Worksheet 29: Terms and definitions

Objective: By defining these words, you should become more familiar with acid – base related terms and their definitions.

Define, neatly and clearly, the following acid – base terms.

1. Arrhenius acid

2. Arrhenius base

3. Alternate acid theory

4. Alternate base theory

5. Hydrogen ion

6. Hydronium ion

7. Hydroxide ion

8. Acidity

9. Alkalinity

10. Electrolyte

11. Indicator

12. Neutralization

13. Salt

14. Titration

15. Hydrolysis
Worksheet 30: Properties of acids and bases

Set A: Properties of acids and bases

Objective: To test your knowledge of properties of acids, bases, and neutral solution

Write "acidic" or "basic" or "both acidic and basic" or "neutral" to indicate if the property describes a solution that is an acid, a base, both or neutral.

1. A solution has a pH greater than 7.

2. A solution turns the color of litmus to blue.

3. A solution has a higher concentration of \( H_2O^+ \) ions than \( OH^- \) ions.

4. A solution has a pH equal to 7.

5. A solution in which phenolphthalein stays colorless.

6. A solution changes color of indicators.

7. A solution is added to water, and the \( H^+ \) concentration of the water increases.

8. A solution changes phenolphthalein from colorless to pink.

9. A solution has a higher concentration of hydroxide ion than hydrogen ion.

10. A solution with equal number of \( H^+ \) ions to \( OH^- \) ions.

11. A solution contains electrolytes.

12. A solution increases the \( OH^- \) ion concentration of another solution.

13. A solution decreases the alkalinity of another solution.

14. A solution contains hydrogen ion as the only positive ion.

15. A solution in which bromthymol will be yellow.

16. A solution undergoes neutralization reaction.

17. A solution reacts with a metal to produce hydrogen gas.

18. A solution contains mobile ions that conducts electrical current.

19. A solution that can turn litmus red.

20. A substance donates a proton in a reaction.

21. A substance accepts a hydrogen ion in a reaction.
Worksheet 27: Set B: Types of solution

Objective: To test your ability to use the Reference Tables K and L

Test results for eight solutions are given below. In the space underneath each beaker, write "Table K" or "Table L" to indicate if the solution in the beaker is listed on Reference Table K or L.

22. [OH-] > [H+]
23. pH = 3.2
24. H₂ gas
25. Decreases alkalinity of another solution

26. Thymol blue
27. phenolphthalein
28. bromthymol blue
29. Litmus paper

Set C: Determining property based on formula

Objective: To test your ability to relate formula of a substance to properties.

Below, a solution is given in the left column. Three properties are listed in the right column. Put checks (✓) in [ ] next to those properties that best describe the solution given.

30. Ca(OH)₂(aq)
   [ ] This solution will have a pH of 10.
   [ ] This solution will turn litmus red
   [ ] This solution will turn litmus blue.

31. H₃PO₄(aq)
   [ ] Phenolphthalein will be pink in this solution
   [ ] Phenolphthalein will be colorless in this solution
   [ ] Concentration of H⁺ is less than that OH⁻ in this solution.

32. HF (aq)
   [ ] Concentration of H₃O⁺ is more than that of OH⁻ in this solution
   [ ] Bromthymol indicator is yellow in this solution
   [ ] This solution will increase the pH of water.

33. NH₃(aq)
   [ ] This solution will decrease the alkalinity of another solution.
   [ ] Litmus will be red.
   [ ] This solution will contain more hydroxide ion than hydrogen ion.

34. CH₃COOH(aq)
   [ ] This solution will conduct electrical current
   [ ] Thymol blue will change from yellow to blue in this solution
   [ ] This solution will react with Ti to produce hydrogen gas.
Worksheet 31: Reactions of acids and bases

Set A: Metal – acid reaction

Objective: To test your ability to determine which metal - acid reaction will occur, and be able to write a complete balanced equations.

Below, equation showing reaction of a metal with an acid is given.

If the reaction will occur, write the products (salt and hydrogen gas) formulas to the right of the arrow. Be sure to balance these equations.

If the reaction will not occur, write “no reaction” to the right of the arrow.

USE TABLE I

<table>
<thead>
<tr>
<th>Metal</th>
<th>Acid</th>
<th>Salt</th>
<th>+</th>
<th>Hydrogen gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ca</td>
<td>HCl</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Ag</td>
<td>HNO₃</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Li</td>
<td>H₃PO₄</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Mg</td>
<td>HC₂H₃O₂</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Zn</td>
<td>HCl</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Au</td>
<td>H₂SO₄</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Al</td>
<td>HNO₃</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Set B: Neutralization reaction

Objective: To test your ability to complete and balance neutralization reactions.

Below, incomplete neutralization equation are given.

Write the products of each reaction to the right of the arrow. Be sure to balance the equations.

<table>
<thead>
<tr>
<th>Acid</th>
<th>+</th>
<th>Base</th>
<th>Salt</th>
<th>+</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. HCl</td>
<td></td>
<td>KOH</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. HNO₃</td>
<td></td>
<td>NaOH</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. H₂SO₄</td>
<td></td>
<td>KOH</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. H₂CO₃</td>
<td></td>
<td>Ca(OH)₂</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. H₃PO₄</td>
<td></td>
<td>LiOH</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. HC₂H₃O₂</td>
<td></td>
<td>Ba(OH)₂</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Worksheet 32: Titration

Set A: Titration - Calculation of moles

Objective: To test your understanding of mole relation in titration (neutralization) problems.

For each titration problem, show set and calculate the unknown. Use the space to right to write equation, show set up and solve.

1. How many moles of KOH are needed to completely neutralize 0.5 L of 1.0 M HCl solution?

2. How many moles of HCl is needed to completely neutralize 1.5 L of a 0.3 M NaOH solution?

3. How many moles of sodium hydroxide is needed to neutralize 0.3 L of 0.1 M nitric acid solution?

4. How many moles of NaOH is needed to completely neutralize 0.1 L of 2 M H$_2$SO$_4$ solution.

5. What is the number of moles of H$_2$SO$_4$ that will react of neutralize 0.5 L of a 6 M KOH solution?

Set B: Titration - Calculation of molarity or volume

Objective: To test your ability to use titration equation to solve for unknown in neutralization problems.

For each titration problem, show set up and solve for the unknown. Use the space to the right to write equation, show set up and solve for the unknown.

6. How many milliliters of 2.5 M HCl are required to exactly neutralize 100 mL of 0.1 M NaOH solution?

7. How many milliliters of 3 M KOH solution is required to exactly neutralize 100 mL of 1.5 M HNO$_3$ solution?

8. What is the molarity of 50 ml HNO$_3$ solution if it takes 180 ml of 0.2 M KOH to neutralize it?

9. What is the molarity of 20 mL NaOH solution that is neutralized by a 5 ml of 0.1 M HCl solution

10. What is the molarity of 80 mL H$_2$SO$_4$ solution that is neutralized by 40 mL of 2 M NaOH solution?
Worksheet 33: Relating H+ concentration to pH

Set A: Relating H+ concentration to pH

Objective: To test your ability to relate concentration of H+ to pH of a solution

Determine the pH of the solutions given the [H+] or [H3O+] concentrations.

Given concentration of solutions

1. [H3O+] = 1.0 x 10^1 M
   pH =

2. [H+] = 1.0 x 10^4 M
   pH =

3. [H+] = 1.0 x 10^11 M
   pH =

4. [OH+] = 1.0 x 10^7 M
   pH =

5. [OH+] = 1.0 x 10^-2 M
   pH =

Determine the ion concentrations.

Given concentration of solutions

6. [H+] = 1.0 x 10^4
   [OH+] =

7. [H+] = 1.0 x 10^-11
   [OH+] =

8. [OH+] = 1.0 x 10^-1
   [H+] =

9. [OH+] = 1.0 x 10^-7
   [H3O+] =

Below, pH of two solutions are given. You are asked to compare H+ (hydrogen or hydronium ion) concentration of one solution to another. Follow the example comparison given below.

<table>
<thead>
<tr>
<th>Solution A</th>
<th>Solution B</th>
<th>Example comparisons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ex.</td>
<td>pH 6</td>
<td>pH 7</td>
</tr>
<tr>
<td></td>
<td>pH 8</td>
<td>pH 10</td>
</tr>
<tr>
<td></td>
<td>pH 13</td>
<td>pH 12</td>
</tr>
<tr>
<td></td>
<td>pH 5</td>
<td>pH 2</td>
</tr>
<tr>
<td></td>
<td>pH 7</td>
<td>pH 11</td>
</tr>
</tbody>
</table>

Solution A has 10 times more H+ than solution B
Solution B has 1/10th the H+ ions of Solution A
As solution A changes to Solution B, there is 10 fold decrease in H+ concentration
Worksheet 34: Naming and writing formulas of acids  

<table>
<thead>
<tr>
<th>Set A: Names and formulas of binary acids</th>
<th>Objective: To test your ability to write names and formulas to binary acids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write names for these binary acid formulas.</td>
<td>Write formulas for these binary acid names.</td>
</tr>
<tr>
<td>1. HBr</td>
<td>4. Hydroiodic acid</td>
</tr>
<tr>
<td>2. H₂S</td>
<td>5. Hydrotelluric acid</td>
</tr>
<tr>
<td>3. HF</td>
<td>6. Hydrochloric acid</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set B: Names and formulas of ternary acids</th>
<th>Objective: To test your ability to write names and formulas to ternary acids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write names for these ternary acid formulas.</td>
<td>Write formulas for these ternary acid names.</td>
</tr>
<tr>
<td>7. HClO₂</td>
<td>12. Sulfurous acid</td>
</tr>
<tr>
<td>8. H₂S₂O₃</td>
<td>13. Acetic acid</td>
</tr>
<tr>
<td>9. H₃PO₄</td>
<td>14. Nitric acid</td>
</tr>
<tr>
<td>10. HNO₂</td>
<td>15. Chloric acid</td>
</tr>
<tr>
<td>11. HClO₄</td>
<td>16. Hypochlorous acid</td>
</tr>
</tbody>
</table>