

Understanding the Periodic Table: A Study Guide Chemistry

Introduction to the Periodic Table

The Periodic Table of Elements is a systematic arrangement of all known chemical elements. Each element is organized by its atomic number, which is the number of protons in its nucleus. The table is divided into rows called periods and columns known as groups. Understanding the layout of the Periodic Table is crucial for predicting the properties and behaviors of elements.

Key Concepts

1. **Atomic Number:** The atomic number indicates the number of protons in an atom. Elements are arranged in increasing atomic numbers from left to right.
2. **Groups and Periods:**
 - **Groups:** Vertical columns in the Periodic Table. Elements in the same group often have similar properties and the same number of valence electrons.
 - **Periods:** Horizontal rows. As you move from left to right across a period, the number of protons and electrons increases.
3. **Classification of Elements:**
 - **Metals:** Typically conductive, malleable, and ductile. Found on the left side of the table.
 - **Nonmetals:** Generally poor conductors of heat and electricity. Located on the right side.
 - **Metalloids:** Exhibit properties of both metals and nonmetals. Found along the zig-zag line (stair-step line) on the table.

Properties of Elements

- **Valence Electrons:** The electrons in the outermost shell of an atom. They determine how an element interacts with others.
- **Ions:** Atoms that have gained or lost electrons. A positive ion (cation) is formed when an atom loses electrons, while a negative ion (anion) is formed when it gains electrons.
- **Malleability:** The ability of a substance to be hammered or pressed into thin sheets.

Groups of the Periodic Table

- **Group 1 (Alkali Metals):** Highly reactive metals with one valence electron.
- **Group 2 (Alkaline Earth Metals):** Reactive metals with two valence electrons.
- **Group 17 (Halogens):** Reactive nonmetals with seven valence electrons.
- **Group 18 (Noble Gases):** Unreactive gasses with a complete set of valence electrons.

Check Your Understanding:

Multiple Choice Questions

1. The elements on the Periodic Table of the Elements are arranged in order of increasing:
 - (1) atomic mass
 - (2) atomic number
 - (3) formula mass
 - (4) oxidation number
2. Which element is classified as a metalloid?
 - (1) Te
 - (2) S
 - (3) Hg
 - (4) I
3. At STP, O₂(g) and O₃(g) are two forms of the same element that have:
 - (1) the same molecular structure and the same properties
 - (2) the same molecular structure and different properties
 - (3) different molecular structures and the same properties
 - (4) different molecular structures and different properties

Free Response Questions

16. Explain, **in terms of electron configuration**, why the elements in Group 2 have similar chemical properties.

17. Identify the element in Period 3 that is an unreactive gas at STP.

18. Explain, **in terms of subatomic particles**, why the radius of a lithium ion is smaller than the radius of a lithium atom.

19. Identify the noble gas whose atoms have the same electron configuration as a potassium ion.

20. Compare the radius of a potassium ion to the radius of a potassium atom.

21. a. Why does the radius increase as you move down a group?

b. Why does the radius decrease as you move across a period?

22. What group is the most stable? Why?

23. Identify *one* element from this table for *each* type of element: metal, metalloid, and nonmetal.

24-25. A neutral atom has the following electron configuration: **2-6**.

a. State the group and period of this element.

G: _____, P: _____

b. Identify this element. _____

Unset

c. Classify this element as metal, nonmetal, or metalloid. ____

d. List two other elements likely to have properties similar to this element. ____

e. Draw the Lewis electron-dot structure for this atom. ____

f. What ion does this atom form? (sign and number) ____