# Chemistry 20 Final Review

## Acids and Bases Checklist

Have you mastered the concepts, applications, and skills associated with the following items? Check them off when you are confident in your understanding.

**Knowledge**

- recall the empirical definitions of acidic, basic, and neutral solutions determined by using indicators, pH, and electrical conductivity
- calculate $H_3O^+(aq)$ and $OH^-(aq)$ concentrations, pH, and pOH of acid and base solutions based on logarithmic expressions
- use appropriate SI units to communicate the concentration of solutions and express pH and concentration to the correct number of significant digits
- compare magnitude changes in pH and pOH with changes in concentration for acids and bases
- explain how the use of indicators, pH meters or pH paper can be used to measure $[H_3O^+(aq)]$
- use the modified Arrhenius theory to define acids as substances that produce $H_3O^+(aq)$ in aqueous solutions and bases as substances that produce $OH^-(aq)$ in aqueous solutions, and recognize that the definitions are limited
- define neutralization as a reaction between hydronium and hydroxide ions
- differentiate between strong acids and bases and weak acids and bases, qualitatively, using the modified Arrhenius (reaction with water) theory and dissociation
- compare the reaction with water (ionization) of monoprotic with that of polyprotic acids and bases

**Key Terms**

| | | |
|---|---|---|
| hydronium ion | pH | pOH |
| acid–base indicator | acid (modified Arrhenius) | base (modified Arrhenius) |
| neutralization | strong acid | weak acid |
| strong base | weak base | monoprotic acid |
| polyprotic acid | monoprotic base | polyprotic base |

## Acid Base Titrations Checklist

Have you mastered the concepts, applications, and skills associated with the following items? Check them off when you are confident in your understanding.

**Knowledge**

- contrast quantitative and qualitative chemical analysis
- use the stoichiometric method to calculate quantities of substances in chemical reactions
- describe different designs for determining the concentration of a solution
- identify and calculate limiting and excess reagents in chemical reactions
- identify the equivalence point on a strong acid–strong base titration curve, and differentiate between an indicator endpoint and a reaction equivalence point
- describe the function and choice of indicators in acid–base titrations

**Key Terms**

| | | |
|---|---|---|
| gravimetric analysis | titration analysis | titration |
| titrant | sample | equivalence point |
| endpoint | standard solution | primary standard |

standardizing

**Acid Base Problems**

1. Give three properties of acids and bases each.

2. Define the following:
    a. Acid according to Arrhenius

    b. Base according to Arrhenius

    c. Acid according to Bronsted-Lowry

    d. Base according to Bronsted-Lowry

3. What is the difference between strong acids and weak acids?

4. What is the difference between strong bases and weak bases?

5. Why is an equilibrium arrow given in some of the dissociation equations for acids and bases?

6. Why is a straight arrow given in some of the ionization/dissociation equations for acids and bases?

7. What is the difference between a diluted acid and a concentrated acid?

8. Explain why the hydronium ($H_3O^+(aq)$) ion and the $H^+$ ion are interchangeable.

9. Write ionization equation for the following:
    a. Hydrochloric acid

    b. Boric acid

    c. Acetic acid

    d. Sulfurous acid

    e. Hydrosulfuric acid

    f. hydrocyanic acid

10. Label the acid, base, conjugate acid, & conjugate base in the following neutralization equations.
    a. Water reacting with the borate ion

    b. Hydronium ion reacting with sulfite ion

    c. Sodium hydroxide reacting with hydroiodic acid

    d. Water reacting with hydroxide ion

11. What is the rule for determining significant digits when **pH** is given?

12. Give the pH for the following hydrogen ion concentrations (don't forget significant digits rules):
    a. 0.02 mol/L
    b. 2.5 mol/L
    c. 0.0065 mol/L
    d. $9.67 \times 10^{-9}$ mol/L
    e. 0.0874 mol/L

13. Give the pH for the following hydroxide ion concentrations:
    a. 0.36 mol/L
    b. 0.559 mol/L
    c. $1.90 \times 10^{-5}$ mol/L
    d. 3.9 mol/L
    e. 0.004 mol/L

14. Give hydrogen ion concentrations for the following pH or pOH (don't forget significant digits rules):
    a. pH = 2.45
    b. pH = 6.550
    c. pOH = 2.990
    d. pOH = 7.0

e. pH = 8.35

15. Predict the pH of the solution made by dissolving 925 mg of nitric acid in enough water to make 850 mL. (1.763)

16. Predict the pH by combing 75.0 ml of hydroiodic acid with a pH of 4.50 and 175.0 ml of hydroiodic acid with a pH of 3.25. (3.39)

17. Predict the pH of the solution prepared by dissolving 3.589 grams of magnesium hydroxide in 1.50 liters of water (assume all the magnesium hydroxide dissolves). (12.914)

18. How much solvent will you have to add to 150 ml of perchloric acid that has a pH of 3.500 to change it to a pH of 4.000? (324 mL)

19. Use the following titration data to determine the concentration and pH of the sulfuric acid
Titration of 20.00 ml sample of $H_2SO_4$ (aq) with 0.550 mol/L of magnesium hydroxide (0.500)

| **Trial** | **1** | **2** | **3** | **4** |
|---|---|---|---|---|
| Initial Burette Reading (mL) | 52.6 | 38.6 | 27.1 | 15.7 |
| Final Burette Reading (mL) | 38.6 | 27.1 | 15.7 | 4.1 |
| Volume of Titration (mL) | | | | |

20. Estimate the mass of acetic acid that was neutralized with 25.6 ml at 0.850 mol/L with barium hydroxide (2.61 g)

21. What volume of 0.500 mol/L carbonic acid can be neutralized completely with 175 g of aluminum hydroxide? (6.72 L)