Families of Elements

Aim

- predict the properties of elements based on their location in the Periodic Table

Notes

Families of Elements

- Alkali metals - Group 1
  - extremely reactive (not found free in nature) - form stable ionic compounds
  - react with water to form a base
  - react with air to form oxides
  - react with acids to form salts
- Alkaline earth metals - Group 2
  - reactive (not found free in nature) - form stable ionic compounds
  - react with water to form a base
  - react with air to form oxides
  - react with acids to form salts
- Nitrogen family - Group 15
  - Members range from typical nonmetals (nitrogen and phosphorus) through metalloids (arsenic and antimony) to metals (bismuth)
  - Nitrogen
    - Forms stable diatomic molecules with a triple bond
    - Component of protein
    - Forms some unstable compounds that are used as explosives
  - Phosphorus
    - Component of nucleic acids (DNA, RNA)
    - More reactive than nitrogen at room temperature
- Oxygen family - Group 16
  - Members range from typical nonmetals (oxygen and sulfur) through metalloids (selenium and tellurium) to metals (polonium)
  - Solids except oxygen
- Halogens (salt formers) - Group 17
  - very reactive nonmetals - high electronegativity
  - not found free in nature
  - form diatomic molecules when free
  - react with metals to form salts
  - Tendency to form positive oxidation state increases with atomic number
  - Found in all three phases due to differences in Van der Waals forces
- Noble gases
  - have complete outer shells
  - Almost inert (not reactive)
    - Krypton, xenon, and radon form compounds with oxygen and fluorine
- Transition elements
  - Positive oxidation state
  - Lose electrons from two outermost energy levels
  - Ions form colored solutions

Comparing Metals and Nonmetals

- Metals
  - Chemical properties - tend to lose electrons easily
    - have low ionization energy (energy needed to remove electrons)
    - have low electron affinity (attraction for electrons)
    - form positive ions when combining with other atoms
  - Physical properties
    - good conductors of heat and electricity
    - lustrous - reflect light, shine when they are polished
    - flexible
      - **malleable** - can be rolled or hammered into sheets
      - **ductile** - can be drawn into wires
    - are solids at room temperature except for mercury
- Nonmetals
  - Chemical properties - tend to gain electrons
    - have high electron affinities
    - produce covalent bonds by sharing electrons with other nonmetals
  - Physical properties
    - exist as gases, molecular solids, or network solids at room temperature except bromine
    - solids are brittle - not ductile or malleable
    - solids are dull - do not reflect light even when polished
    - poor conductors of heat and electricity
- Metalloids (semi-metals) - elements at the border between metals and nonmetals that have some properties of both
  - have properties intermediate to metals and nonmetals (special case of nonmetals)

Answer the questions below by circling the number of the correct response

1. Which term best describes the element nitrogen at room temperature? (1) unstable (2) inactive (3) inert (4) explosive

2. The elements that react with water to form strong bases are found in Group (1) 1 (2) 15 (3) 13 (4) 17

3. Phosphorus is best classified as a (1) nonmetal (2) metal (3) metalloid (4) transition element

4. The alkali metals all have the same (1) electronegativity (2) oxidation number (3) atomic radius (4) ionization energy

5. The alkaline earth metals are those elements in Group (1) 1 (IA (2) 2 (IIA) (3) 11 (IB) (4) 12 (IIB)

6. An element that exhibits the largest variety of oxidation states is (1) Li (2) O (3) C (4) N

7. Which Group in the Periodic Table contains both metals and nonmetals? (1) 11 (IB) (2) 2 (IIA) (3) 18 (0) (4) 14 (IVA)

8. This element assumes only a +3 oxidation state in chemical combination (1) Na (2) Si (3) Al (4) Cl

9. Which is an alkaline earth metal? (1) Na (2) Ga (3) Ca (4) Ta

10. Elements in which electrons from more than one energy level may be involved in bond formation are called (1) alkali elements (2) transition elements (3) alkaline earth elements (4) halogens

11. Which is a transition element?
    (1) Rb (3) Sb
    (2) Au (4) Xe

12. Which type of element frequently forms colored compounds and generally exhibits more than one positive oxidation state?
    (1) alkaline earths (3) transition elements
    (2) alkali metals (4) noble gases

13. Which Group in the Periodic Table contains the most active metals?
    (1) 1 (IA) (3) 11 (IB)
    (2) 17 (VIIA) (4) VIIB(7)

14. Which Period contains elements that are all gases at STP ?
    (1) 1 (3) 2
    (2) 3 (4) 4

15. Which Group 18 (0) element in the ground state has a maximum of 2 completely filled principal energy levels?
    (1) Kr (3) Xe
    (2) He (4) Ne

16. A nonmetal which exists in the liquid state at room temperature is
    (1) aluminum (3) hydrogen
    (2) mercury (4) bromine

17. The only metal which is a liquid at STP is in Period
    (1) 5 (3) 6
    (2) 3 (4) 4

18. Which Group contains an element that is a liquid at room temperature?
    (1) 18 (0) (3) 2 (IIA)
    (2) 16 (VIA) (4) 17 (VIIA)