

**MINISTRY OF PUBLIC HEALTH OF UKRAINE
NATIONAL UNIVERSITY OF PHARMACY**

Educational degree master Training area 22 – PUBLIC HEALTH
(level of educational degree) (code number and title of training area)
 Speciality 226 – PHARMACY, INDUSTRIAL PHARMACY Educational program PHARMACY (ФМ(5,0)англ)
(code number and title of speciality) (title of educational program)
 Semester autumn semester, 2019/2020 academic year Subject ANALYTICAL CHEMISTRY
(title of academic subject)

**FINAL MODULE CONTROL
MODULE 1. QUALITATIVE ANALYSIS. BASIC OF QUANTITATIVE ANALYSIS**

QUESTION CARD (EXAMPLE)

1. Carry out qualitative analysis of the certain salt. Write the equations of the reactions of cation and anion detection and reactions of cation and anion with the respective group reagents; specify the conditions of their carrying out.
2. Carry out determination of KHCO_3 ($M(\text{KHCO}_3) = 100.115 \text{ g/mole}$) by the method of acid-base titration (the pipetting method). Write the equation of reaction. Calculate the stoichiometrical ratio s and the factor of equivalence f for the substance to be determined. Calculate the sample mass of the substance to be determined, which is necessary for reliable determination carrying out, in two ways – according to the molar mass of equivalent and according to the molar mass ($c(\text{HCl}) = 0.1 \text{ mole/dm}^3$, $\omega(\text{KHCO}_3) \approx 90\%$, $V_{m.f} = 200.00 \text{ cm}^3$, $V_p = 10.00 \text{ cm}^3$).
3. Carry out determination of NaOH ($M(\text{NaOH}) = 39.9971 \text{ g/mole}$) by the method of acid-base titration (the method of separate samples). Write the equation of reaction. Calculate the stoichiometrical ratio s and the factor of equivalence f for the substance to be determined. Calculate the percentage of the substance to be determined in three ways – according to the molar mass of equivalent, according to the molar mass and according to the titre of the titrant by the substances to be determined ($c(\text{HCl}) = 0.1005 \text{ mole/dm}^3$, $V(\text{HCl}) = 20.56 \text{ cm}^3$, $m(\text{NaOH}) = 0.1234 \text{ g}$).
4. Answer the tests.

POINTS DISTRIBUTION

question 1	10 points
question 2	8 points
question 3	12 points
question 4	10 points
in all	40 points

Estimation scale: national and ECTS

Points in all	ECTS mark	Mark by national scale
36 – 40	A	5
34 – 35	B	4
30 – 33	C	
26 – 29	D	3
24 – 25	E	
0 – 23	F	2

It has been approved at the meeting of the Analytical Chemistry Department.
The minutes №1 from 29. 08. 2019 year.

Head of the Analytical Chemistry Department, prof. _____

(sign)

I. S. Grytsenko

Examiner, as. prof. _____

(sign)

O. Ye. Mykytenko

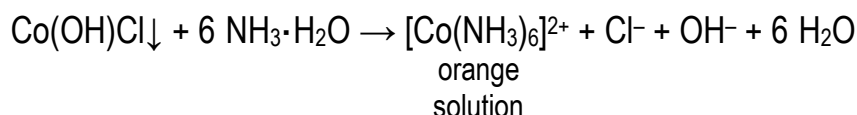
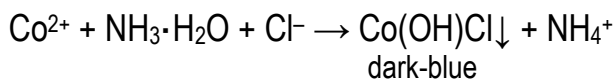
performed by as. prof. Klimenko L. Yu., as. prof. Mykytenko O. Ye., as. prof. Kostina T. A.

FINAL CONTROL №1

1. Carry out qualitative analysis of CoCl_2 . Write the equations of the reactions of cation and anion detection and reactions of cation and anion with the respective group reagents; specify the conditions of their carrying out.

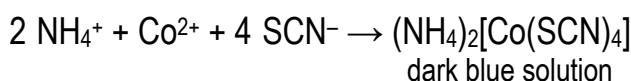


1. Action of the group reagent for Co^{2+} -cations – ammonia solution:

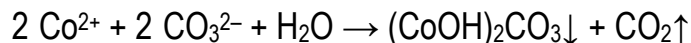


2. Identification of Co^{2+} -cations:

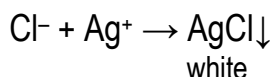
- 2.1. Action of ammonium thiocyanate solution:



3. Soda extraction:

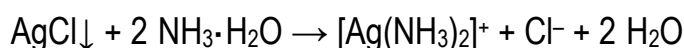
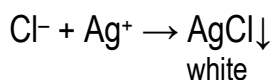


4. Action of the group reagent for Cl^- -anions – silver nitrate solution:



5. Identification of Cl^- -anions:

- 5.1. Formation of AgCl caseous precipitate and its dissolution in $\text{NH}_3 \cdot \text{H}_2\text{O}$:



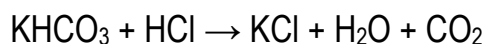
- 5.2. Action of potassium dichromate:

The reaction is carried out in a dry way. Chloride-ions interact with $\text{K}_2\text{Cr}_2\text{O}_7$ in the presence of H_2SO_4 and form the volatile substance CrO_2Cl_2 :



Gaseous CrO_2Cl_2 is identified by appearance of a red-violet colour of filter paper impregnated with diphenylcarbazide solution.

2. Carry out determination of KHCO_3 ($M(\text{KHCO}_3) = 100.115 \text{ g/mole}$) by the method of acid-base titration (the pipetting method). Write the equation of reaction. Calculate the stoichiometrical ratio s and the factor of equivalence f for the substance to be determined. Calculate the sample mass of the substance to be determined, which is necessary for reliable determination carrying out, in two ways – according to the molar mass of equivalent and according to the molar mass ($c(\text{HCl}) = 0.1 \text{ mole/dm}^3$, $\omega(\text{KHCO}_3) \approx 90\%$, $V_{m.f} = 200.00 \text{ cm}^3$, $V_p = 10.00 \text{ cm}^3$).



indicator – methyl orange

$$s = 1; f(\text{KHCO}_3) = 1; f(\text{HCl}) = 1;$$

$$E(\text{KHCO}_3) = M(\text{KHCO}_3) \cdot f(\text{KHCO}_3) = 100.115 \cdot 1 = 100.115 \text{ g/mole}$$

Given:

$$c(\text{HCl}) = 0.1 \text{ mole/dm}^3$$

$$V_{\text{min}}(\text{HCl}) = 20 \text{ cm}^3$$

$$\omega(\text{KHCO}_3) \approx 90\%$$

$$E(\text{KHCO}_3) = 100.115 \text{ g/mole}$$

$$M(\text{KHCO}_3) = 100.115 \text{ g/mole}$$

$$V_{m.f} = 200.00 \text{ cm}^3$$

$$V_p = 10.00 \text{ cm}^3$$

$$m(\text{KHCO}_3) - ?$$

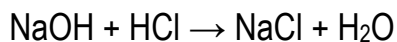
calculation of $m(\text{KHCO}_3)$ according to $E(\text{KHCO}_3)$

$$\begin{aligned} m(\text{KHCO}_3) &= \frac{c(\text{HCl}) \cdot V(\text{HCl}) \cdot E(\text{KHCO}_3) \cdot 100 \cdot V_{m.f}}{1000 \cdot \omega(\text{KHCO}_3) \cdot V_p} = \\ &= \frac{0,1 \cdot 20 \cdot 100.115 \cdot 100 \cdot 200.00}{1000 \cdot 90 \cdot 10.00} = 4.45 \text{ g} \end{aligned}$$

calculation of $m(\text{KHCO}_3)$ according to $M(\text{KHCO}_3)$ and s

$$\begin{aligned} m(\text{KHCO}_3) &= \frac{c(\text{HCl}) \cdot V(\text{HCl}) \cdot s \cdot M(\text{KHCO}_3) \cdot 100 \cdot V_{m.f}}{1000 \cdot \omega(\text{KHCO}_3) \cdot V_p} = \\ &= \frac{0,1 \cdot 20 \cdot 1 \cdot 100.115 \cdot 100 \cdot 200.00}{1000 \cdot 90 \cdot 10.00} = 4.45 \text{ g} \end{aligned}$$

3. Carry out determination of NaOH ($M(\text{NaOH}) = 39.9971 \text{ g/mole}$) by the method of acid-base titration (the method of separate samples). Write the equation of reaction. Calculate the stoichiometrical ratio s and the factor of equivalence f for the substance to be determined. Calculate the percentage of the substance to be determined in three ways – according to the molar mass of equivalent, according to the molar mass and according to the titre of the titrant by the substances to be determined ($c(\text{HCl}) = 0.1005 \text{ mole/dm}^3$, $V(\text{HCl}) = 20.56 \text{ cm}^3$, $m(\text{NaOH}) = 0.1234 \text{ g}$).



indicator – phenolphthalein

$$s = 1; f(\text{NaOH}) = 1; f(\text{HCl}) = 1;$$

$$E(\text{NaOH}) = M(\text{NaOH}) \cdot f(\text{NaOH}) = 39.9997 \cdot 1 = 39.9997 \text{ g/mole}$$

Given:

$$m(\text{NaOH}) = 0.1234 \text{ g}$$

$$c(\text{HCl}) = 0.1005 \text{ mole/dm}^3$$

$$V(\text{HCl}) = 20.56 \text{ cm}^3$$

$$E(\text{NaOH}) = 39.9997 \text{ g/mole}$$

$$M(\text{NaOH}) = 39.9997 \text{ g/mole}$$

$$\omega(\text{NaOH}) = ?$$

calculation of $\omega(\text{NaOH})$ according to $E(\text{NaOH})$

$$\begin{aligned} \omega(\text{NaOH}) &= \frac{c(\text{HCl}) \cdot V(\text{HCl}) \cdot E(\text{NaOH}) \cdot 100}{1000 \cdot m(\text{NaOH})} = \\ &= \frac{0.1005 \cdot 20.56 \cdot 39.9997 \cdot 100}{1000 \cdot 0.1234} = 65.15\% \end{aligned}$$

calculation of $\omega(\text{NaOH})$ according to $M(\text{NaOH})$ and s

$$\omega(\text{NaOH}) = \frac{c(\text{HCl}) \cdot V(\text{HCl}) \cdot s \cdot M(\text{NaOH}) \cdot 100}{1000 \cdot m(\text{NaOH})} = \frac{0.1005 \cdot 20.56 \cdot 1 \cdot 39.9997 \cdot 100}{1000 \cdot 0.1234} = 65.15\%$$

calculation of $\omega(\text{NaOH})$ according to $T(\text{HCl}/\text{NaOH})$

$$T(\text{HCl}/\text{NaOH}) = \frac{c(\text{HCl})_{\text{theor}} \cdot E(\text{NaOH})}{1000} = \frac{0.1000 \cdot 39.9997}{1000} = 0.004000 \text{ g/cm}^3$$

$$T(\text{HCl}/\text{NaOH}) = \frac{c(\text{HCl})_{\text{theor}} \cdot s \cdot M(\text{NaOH})}{1000} = \frac{0.1000 \cdot 1 \cdot 39.9997}{1000} = 0.004000 \text{ g/cm}^3$$

$$K(\text{HCl}) = \frac{c(\text{HCl})_{\text{pract}}}{c(\text{HCl})_{\text{theor}}} = \frac{0.1005}{0.1000} = 1.005$$

$$\omega(\text{NaOH}) = \frac{K(\text{HCl}) \cdot V(\text{HCl}) \cdot T(\text{HCl}/\text{NaOH}) \cdot 100}{m(\text{NaOH})} = \frac{1.005 \cdot 20.56 \cdot 0.004000 \cdot 100}{0.1234} = 65.15\%$$