

**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, 2018/2019 academic year Subject ANALYTICAL CHEMISTRY
(title of academic subject)

THEMATIC CONTROL №2

QUESTION CARD (EXAMPLE)

- Classify the certain anions according to the groups (the acid-base classification).
- Write the equations of reactions and specify the conditions for the certain anion detection.
- Calculate the mass of KOH, which should be taken to prepare 4 dm³ of 0.25 mole/dm³ solution.
- Calculate the volume of H₂SO₄ ($\rho = 1.110 \text{ g/cm}^3$), which should be taken to prepare 1 dm³ of the solution with $c(1/2\text{H}_2\text{SO}_4) = 0.1 \text{ mole/dm}^3$.
- Carry out standardization of HCl solution with the concentration of 0.05 mole/dm³ against the standard substance Na₂CO₃ ($M(\text{Na}_2\text{CO}_3) = 105.989 \text{ g/mole}$) by the method of separate samples (methyl orange is used as an indicator). Write the equation of reaction. Calculate the stoichiometrical ratio s , the factor of equivalence f for the standard substance and its molar mass of equivalent E . Calculate the sample mass of the standard substance, which is necessary for reliable determination carrying out, in two ways – according to the molar mass of equivalent and according to the molar mass.
- Answer the tests.

POINTS DISTRIBUTION

question 1	1 point
question 2	2 point
question 3	3 points
question 4	3 points
question 5	4 points
question 6	2 points
in all	15 points

Estimation scale: national and ECTS

Points in all	ECTS mark	Mark by national scale
13.5 – 15.0	A	5
12.3 – 13.4	B	4
11.1 – 12.2	C	
9.5 – 11.0	D	3
9.0 – 9.4	E	
0 – 9.0	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

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(sign)

O. Ye. Mykytenko

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

THEMATIC CONTROL №2

1. Classify the certain anions according to the groups (the acid-base classification).

CO_3^{2-} – Ist group

SO_3^{2-} – Ist group

S^{2-} – IInd group

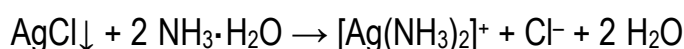
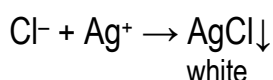
Cl^- – IInd group

NO_3^- – III^d group

2. Write the equations of reactions and specify the conditions for the certain anion detection.

Identification of Cl⁻-anions:

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



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.

3. Calculate the mass of KOH, which should be taken to prepare 4 dm³ of 0.25 mole/dm³ solution.

Given:

$$V(\text{KOH}) = 4 \text{ dm}^3$$

$$c(\text{KOH}) = 0.25 \text{ mole/dm}^3$$

$$E(\text{KOH}) = 56.1056 \text{ g/mole}$$

$$M(\text{KOH}) = 56.1056 \text{ g/mole}$$

$$m(\text{KOH}) = ?$$

$$m(\text{KOH}) = c(\text{KOH}) \cdot V(\text{KOH}) \cdot E(\text{KOH}) = 0.25 \cdot 4 \cdot 56.1056 = 56.10 \text{ g}$$

$$m(\text{KOH}) = c(\text{KOH}) \cdot V(\text{KOH}) \cdot M(\text{KOH}) = 0.25 \cdot 4 \cdot 56.1056 = 56.10 \text{ g}$$

4. Calculate the volume of H_2SO_4 ($\rho = 1.110 \text{ g/cm}^3$), which should be taken to prepare 1 dm³ of the solution with $c(1/2\text{H}_2\text{SO}_4) = 0.1 \text{ mole/dm}^3$.

Given:

$$V(\text{H}_2\text{SO}_4)_{\text{dil}} = 1 \text{ dm}^3 = 1000 \text{ cm}^3$$

$$c(1/2\text{H}_2\text{SO}_4)_{\text{dil}} = 0.1 \text{ mole/dm}^3$$

$$\rho(\text{H}_2\text{SO}_4)_{\text{conc}} = 1.110 \text{ g/cm}^3$$

$$V(\text{H}_2\text{SO}_4)_{\text{conc}} = ?$$

According to Supplement 2

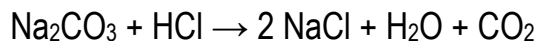
$$c(\text{H}_2\text{SO}_4)_{\text{conc}} = 1.820 \text{ mole/dm}^3, \text{ it corresponds to } \rho = 1.110 \text{ g/cm}^3$$

$$c(\text{H}_2\text{SO}_4)_{\text{dil}} = c(1/2\text{H}_2\text{SO}_4)_{\text{dil}} \cdot f(\text{H}_2\text{SO}_4) = 0.1 \cdot 1/2 = 0.05 \text{ mole/dm}^3$$

$$c(1/2\text{H}_2\text{SO}_4)_{\text{dil}} \cdot V(\text{H}_2\text{SO}_4)_{\text{dil}} = c(1/2\text{H}_2\text{SO}_4)_{\text{conc}} \cdot V(\text{H}_2\text{SO}_4)_{\text{conc}}$$

$$V(\text{H}_2\text{SO}_4)_{\text{conc}} = \frac{c(\text{H}_2\text{SO}_4)_{\text{dil}} \cdot V(\text{H}_2\text{SO}_4)_{\text{dil}}}{c(\text{H}_2\text{SO}_4)_{\text{conc}}} = \frac{0.05 \cdot 1000}{1.820} = 27.5 \text{ cm}^3$$

5. Carry out standardization of HCl solution with the concentration of 0.05 mole/dm³ against the standard substance Na₂CO₃ ($M(\text{Na}_2\text{CO}_3) = 105.989$ g/mole) by the method of separate samples (methyl orange is used as an indicator). Write the equation of reaction. Calculate the stoichiometrical ratio s , the factor of equivalence f for the standard substance and its molar mass of equivalent E . Calculate the sample mass of the standard substance, which is necessary for reliable determination carrying out, in two ways – according to the molar mass of equivalent and according to the molar mass.



indicator – methyl orange

$$s = 1/2; f(\text{Na}_2\text{CO}_3) = 1/2; f(\text{HCl}) = 1;$$

$$E(\text{Na}_2\text{CO}_3) = M(\text{Na}_2\text{CO}_3) \cdot f(\text{Na}_2\text{CO}_3) = 105.989 \cdot 1/2 = 52.9942 \text{ g/mole}$$

Given:

$$c(\text{HCl}) = 0.05 \text{ mole/dm}^3$$

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

$$E(\text{Na}_2\text{CO}_3) = 52.9942 \text{ g/mole}$$

$$M(\text{Na}_2\text{CO}_3) = 105.989 \text{ g/mole}$$

$$m(\text{Na}_2\text{CO}_3) = ?$$

calculation of $m(\text{Na}_2\text{CO}_3)$ according to $E(\text{Na}_2\text{CO}_3)$

$$\begin{aligned} m(\text{Na}_2\text{CO}_3) &= \frac{c(\text{HCl}) \cdot V(\text{HCl}) \cdot E(\text{Na}_2\text{CO}_3)}{1000} = \\ &= \frac{0.05 \cdot 20 \cdot 52.9942}{1000} = 0.05 \text{ g} \end{aligned}$$

calculation of $m(\text{Na}_2\text{CO}_3)$ according to $M(\text{Na}_2\text{CO}_3)$ and s

$$\begin{aligned} m(\text{Na}_2\text{CO}_3) &= \frac{c(\text{HCl}) \cdot V(\text{HCl}) \cdot s \cdot M(\text{Na}_2\text{CO}_3)}{1000} = \\ &= \frac{0.05 \cdot 20 \cdot 1/2 \cdot 105.989}{1000} = 0.05 \text{ g} \end{aligned}$$