Recitation 9 (Buffers)

Name: UGA ID:

Instructions:

- Please enter your first and last name as it appears on the eLC roster (do not use a nickname).
- Your UGA myID is a combination of letters and numbers (example: mine is wpe28548). **Do not use your 81x number.**
- If you do not have a printer, type your answers in the then upload the worksheet template to Gradescope by Wednesday, April 7 at 11:59 pm. Write your work on separate sheets of paper, convert to a PDF and upload to eLC.
- If you have a printer download the worksheet, convert it to a PDF and upload to Gradescope by Wednesday, April 7 at 11:59 pm. You do not need to upload anything to eLC.

1. A 1.00 L buffer solution is 0.250 M in HF and 0.250 M in NaF. Calculate the pH of the solution after the addition of 100.0 mL of 1.00 M HCl. The K_a for HF is 3.5×10^{-4}.

2. A 1.50 L buffer solution is 0.250 M in HF and 0.250 M in NaF. Calculate the pH of the solution after the addition of 0.0500 moles of solid NaOH. Assume no volume change upon the addition of base. The K_a for HF is 3.5×10^{-4}.

3. Define buffer capacity.

A. Buffer capacity is the amount of acid or base that can be added to a buffer without destroying its effectiveness.

B. Buffer capacity is the amount of acid that can be added until all of the base is used up.

C. Buffer capacity is the amount of base that can be added until all of the acid is used up.

D. Buffer capacity is the amount of acid that can be added until all of the acid is used up.

E. Buffer capacity is the amount of base that can be added until all of the base is used up.

4. The following pictures represent solutions that contain a weak acid HA and/or its potassium salt KA. Unshaded spheres represent H atoms and shaded spheres represent A^- ions. (K^+, H_3O^+, OH^-, and solvent H_2O molecules have been omitted for clarity.)

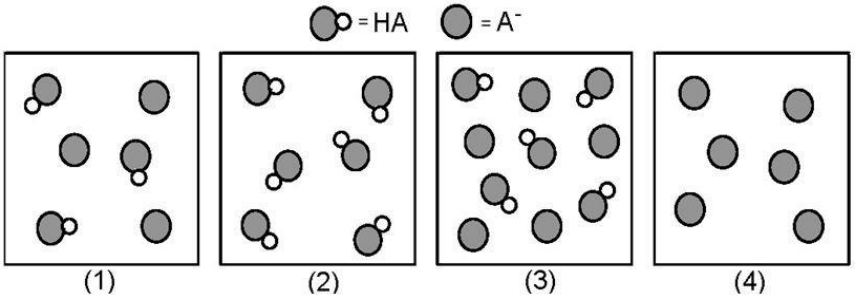
Which solution has the **highest** pH?

A. (1)

B. (2)

C. (3)

D. (4)



5. Identify all the correct statements about an acid–base buffer solution.

I. It can be prepared by combining a strong acid with a salt of its conjugate base.

II. It can be prepared by combining a weak acid with a salt of its conjugate base.

III. It can be prepared by combining a weak base with its conjugate acid.

IV. The pH of a buffer solution does not change when the solution is diluted.

V. A buffer solution resists changes in its pH when an acid or base is added to it.

A. I, II, and IV

B. I, II, IV, and V

C. II, III, and V

D. II, III, and IV

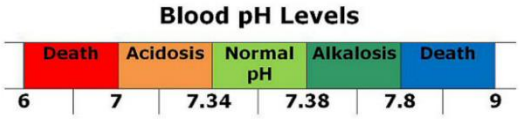
E. II, III, IV, and V

6. When placed in 1 L of water, which of the following combinations would give a buffer solution?

1. 0.5 mol HClO and 0.5 mol NaClO
2. 0.5 mol HBr and 0.5 mol NaF
3. 0.5 mol HBr and 1.0 mol NaF
4. 0.5 mol HBr and 1.0 mol NaOH

A. 1 only
B. 1 and 2 only
C. 1 and 3 only
D. 3 and 4 only
E. all would give buffer solutions

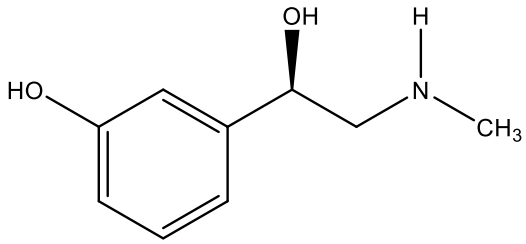
7. To simulate the pH of blood, which is 7.4, an undergraduate researcher in a biology lab produced a buffer solution by dissolving sodium dihydrogen phosphate (NaH_2PO_4, $K_a = 6.2 \times 10^{-8}$) and sodium hydrogen phosphate (Na_2HPO_4) together in an aqueous solution. What mole ratio of Na_2HPO_4/NaH_2PO_4 did she need to use?



8. What is the pH of a buffer solution where $[HA] = [A^-]$?

A. pH = 1
B. pH = pOH
C. pH = K_a
D. pH = 7.0
E. pH = pK_a

9. Phenylephrine (PE, see the structure below) is a nasal decongestant and is the active ingredient in Sudafed, which contains phenylephrine hydrochloride (PEHCl). This conjugate acid of phenylephrine (PEH^+) has a $pK_a = 5.5$. At a physiological pH of 7.4. what is the ratio of concentrations, $[PE]/[PEH^+]$?



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A. 6.7

B. 79

C. 0.01

D. 21

E. 0.14

10. Consider a solution initially containing 0.50 mol ammonia and 0.30 mol of ammonium ion. How many moles of ammonia and how many moles of ammonium ion are present after addition of 0.20 mol of HCl to this solution?

[ ] Mol NH_3

[ ] mol NH_4^+

11. Calculate the pH of a solution originally containing 0.20 mol of cyanic acid (HCNO) following addition of 80 mL of 1.00 M NaOH. (K_a of HCNO = 3.5×10^{-4}). The initial volume of the cyanic acid solution was 920 mL.

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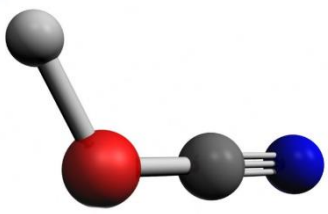

12. Consider a solution initially containing 0.300 mol of hydrofluoric acid. How many grams of NaF would be needed to set the pH = 3.00? (HF, $K_a = 7.2 \times 10^{-4}$)?

13. Which of the following acids (listed with Ka values) and their conjugate base would form a buffer with a pH of 2.34?

A. C_6H_5COOH, $K_a = 6.5 \times 10^{-5}$

B. HN_3, $K_a = 2.5 \times 10^{-5}$

C. HClO, $K_a = 2.9 \times 10^{-8}$

D. HF, $K_a = 3.5 \times 10^{-4}$

E. $HClO_2$, $K_a = 1.1 \times 10^{-2}$

14. Calculate the pH of a buffer that is 1.58 M HClO and 0.099 M NaClO. The K_a for HClO is 2.9×10^{-8}.