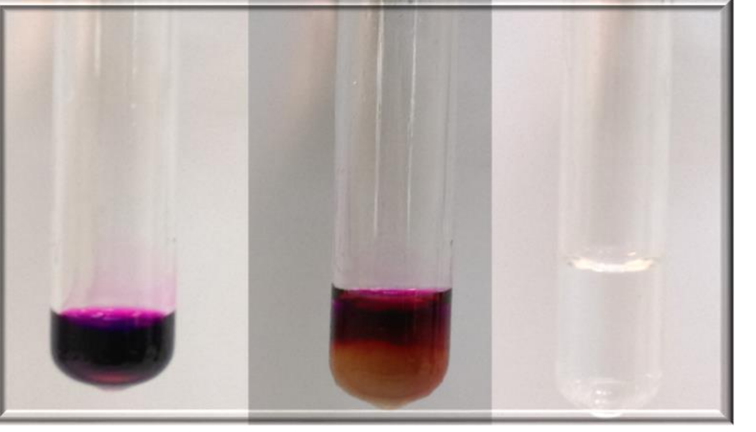
Add 0.5 cm^3 of 0.1 mol/dm^3 $KMnO_4$ and several drops of concentrated H_2SO_4 to 0.5 cm^3 of Cl^- solution.

Reaction:

$$10Cl^- + 2MnO_4^- + 16H^+ \Rightarrow 5Cl_2 + 2Mn^{2+}\ 8H_2O$$

Potassium permanganate, as strong oxidant, is reduced in acid environment (the solution becomes discoloured), while Cl^-, as weak reducer, escapes in the form of gas with a characteristic odour.





Task 9

The aim of the task is to detect CO_3^{2-} ions

Execution

a. Test with strong acid

Add drop by drop 2 mol/dm^3 H_2SO_4 to0.5 cm^3 of CO_3^{2-} solution. Observe the course of reaction.

$$CO_3^{2-} + 2\ H_3O^+ \Rightarrow H_2CO_3 + 2H_2O \Rightarrow 3H_2O + \uparrow CO_2$$

b. Test with Ba^{2+} ions

Add 0.5 cm^{3}of 0.1 mol/dm^3 $BaCl_2$ to 0.5 cm^3 of CO_3^{2-} solution. Reaction:

$$Ba^{2+} + CO_3^{2-} \Rightarrow \downarrow BaCO_3$$

White precipitate of barium carbonate is soluble in acetic, nitric and hydrochloric acids, and insoluble in sulphuric acid.

Task 10

The aim of the task is to detect PO_4^{3-} ions

Execution

Add 5 drops of concentrated HNO_3 and 0.5 cm^3 of $(NH_4)_2MoO_4$ to 0.5 cm^3 of PO_4^{3-} solution. Heat the test tube over a burner.

Reaction:

$$Na_2HPO_4 + 12(NH_4)_2MoO_4 + 23\ HNO_3 \Rightarrow (NH_4)_3P(Mo_3O_{10})_4 + 21\ NH_4NO_3 + 2\ NaNO_3 + 12\ H_2O$$

Task 11

The aim of the task is to detect SO_4^{2-} ions

Execution

a. Test with Pb^{2+} (lead) ions

Add 0.5 cm^3 of 2 mol/dm^3 $Pb(CH_3COO)_2$ to 0.5 cm^3 of SO_4^{2-} solution. Reaction:

$$SO_4^{2-} + Pb^{2+} \Rightarrow \downarrow PbSO_4$$

The resulting white precipitate of $PbSO_4$ is insoluble in inorganic acids, except concentrated sulphuric acid (VI), and it is also insoluble in concentrated NaOH and KOH.

b. Test with Ba^{2+} (barium) ions

Add 0.5 cm^3 of 1 mol/dm^3 barium chloride ($BaCl_2$) to 0.5 cm^3 of SO_4^{2-} solution. Reaction:

$$SO_4^{2-} + Ba^{2+} \Rightarrow \downarrow BaSO_4$$

The resulting white precipitate of $BaSO_4$ is insoluble in HCl and HNO_3 event after heating, while it is soluble in concentrated H_2SO_4.

Task 12

The aim of the task is to detect $C_2O_4^{2-}$ ions

Execution

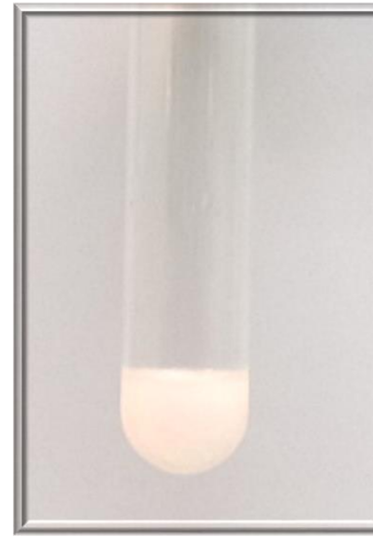
a. Test with $CaCl_2$

Add drop by drop 0.5 $cm^3$of 1 mol/dm^3 $CaCl_2$ to0.5 $cm^3$of $C_2O_4^{2-}$ solution.

Reaction:

$$Ca^{2+} + C_2O_4^{2-} \Rightarrow \downarrow CaC_2O_4$$

Calcium chloride causes the precipitation of white crystalline precipitate, which is soluble in mineral acids, and insoluble in acetic acid.



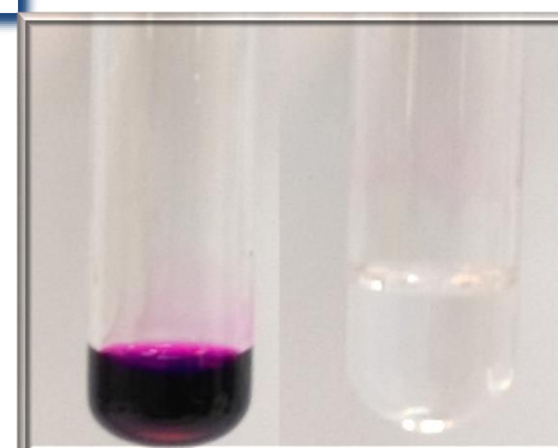
b. Test with potassium premanganate

Add 0.5 $cm^3$of 0.1 mol/dm^3 $KMnO_4$ and 0.5 $cm^3$of concentrated H_2SO_4 to 0.5 cm^3 of $C_2O_4^{2-}$ solution.

Reaction:

$$2MnO_4^{2-} + 5C_2O_4^{2-} + 16H^{+} \Rightarrow 10CO_2 + 2Mn^{2+} \quad 8H_2O$$

Potassium permanganate becomes discoloured in acid solution containing oxalate ions ($C_2O_4^{2-}$). Characteristic bubbles of CO_2 are formed during this reaction.



Disinfection (decontamination)

Disinfection is a process that is designed to kill actively growing and vegetative microbial microorganisms to prevent infection.

Disinfectants - chemical substances that destroy (kill) all microorganisms and their spore forms, also preventing the reproduction of microorganisms. Aseptic conditions can be achieved with disinfectants.

There are two synonymous terms that should be distinguished: **antiseptics and aseptics.**

Disinfection (decontamination)

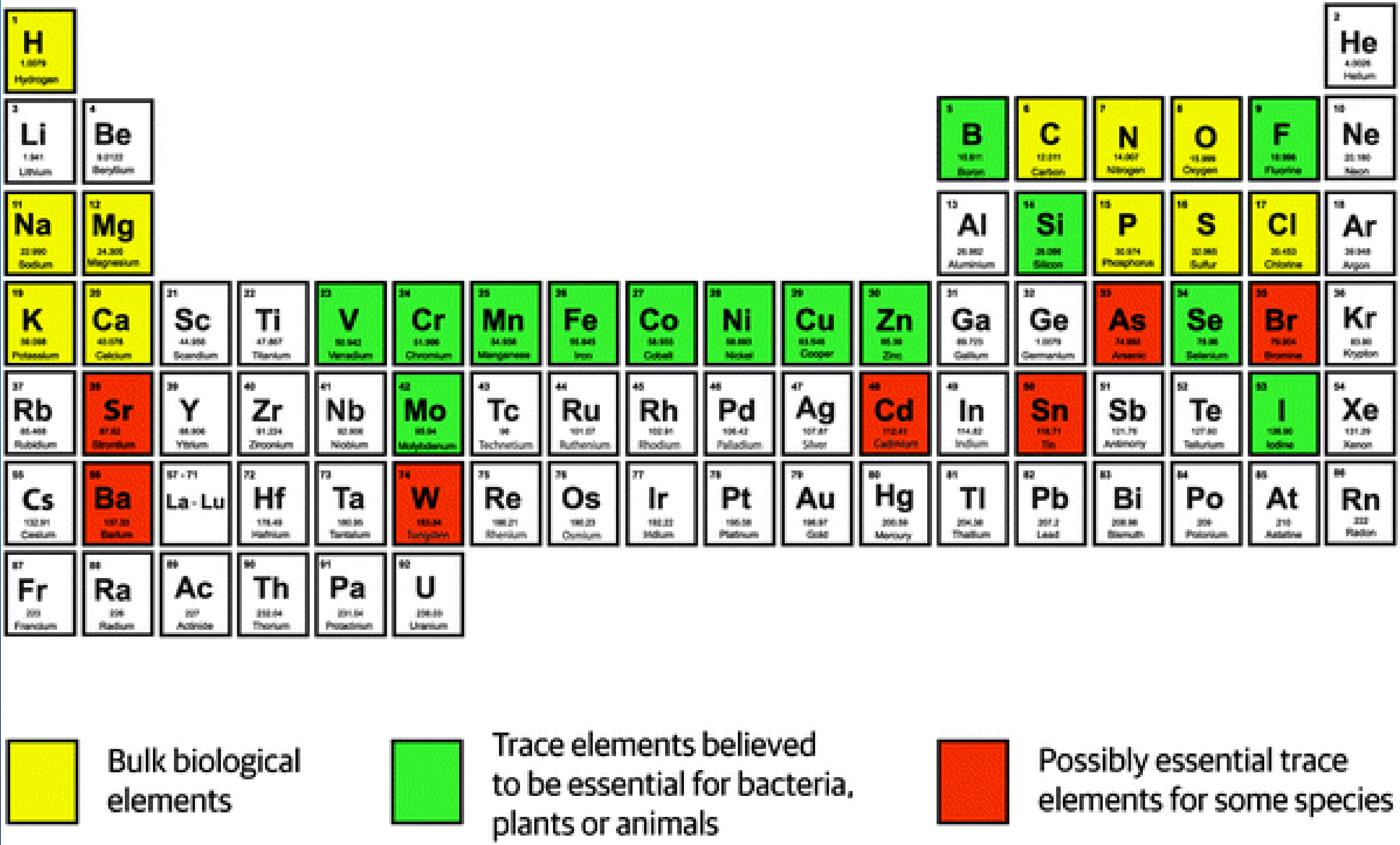
- **Antiseptics** are the destruction of microbes on tissues with antiseptics substances

- **Aseptics** are all proceedings preventing infection with pathogenic microorganisms.

Physical and chemical methods are used in aseptics. Aseptic conditions are an environment devoid of any pathogenic life forms.

Disinfection (decontamination)

- **Antiseptic preparations** includes substances used to disinfect tissues and prevent infections on the surface of the skin and mucous membranes.
- **Antiseptics** is any chemical compound (or element, e.g. fluorine, ozone, chlorine) that destroys microorganisms and prevents their reproduction.
- disinfectants these are substances used to disinfect rooms, objects (instruments, sanitary equipment, furniture, walls, floors), or fragments of the natural environment (e.g. soil, watercourses)


H He
Li Be B C N O F Ne
Na Mg Al Si P S Cl Ar
K Ca Sc Ti V Cr Mn Fe Co Ni Cu Zn Ga Ge As Se Br Kr
Rb Sr Y Zr Nb Mo Tc Ru Rh Pd Ag Cd In Sn Sb Te I Xe
Cs Ba La - Lu Hf Ta W Re Os Ir Pt Au Hg Tl Pb Bi Po At Rn
Fr Ra Ac Th Pa U
Bulk biological elements
Trace elements believed to be essential for bacteria, plants or animals
Possibly essential trace elements for some species

Calcium (Ca)

- Calcium is an essential component of bone and cartilage
- Calcium is essential for the normal clotting of blood, by stimulating the release of thromboplastin from the blood platelets
- Calcium is an activator for several key enzymes, including pancreatic lipase, acid phosphatase, cholinesterase and succinic dehydrogenase
- Calcium stimulates muscle contraction (ie. promotes muscle tone and normal heart beat)
- Calcium, in conjunction with lipids, plays a key role in the regulation of the permeability of cell membranes
- Calcium occurs in the form of calcium phosphate in bones
- The ionic form of Ca^{2+} is present in extracellular fluids

Manganese

Potassium permanganate $KMnO_4$ belongs to the group of oxidizing antiseptics. Under the influence of organic compounds, e.g. proteins, it is reduced and releases oxygen that destroys bacteria, fungi and protozoa. It dissolves easily in water. Depending on the concentration, aqueous solutions are pink or dark purple.

- It works astringent, anti-inflammatory, anti-inflammatory, bactericidal, bacteriostatic,fungicidal, fungistatic, antiviral and antiprotozoal.
- Concentrated solutions are coloring and corrosive on the skin. Under the influence of body secretions and enzymes, it gradually turns into manganese dioxide MnO_2
- Potassium permanganate neutralizesvenoms invertebrates and vertebrates.
- In antiseptics are used

0.5-4% solutions. They are used fordecontaminating wounds and burns.

Iodine

Iodine It is very hard soluble in water, easily soluble in alcohols and acetone.

Easily soluble in aqueous potassium iodide solution

iodine has antiseptic properties is used to disinfect intact skin. It has bactericidal, fungicidal and virucidal effect, irritates tissues, causes surface necrosis (necrosis) of smeared tissue.

Iodine is used in the form of a 3-10% solution in 70% or 95% ethyl alcohol. Iodine reacts with the amino groups of proteins, inhibiting their activity. It also releases oxygen from aqueous solutions, which complements the sanitizing effect.

- To disinfect the skin - wash with iodine or Lugol's solution. Do not apply undiluted directly to wounds and burns. Undiluted, it is suitable for disinfecting only around wounds, burns and intact skin.

Iodine

- Iodine is an essential constituent of the thyroid hormones
- Iodine does not accumulate in the body, therefore it must be constantly supplied with the diet
- Iodine deficiency causes hypothyroidism, which has serious metabolic consequences leading to a slowing of vital functions and all cellular changes.

Factors affecting the effectiveness of biocidal preparations

- contact time of the preparation with microorganisms (+++)
- concentration of the preparation(++)
- temperature (++)
- water hardness and environmental pH(+/-)
- number of microorganisms(--)
- protein load (large amount of organic substance in the environment: food residues, feces)(--)
- the presence of surfactants.(++)

Of the factors outlined above, the duration and concentration of the preparation are undoubtedly the most important