**Topic 5: THE BUFFER SYSTEMS.**

**1. Actuality of the topic:** Buffer systems support the constancy of the reaction environment of biological fluids in living organisms. Buffer systems are widely used for the practical creation of an environment with a certain pH.

**2. Key questions of the theme:**

2.1. Determination of buffer system.

2.2. The main types of buffer system.

2.3. Basic equations of the buffer systems. Formula Henderson-Hasselbach”s.

2.4. The mechanism of action of buffer system.

2.5. Buffer capacity. Factors on which it depends.

2.6. Buffer systems of the human body.

2.7. The biological significance of buffer systems.

**3. Literature:**

3.1. Lecture material.

3.2. M.I. Ravitch-Scherbo, Vladimir Novikov. Physical and Colloid Chemistry, 1975, p.90-97.

**4. Standard test solution control.**

4.1. Calculating pH of buffer system.

**Task.** Calculate the pH of buffer system which consists of 100 ml of dilute acetic acid, C = 0,1 mol/l and 200 ml of sodium acetate C = 0,2 mol/l, Kd (acid) = 1,75·10-5.



4.2. Quantification of components for the preparation of buffer systems with a certain pH.

**Task.** Calculate the volume of sodium acetate C = 0,1 mol/l and the amount of acetic acid with C = 0,1 mol/l which must be mixed to prepare 3l of acetate buffer рH = 5,24 (Кd (acid) = =1,75·10-5).



Antilog of 0,48 is equal to 3. [V (salt)] / [V (acid)] = 3/1. So you need 3 parts of salt solution and one part acid solution for the preparation of buffer systems with pH = 5,24. The volume of salt is: 3000 · 3/4 = 2250ml, and acid 3000 1/4 = 750ml.

**5. Homework** (must be performed in the laboratory notebook):

**Task 1.** Calculate the pH of buffer solution that contains 3,6 ml of ammonium chloride solution C = 0,2 mol/l and 2,6 ml of ammonium hydroxide solution С = 0,1 mol/l (Кd(NH4OH)=1,8·10-5).

**Task 2.** Calculate the volume of acetic acid with C = 0,1 mol/l sodium acetate C = 0,1 mol/l which must be mixed to obtain 150 ml solution рН = 4,94. (Кd (СН3СООН) = 1,75·10-5).

**6. Laboratory work.**

***Experiment 1.* Preparation of buffer systems and the calculation of pH.**



Add one drop of universal indicator in 1 ml solution obtained. Determine the approximate pH of a color table and calculate the pH with the formula:



***Experiment 2.* Effect of acid and alkali on the pH of the buffer solution.**

Divide 9 ml of solution № 1 obtained in experiment № 1 equally into 3 tubes: in the first tube 3 drops of hydrochloric acid with C = 0,1 mol/l were added, the second - 3 drops of sodium hydroxide with C =0,1 mol/l. In each tube add 2 drops of methyl red indicator. Compare the color of the solution and draw conclusions.

Conclusion:

***Experiment 3.* Effect of dilution on the pH of the buffer solution.**

In 2 tubes evenly divide the solution number 2 obtained in experiment number 1. In the first tube to 2 ml of water. To each tube add 2 drops of methyl red indicator. Compare the color and draw conclusions.

Conclusion:

***Experiment 4.***

Prepare 10 ml of acetate buffer with a calculated pH 5,24 and determine its approximate pH (see reference 4.2.).

Conclusion: