MINISTRY OF PUBLIC HEALTH OF UKRAINE
NATIONAL UNIVERSITY OF PHARMACY

Educational degree *master* (level of educational degree) Training area *22 – PUBLIC HEALTH* (code number and title of training area)

Speciality *226 – PHARMACY, INDUSTRIAL PHARMACY* (code number and title of speciality) Educational program *PHARMACY* (Фм(5,0)англ) (title of educational program)

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

THEMATIC CONTROL №2

QUESTION CARD (EXAMPLE)

1. **Classify the certain anions according to the groups (the acid-base classification).**
2. **Write the equations of reactions and specify the conditions for the certain anion detection.**
3. **Calculate the mass of KOH, which should be taken to prepare 4 dm^3 of 0.25 mole/dm^3 solution.**
4. **Calculate the volume of H_2SO_4 (ρ = 1.110 g/cm^3), which should be taken to prepare 1 dm^3 of the solution with $c(1/2H_2SO_4)$ = 0.1 mole/dm^3.**
5. **Carry out standardization of HCl solution with the concentration of 0.05 mole/dm^3 against the standard substance Na_2CO_3 ($M(Na_2CO_3)$ = 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.**
6. **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

Examiner, as. prof. _____ (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 $NH_3 \cdot H_2O$:

$$Cl^- + Ag^+ \rightarrow \underset{\text{white}}{AgCl\downarrow}$$

$$AgCl\downarrow + 2\ NH_3 \cdot H_2O \rightarrow [Ag(NH_3)_2]^+ + Cl^- + 2\ H_2O$$

2. Action of potassium dichromate:
The reaction is carried out in a dry way. Chloride-ions interact with $K_2Cr_2O_7$ in the presence of H_2SO_4 and form the volatile substance CrO_2Cl_2:

$$4\ CaCl_2 + K_2Cr_2O_7 + 3\ H_2SO_4 \rightarrow 2\ CrO_2Cl_2\uparrow + 2\ CaSO_4 + K_2SO_4 + 3\ H_2O$$

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 dm^3 of 0.25 mole/dm^3 solution.

Given:

$V(KOH) = 4$ dm^3
$c(KOH) = 0.25$ mole/dm^3
$E(KOH) = 56.1056$ g/mole
$M(KOH) = 56.1056$ g/mole
$m(KOH)$ – ?

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

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

4. Calculate the volume of H_2SO_4 (ρ = 1.110 g/cm^3), which should be taken to prepare 1 dm^3 of the solution with $c(1/2H_2SO_4)$ = 0.1 mole/dm^3.

Given:

$V(H_2SO_4)_{dil} = 1$ dm^3 = 1000 cm^3
$c(1/2H_2SO_4)_{dil} = 0.1$ mole/dm^3
$\rho(H_2SO_4)_{conc} = 1.110$ g/cm^3
$V(H_2SO_4)_{conc}$ – ?

According to *Supplement* 2
$c(H_2SO_4)_{conc} = 1.820$ mole/dm^3, it corresponds to $\rho = 1.110$ g/cm^3

$$c(H_2SO_4)_{dil} = c(1/2H_2SO_4)_{dil} \cdot f(H_2SO_4) = 0.1 \cdot 1/2 = 0.05 \text{ mole/dm}^3$$

$$c(1/2H_2SO_4)_{dil} \cdot V(H_2SO_4)_{dil} = c(1/2H_2SO_4)_{conc} \cdot V(H_2SO_4)_{conc}$$

$$V(H_2SO_4)_{conc} = \frac{c(H_2SO_4)_{dil} \cdot V(H_2SO_4)_{dil}}{c(H_2SO_4)_{conc}} = \frac{0.05 \cdot 1000}{1.820} = 27.5 \text{ cm}^3$$

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

5. Carry out standardization of HCl solution with the concentration of 0.05 mole/dm³ against the standard substance Na_2CO_3 ($M(Na_2CO_3)$ = 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.

$Na_2CO_3 + HCl \rightarrow 2\ NaCl + H_2O + CO_2$
indicator *– methyl orange*
$s = 1/2$; $f(Na_2CO_3) = 1/2$; $f(HCl) = 1$;
$E(Na_2CO_3) = M(Na_2CO_3) \cdot f(Na_2CO_3) = 105.989 \cdot 1/2 = 52.9942$ g/mole

Given:

$c(HCl) = 0.05$ mole/dm³
$V_{min}(HCl) = 20$ cm³
$E(Na_2CO_3) = 52.9942$ g/mole
$M(Na_2CO_3) = 105.989$ g/mole
$m(Na_2CO_3)$ – ?

calculation of $m(Na_2CO_3)$ according to $E(Na_2CO_3)$

$$m(Na_2CO_3) = \frac{c(HCl) \cdot V(HCl) \cdot E(Na_2CO_3)}{1000} =$$
$$= \frac{0.05 \cdot 20 \cdot 52.9942}{1000} = 0.05 \text{ g}$$

calculation of $m(Na_2CO_3)$ according to $M(Na_2CO_3)$ and *s*

$$m(Na_2CO_3) = \frac{c(HCl) \cdot V(HCl) \cdot s \cdot M(Na_2CO_3)}{1000} =$$
$$= \frac{0.05 \cdot 20 \cdot 1/2 \cdot 105.989}{1000} = 0.05 \text{ g}$$