

Topic 5.

SOLUTIONS: ACIDS, BASES, AND PH. ACID-BASE EQUILIBRIA IN BIOSYSTEMS. BUFFER SYSTEMS

Theoretical QUESTIONS for preparation:

1. Acids, bases and their properties

- a. Acid-base theories*
- b. Properties of acids and bases*
- c. Strength of acids and bases*

2. Overview of pH

- a. pH of strong acids and bases
- b. pH of weak acids and bases

3. Buffers and pH of buffers

pH-buffer systems in the blood

TASKS

1. Divide the list of substances into electrolytes and non-electrolytes: CaCl_2 , HCOOH , KOH , $\text{C}_6\text{H}_{12}\text{O}_6$, AgNO_3 , CH_4 , $\text{C}_2\text{H}_5\text{OH}$, $\text{C}_6\text{H}_5\text{NH}_2$.

| ELECTROLYTES | NON-ELECTROLYTES |
|---------------------|-------------------------|
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2. Divide the list of substances into strong and weak electrolytes: H_3PO_4 , H_3BO_3 , $\text{Ca}(\text{OH})_2$, $\text{C}_6\text{H}_5\text{COOH}$, HCN , NaOH , K_2CO_3 , HF , NH_4OH , HJ , NaHCO_3 .

| STRONG ELECTROLYTES | WEAK ELECTROLYTES |
|----------------------------|--------------------------|
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3. Calculate pH in 0.01 M HCl solution and pH in 0.001 M KOH solution.

GIVEN:

QUESTION: _____

FORMULA:

CALCULATIONS:

ANSWER: _____

4. Calculate pH in 0.1 M HNO_3 solution and pH in 0.0001 M NaOH solution.

GIVEN:

QUESTION: _____

FORMULA:

CALCULATIONS:

ANSWER: _____

5. Calculate pH in 0.005 M sulfuric acid (H_2SO_4) solution and 0.05 M barium hydroxide ($\text{Ba}(\text{OH})_2$) solution.

GIVEN:

QUESTION: _____

FORMULA:

CALCULATIONS:

ANSWER: _____

6. Calculate pH in 0.0005 M sulfuric acid (H_2SO_4) solution and 0.005 M calcium hydroxide ($\text{Ca}(\text{OH})_2$) solution.

GIVEN:

QUESTION: _____

FORMULA:

CALCULATIONS:

ANSWER: _____

7. Calculate pH in 0,1 M acetic acid solution and pH in 0,1 M ammonium hydroxide solution. $K_d(\text{CH}_3\text{COOH})=10^{-5}$, $K_d(\text{NH}_4\text{OH})=10^{-5}$.

GIVEN:

QUESTION: _____

FORMULA:

CALCULATIONS:

ANSWER: _____

Training exercises

1. Diabetes mellitus causes ketosis as a result of activated oxidation of fatty acids. What disorders of acid-base equilibrium may be caused by excessive accumulation of ketone bodies (acetoacetic acid, beta-hydroxybutyric acid and acetone) in blood? Why?
- a. Respiratory acidosis;
 - b. Metabolic alkalosis;
 - c. Any changes won't happen;
 - d. Metabolic acidosis;
 - e. Respiratory alkalosis.

2. An infant has apparent diarrhea resulting from improper feeding. One of the main diarrhea effects is plentiful excretion of sodium bicarbonate. What form of acid-base balance disorder is the case? Why?
- a. Respiratory alkalosis;
 - b. Metabolic alkalosis;
 - c. Respiratory acidosis;
 - d. Metabolic acidosis;
 - d. No disorders of acid-base balance will be observed.
3. Index of pH of the blood changed and became 7.3 in the patient with diabetes mellitus. Detecting of the components of what buffer system is used while diagnosing disorder of the acid-base equilibrium?
- a. Protein;
 - b. Phosphate;
 - c. Hemoglobin;
 - d. Oxyhemoglobin;
 - e. Bicarbonate.
4. Active physical work induces rise of concentration of carbonic acid in blood. This causes deepening and acceleration of respiration thus reducing concentration of carbonic acid and hydrogen ions in blood. This maintains the following process:
- a. Homeostasis;
 - b. Immunity;
 - c. Ontogenesis;
 - d. Orthobiosis;
 - e. Anabiosis.
5. A 30-year-old comatose patient with type I diabetes mellitus had been admitted to a hospital. Laboratory tests revealed hyperglycemia, ketonemia (high concentration of acetoacetic acid, beta-hydroxybutyric acid and acetone). What change will it cause upon the acid-base balance of this patient?

6. An emergency medical team evaluates an Olympic athlete and determines that she has alkalosis. What component of the carbonic-acid-bicarbonate buffer would the athlete be given to decrease the pH of the blood?
