

Potentially Useful Information

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Questions

1. Carbonic acid (H₂CO₃) is a diprotic acid.

The K_as are as follows:

$$K_{a1} = 4.3 \times 10^{-7}$$

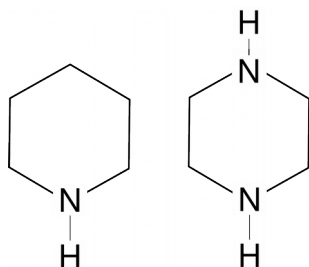
$$K_{a2} = 4.7 \times 10^{-11}$$

What is the pH of a 0.222 M solution of phosphoric acid?

- A. 6.37
- B. 7.92
- C. 3.57
- D. 2.46
- E. 6.53

2. Which of these compounds is the stronger base (the one more likely to become protonated?)

- A. Piperidine
- B. Piperazine
- C. They are the same.



piperidine

piperazine

3. Which of the following will produce an acidic solution in water?

- X. NH₄NO₃
- Y. NaCl
- Z. NaF

- A. X and Y
- B. X
- C. Y
- D. Z
- E. Y and Z

4. Which of the following will produce an basic solution in water?

- X. NH₄NO₃
- Y. NaCl
- Z. NaF

- A. X and Y
- B. X
- C. Y
- D. Z
- E. Y and Z

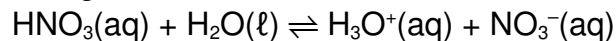
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5. Which of the following will produce an neutral solution in water?

- X. NH_4NO_3
- Y. NaCl
- Z. NaF

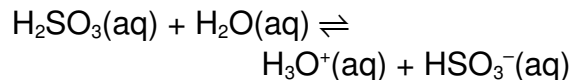
- A. X and Y
 - B. X
 - C. Y
 - D. Z
 - E. Y and Z
-

6. If you add 0.1 M NaNO_3 to 0.1 M HNO_3 (see the reaction below) will the pH change?



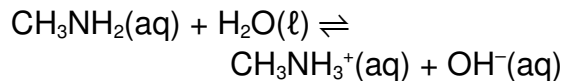
- A. No, because neither Na^+ or NO_3^- will change the pH.
 - B. No, because of Le Châtliers Principle.
 - C. Yes, because Na^+ will change the pH.
 - D. Yes, because of Le Châtliers Principle.
 - E. Yes, because NO_3^- will change the pH.
-

7. If you add 0.3 M NaHSO_3 to a solution of 0.1 M H_2SO_3 (see reaction), how will the pH change?



- A. It will stay the same.
 - B. It will go down.
 - C. It will go up.
-

8. Consider the acid base reaction below and choose the base-conjugate acid pair from the list.



- | | base | conjugate acid |
|----|--------------------------|----------------------------|
| A. | CH_3NH_2 | CH_3NH_3^+ |
| B. | CH_3NH_2 | OH^- |
| C. | H_2O | OH^- |
| D. | H_2O | CH_3NH_3^+ |
| E. | None of the above. | |
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CHEM 1412 MWF Spring 2016

Worksheet #25 – pH of Salts and the Common Ion Effect

Name _____

Team _____

pH of Salts and the Common Ion Effect

Why?

The addition of some salts to water causes a change in pH. Other salts don't cause a change in pH. Which salts cause changes to the pH and does the pH go up or down? How can you calculate the pH? What happens to the pH when you add a neutral salt, such as NaNO_2 to a dilute solution of HNO_2 ? Stay tuned.

Learning Objectives

Students should be able to:

- Predict whether a salt solution will be acidic or basic.
- Calculate the pH of salt solutions.
- Predict whether the addition of a salt to an acid-base equilibrium will cause the pH of a solution to increase or decrease.
- Calculate the pH of solutions in the presence of added salt.

Resources

Gilbert, 16.6 and 16.7

ChemTours

No ChemTours today.

Videos

[pH of Salts](https://vimeo.com/20873043)

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This video summarizes the basic pH effects of salts. 10:12 minutes.

[Calculation of the pH of 0.1 M Sulfuric Acid](https://www.youtube.com/watch?v=6exH6k9k60o)

<https://www.youtube.com/watch?v=6exH6k9k60o>

This video works out the problem presented in the book on p 797. 12:11 minutes

Prerequisites

Equilibrium, algebra, K_a , K_b , K_w , conjugate acid, and conjugate base.

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Vocabulary

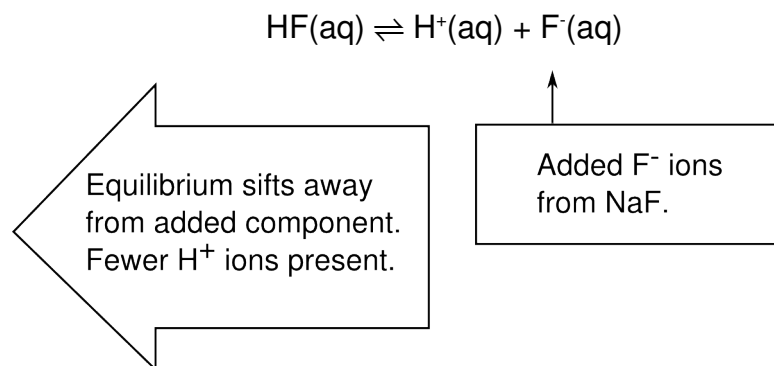
Common ion effect.

Focus Information

Common Ion Effect

Good news! If you have been paying attention, you already know this! The common ion effect is just Le Chatlier's principle! In the common ion effect, the addition of salts that have a common ion with a weak acid can change the pH. For instance, consider what happens when you add NaF to the reaction below.

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That was easy! By the way, when the $[\text{H}^{\text{+}}]$ goes down, the pH goes up.

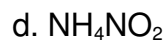
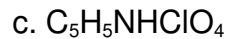
Key Questions

1. What is the pH of a 0.5 M solution of NaCl?

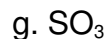
Answer _____

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2. Are solutions of the following salts acidic, basic or neutral? For acidic or basic solutions write the appropriate chemical equation.



Note NH_4^+ $\text{pK}_a = 9.25$, NO_2^- $\text{pK}_b = 10.85$



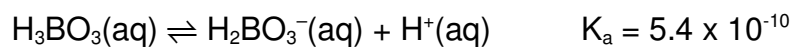
3. Arrange the following 0.10 M solutions in order of most acidic to most basic.

KOH , KNO_3 , KCN , NH_4Cl , HCl

Answer _____

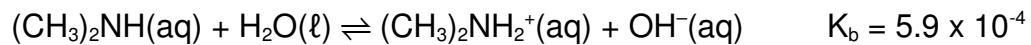
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4. a. What are K_b and pK_b for $H_2BO_3^-$?



$K_b =$ _____ $pK_b =$ _____

b. What are K_a and pK_a for $(CH_3)_2NH_2^+$?



$K_b =$ _____ $pK_b =$ _____

5. Calculate the pH of a 0.10 M solution of NaOCl. The pK_a of HOCl is 3.5×10^{-8} .

Answer _____

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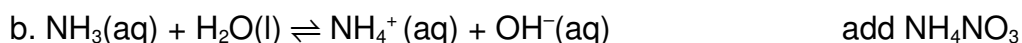
6. Calculate the pH of a 0.25 M solution of methylamine chloride ($\text{CH}_3\text{NH}_3\text{Cl}$) in water. The K_b for methylamine (CH_3NH_2) is 4.38×10^{-4} .

Answer _____

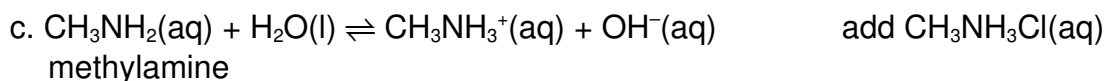
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7. For each case below indicate whether the equilibrium shifts to the right or to the left with the addition of the compound indicated and say whether the pH increases or decreases after you add the compound.



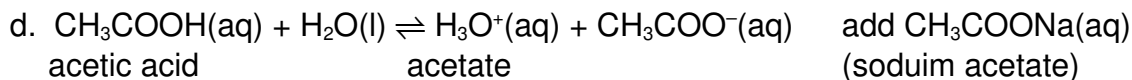
Reaction shifts _____ pH goes _____



Reaction shifts _____ pH goes _____



Reaction shifts _____ pH goes _____



Reaction shifts _____ pH goes _____

Worksheet 25

8. You make two solutions

Solution A = 0.1 M NH_4Cl

Solution B = 0.1 M $\text{NH}_4\text{Cl}(\text{aq})$ + 0.1 M $\text{NH}_3(\text{aq})$

a. Will solution A be acidic or basic?

Answer _____

b. Which solution will have the lower pH?

Answer _____

9. Calculate the pH of a solution containing 0.20 M $\text{HC}_2\text{H}_3\text{O}_2$ (acetic acid) K_a 1.8×10^{-5} and 0.50 M $\text{NaC}_2\text{H}_3\text{O}_2$ (sodium acetate).

Answer _____