

# Arrhenius Acids and Bases Regents Practice

- The electrical conductivity of an aqueous solution depends on the concentration of which particles in the solution?
  - molecules
  - electrons
  - atoms
  - ions
- Which compound is an electrolyte?
  - H<sub>2</sub>O
  - C<sub>2</sub>H<sub>6</sub>
  - H<sub>3</sub>PO<sub>4</sub>
  - CH<sub>3</sub>OH
- Which substance is an electrolyte?
  - O<sub>2</sub>
  - Xe
  - C<sub>3</sub>H<sub>8</sub>
  - KNO<sub>3</sub>
- Which two compounds are electrolytes?
  - KOH and CH<sub>3</sub>COOH
  - KOH and C<sub>5</sub>H<sub>12</sub>
  - CH<sub>3</sub>OH and CH<sub>3</sub>COOH
  - CH<sub>3</sub>OH and C<sub>5</sub>H<sub>12</sub>
- Which compound is an electrolyte?
  - CCl<sub>4</sub>
  - CH<sub>3</sub>OH
  - C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>
  - Ca(OH)<sub>2</sub>
- Which type of substance yields hydrogen ions, H<sup>+</sup>, in an aqueous solution?
  - an Arrhenius acid
  - an Arrhenius base
  - a saturated hydrocarbon
  - an unsaturated hydrocarbon
- Which substance yields H<sup>+</sup>(aq) as the only positive ion in an aqueous solution?
  - CH<sub>3</sub>CHO
  - CH<sub>3</sub>CH<sub>2</sub>OH
  - CH<sub>3</sub>COOH
  - CH<sub>3</sub>OCH<sub>3</sub>
- When dissolved in water, an Arrhenius base yields
  - hydrogen ions
  - hydronium ions
  - hydroxide ions
  - oxide ions
- Potassium hydroxide is classified as an Arrhenius base because KOH contains
  - OH<sup>-</sup> ions
  - O<sup>2-</sup> ions
  - K<sup>+</sup> ions
  - H<sup>+</sup> ions
- Which compound is an Arrhenius acid?
  - CaO
  - HCl
  - K<sub>2</sub>O
  - NH<sub>3</sub>

11. Explain, in terms of mobile ions, why HCl is an electrolyte.

when dissolved in water, HCl dissociates into  
mobile ions.

12. Which would have a greater conductivity, 0.1 M NaOH or 1.0 M NaOH? Explain in terms of mobile ions.

1.0 M NaOH has more mobile ions, so it would have  
a greater conductivity.

- Which statement describes characteristics of a 0.01 M KOH(aq) solution? *→ BASE*
  - The solution is acidic with a pH less than 7.
  - The solution is acidic with a pH greater than 7.
  - The solution is basic with a pH less than 7.
  - The solution is basic with a pH greater than 7.
- When the hydronium ion concentration of an aqueous solution is increased by a factor of 10, the pH value of the solution
  - decreases by 1
  - increases by 1
  - decreases by 10
  - increases by 10
- When the pH of an aqueous solution is changed from 1 to 2, the concentration of hydronium ions in the solution is
  - decreased by a factor of 2
  - decreased by a factor of 10
  - increased by a factor of 2
  - increased by a factor of 10
- When the pH of a solution is changed from 4 to 3, the hydronium ion concentration of the solution
  - decreases by a factor of 10
  - increases by a factor of 10
  - decreases by a factor of 100
  - increases by a factor of 100

- When the hydronium ion concentration of a solution is increased by a factor of 10, the pH value of the solution
  - decreases 1 pH unit
  - decreases 10 pH units
  - increases 1 pH unit
  - increases 10 pH units
- When the hydronium ion concentration of a solution is increased by a factor of 10, the pH value of the solution
  - decreases 1 pH unit
  - decreases 10 pH units
  - increases 1 pH unit
  - increases 10 pH units
- When the pH value of a solution is changed from 2 to 1, the concentration of hydronium ions
  - decreases by a factor of 2
  - increases by a factor of 2
  - decreases by a factor of 10
  - increases by a factor of 10

*Same exact question I know!*

8. Base your answer to the following question on the information below and on your knowledge of chemistry.

The pH of various aqueous solutions are shown in the table below.

pH of Various Aqueous Solutions

Aqueous Solution	pH
HCl(aq)	2
HC <sub>2</sub> H <sub>3</sub> O <sub>2</sub> (aq)	3
NaCl(aq)	7
NaOH(aq)	12

State how many times greater the hydronium ion concentration in the HCl(aq) is than the hydronium ion concentration in the HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>(aq).

*3* *H<sub>3</sub>O<sup>+</sup>* *2*  
*It is 10x greater.*

Base your answers to questions 9 and 10 on the information below.

Some carbonated beverages are made by forcing carbon dioxide gas into a beverage solution. When a bottle of one kind of carbonated beverage is first opened, the beverage has a pH value of 3.

- After the beverage bottle is left open for several hours, the hydronium ion concentration in the beverage solution decreases to  $\frac{1}{1000}$  of the original concentration. Determine the new pH of the beverage solution.

*↳ becomes more basic (1000 = 10 x 10 x 10) new pH = 6*

- State, in terms of the pH scale, why this beverage is classified as acidic.

*A pH lower than 7 is acidic.*

- What is the color of the indicator thymol blue in a solution that has a pH of 11?  
A) red      **B) blue**  
C) pink      D) yellow
- Phenolphthalein is pink in an aqueous solution having a pH of  
~~A) 5~~   ~~B) 2~~   ~~C) 7~~   **D) 12**
- Three samples of the same solution are tested, each with a different indicator. All three indicators, bromthymol blue, bromcresol green and thymol blue, appear blue if the pH of the solution is  
~~X) 4.7~~   ~~X) 6.0~~   ~~X) 7.8~~   **D) 9.9**

Base your answers to questions 7 and 8 on information below and your knowledge of chemistry.

A sample of nitric acid contains both  $\text{H}_3\text{O}^+$  ions and  $\text{NO}_3^-$  ions. This sample has a pH value of 1.

7. What is the color of methyl orange after it is added to this sample?  
**Red**

8. Write the name of the cation present in this sample.

$\downarrow$   
 $\oplus$  ion  
**hydronium (Table E)**

Base your answers to questions 4 and 5 on the information below and on your knowledge of chemistry.

The incomplete data table below shows the pH value of solutions A and B and the hydrogen ion concentration of solution A.

Hydrogen Ion and pH Data for HCl(aq) Solutions

HCl(aq) Solution	Hydrogen Ion Concentration (M)	pH
A	$1.0 \times 10^{-2}$	2.0
B	?	5.0

- Determine the hydrogen ion concentration of solution B.  **$1.0 \times 10^{-5}$**
- State the color of methyl orange in a sample of solution A. **red @ pH = 2**
- Base your answer to the following question on the information below and on your knowledge of chemistry.

The pH of various aqueous solutions are shown in the table below.

pH of Various Aqueous Solutions

Aqueous Solution	pH
HCl(aq)	2
$\text{HC}_2\text{H}_3\text{O}_2(\text{aq})$	3
NaCl(aq)	7
NaOH(aq)	12

Complete the table by writing the color of thymol blue in the NaCl(aq) and in the NaOH(aq) solutions.

	Aqueous Solution	Color of Thymol Blue
<b>pH 7</b>	NaCl(aq)	<b>yellow</b>
<b>pH 12</b>	NaOH(aq)	<b>blue</b>

1. One acid-base theory defines an acid as an

- ~~A) H<sup>-</sup> acceptor~~      ~~B) H<sup>-</sup> donor~~  
 C) H<sup>+</sup> acceptor      **D) H<sup>+</sup> donor**

2. According to one acid-base theory, NH<sub>3</sub> acts as a base when an NH<sub>3</sub> molecule

- A) accepts an H<sup>+</sup> ion**      ~~B) donates an H<sup>+</sup> ion~~  
~~C) accepts an OH<sup>-</sup> ion~~      ~~D) donates an OH<sup>-</sup> ion~~

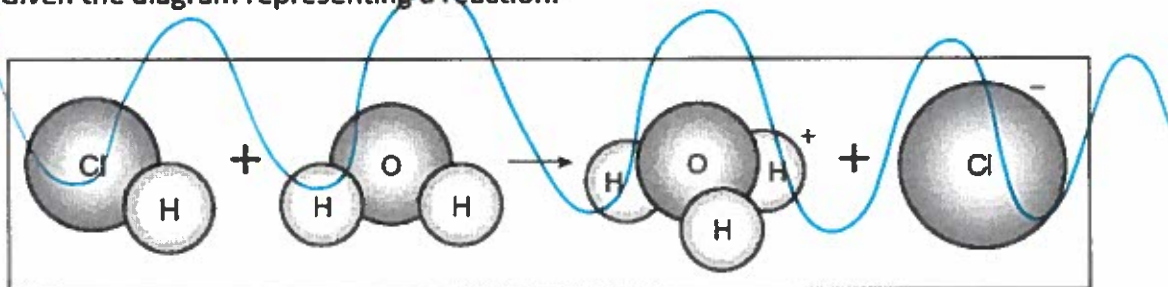
3. According to one acid-base theory, a base is an

- A) H<sup>+</sup> acceptor**      ~~B) H<sup>+</sup> donor~~  
~~C) Na<sup>+</sup> acceptor~~      ~~D) Na<sup>+</sup> donor~~

4. A substance that dissolves in water and produces hydronium ions as the only positive ions in the solution is classified as

- A) an alcohol      **B) an acid**  
 C) a base      D) a salt

5. Given the diagram representing a reaction:



6. Which compounds yield hydrogen ions as the only positive ions in an aqueous solution?

- A) H<sub>2</sub>CO<sub>3</sub> and HClO<sub>2</sub>**      ~~B) H<sub>2</sub>CO<sub>3</sub> and NaHCO<sub>3</sub>~~  
~~C) NH<sub>3</sub> and HClO<sub>2</sub>~~      ~~D) NH<sub>3</sub> and NaHCO<sub>3</sub>~~

ACIDS  
(Table K)

7. Given the balanced equation representing a reaction:



According to one acid-base theory, the H<sub>2</sub>O(l) molecules act as

- A) a base because they accept H<sup>+</sup> ions**      ~~B) a base because they donate H<sup>+</sup> ions~~  
 C) an acid because they accept H<sup>+</sup> ions      ~~D) an acid because they donate H<sup>+</sup> ions~~

H<sub>3</sub>O<sup>+</sup>

1. Which acid and base react to form water and sodium sulfate?



- A) sulfuric acid and sodium hydroxide  
 B) sulfuric acid and potassium hydroxide  
 C) sulfurous acid and sodium hydroxide  
 D) sulfurous acid and potassium hydroxide

2. What are the products when potassium hydroxide reacts with hydrochloric acid?



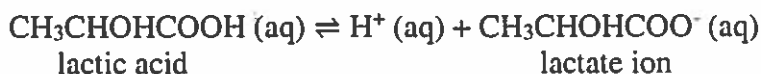
- A) KH(s), Cl<sup>+</sup>(aq), and OH<sup>-</sup>(aq)  
 B) K(s), Cl<sub>2</sub>(g), and H<sub>2</sub>O(l)  
 C) KCl(aq) and H<sub>2</sub>O(l)  
 D) KOH(aq) and Cl<sub>2</sub>(g)

3. Which solution reacts with LiOH(aq) to produce a salt and water?

- A) KCl(aq)                       B) CaO(aq)  
 C) NaOH(aq)                       D) H<sub>2</sub>SO<sub>4</sub>(aq) acid
- base

Base your answer to questions 4 and 5 on the information below and on your knowledge of chemistry.

A student makes an aqueous solution of lactic acid. The solution is placed in a sealed flask to be used in a laboratory investigation. The equation below represents the lactic acid equilibrium system in the flask.



4. Explain, in terms of Le Chatelier's principle, why increasing the concentration of H<sup>+</sup> (aq) increases the concentration of lactic acid.

Increasing a product such as H<sup>+</sup> will cause the equilibrium to shift left, producing more lactic acid.

5. Explain, in terms of the reaction rates, why the concentrations of the reactants and products remain constant in this system.

The reaction rates are equal!

Base your answers to questions 6 and 7 on the information below and on your knowledge of chemistry.

The gastric juice of the human stomach has a pH value of approximately 1.5. Hydrochloric acid in the gastric juice is necessary for the digestion process. However, excess hydrochloric acid may harm the stomach lining. One type of antacid uses Mg(OH)<sub>2</sub>(s) to neutralize excess hydrochloric acid in the stomach. This neutralization is represented by the incomplete equation below.



6. Describe the changes in both the hydrogen ion concentration and the pH of the gastric juice of a human after ingesting this type of antacid.

H<sup>+</sup> concentration decreases, and pH increases

7. Fill in the missing product in the equation.

1. In a titration, 20.0 milliliters of a 0.150 M NaOH(aq) solution exactly neutralizes 24.0 milliliters of an HCl(aq) solution. What is the concentration of the HCl(aq) solution?

$$(20) \times (0.150) = (24) \times$$

$$\frac{3}{24} = \frac{24 \times}{24}$$

- A) 0.125 M      B) 0.180 M      C) 0.250 M      D) 0.360 M

2. Which process is used to determine the concentration of an acid?

- A) chromatography      B) distillation  
C) electrolysis      D) titration

3. Which volume of 2.0 M NaOH(aq) is needed to completely neutralize 24 milliliters of 1.0 M HCl(aq)?

$$(1.0)(24) = (2.0)(x)$$

- A) 6.0 mL      B) 12 mL      C) 24 mL      D) 48 mL

4. What is the volume of 0.30 M NaOH(aq) needed to completely neutralize 15.0 milliliters of 0.80 M HCl(aq)?

$$(0.8)(15) = (0.3) \times$$

- A) 3.6 mL      B) 5.6 mL      C) 20. mL      D) 40. mL

Base your answers to questions 5 through 8 on the information below and on your knowledge of chemistry.

During a titration, 10.00 mL of acetic acid, HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>(aq), is completely neutralized by adding 12.50 mL of 0.64 M sodium hydroxide, NaOH(aq).

5. Explain why it is better to use data from multiple trials to determine the molarity of acetic acid, rather than data from a single trial.

Data from multiple trials will give more accurate results.

6. Determine the molarity of the acetic acid.

$$V_A = 10.00 \text{ mL} \quad M_A = x$$

$$V_B = 12.50 \text{ mL}$$

$$M_B = 0.64 \text{ M}$$

$$x(10.00) = (0.64)(12.50)$$

$$x = 0.80 \text{ M}$$

7. State the number of significant figures used to express the volume of the acetic acid.

4

8. Identify the only positive ion in the HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>(aq).

H<sup>+</sup>

Base your answers to questions 9 through 12 on the information below and on your knowledge of chemistry.

A company produces a colorless vinegar that is 5.0% HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> in water. Using thymol blue as an indicator, a student titrates a 15.0-milliliter sample of the vinegar with 43.1 milliliters of a 0.30 M NaOH (aq) solution until the acid is neutralized.

9. Determine the molarity of the HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> in the vinegar sample, using the titration data.

$$V_A = 15 \quad M_A = x$$

$$V_B = 43.1$$

$$M_B = 0.30$$

$$x(15) = (0.30)(43.1)$$

$$x = 0.86 \text{ M}$$

10. The concentration of the base used in this titration is expressed to what number of significant figures?

2

11. Identify the negative ion in the NaOH(aq) used in this titration.

OH<sup>-</sup> (hydroxide)

12. Based on Table M, what is the color of the indicator in the vinegar solution before any base is added?

yellow

acidic



1. The electrical conductivity of an aqueous solution depends on the concentration of which particles in the solution?

- A) molecules                      B) electrons  
C) atoms                            D) ions

2. Which compound is an electrolyte?

- A) H<sub>2</sub>O                                B) C<sub>2</sub>H<sub>6</sub>  
C) H<sub>3</sub>PO<sub>4</sub>                            D) CH<sub>3</sub>OH

3. Which substance is an electrolyte?

- A) O<sub>2</sub>    B) Xe    C) C<sub>3</sub>H<sub>8</sub>    D) KNO<sub>3</sub>

4. Which two compounds are electrolytes?

- A) KOH and CH<sub>3</sub>COOH    B) KOH and C<sub>5</sub>H<sub>12</sub>  
C) CH<sub>3</sub>OH and CH<sub>3</sub>COOH    D) CH<sub>3</sub>OH and C<sub>5</sub>H<sub>12</sub>

5. Which compound is an electrolyte?

- A) CH<sub>3</sub>CHO                        B) CH<sub>3</sub>OCH<sub>3</sub>  
C) CH<sub>3</sub>COOH                      D) CH<sub>3</sub>CH<sub>2</sub>CH<sub>3</sub>

6. Which substance is an electrolyte?

- A) C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>(s)                      B) C<sub>7</sub>H<sub>5</sub>OH(l)  
C) NaOH(s)                        D) H<sub>2</sub>(g)

7. Which compound is an electrolyte?

- A) CCl<sub>4</sub>                                B) CH<sub>3</sub>OH  
C) C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>                        D) Ca(OH)<sub>2</sub>

8. Which compound is an electrolyte?

- A) butene                            B) propane  
C) dimethyl ether                D) methanoic acid

9. Which compounds are classified as electrolytes?

- A) KNO<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub>            B) KNO<sub>3</sub> and CH<sub>3</sub>OH  
C) CH<sub>3</sub>OCH<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub>    D) CH<sub>3</sub>OCH<sub>3</sub> and CH<sub>3</sub>OH