

## Study Guide for Placement Exam

### Atomic structure and isotopes

- Define atomic number and mass number
- Explain how subatomic particles are distributed in an atom
- Explain the role of subatomic particles in determining identity, mass and charge of an atom or ion
- Select atoms that are isotopes of one another
- Calculate the numbers of protons and neutrons in an isotope from mass number or full atomic symbol
- Determine the mass number and write full atomic symbol from numbers of protons and neutrons
- Calculate the number of electrons, protons, and neutrons in an atom or ion
- Predict if electrons are lost or gained to form anions or cations

### Periodic properties and the periodic table

- Locate the following on a periodic table of the elements: metals, semimetal, and nonmetals; halogens, alkali metals, alkaline earth metals, noble gases, transition metals, lanthanides, actinides, and main group elements
- Use the periodic table to predict trends in atomic radii, electronegativity, metallic character, or similar chemical properties
- Classify/identify an element as a metal, semimetal, or nonmetal based on properties or location in periodic table
- Associate elements with the group/family to which they belong

### Organization of matter into molecules and ions

- Describe the difference between or identify representations of: atoms and molecules, elements and compounds; diatomic and polyatomic molecules; homonuclear and heteronuclear molecules
- Know which elements in the periodic table exist as molecules in their elemental state and which as atoms

### Chemical and physical changes, States of Matter

- Distinguish between physical and chemical changes
- Describe or recognize differences in the organization of matter in solid, liquid or gas phases
- Determine if heat is absorbed or released when different phase changes occur

### Electronic structure

- Predict the number of valence electrons an atom has based on location in periodic table
- Represent valence electrons in atoms with dots around the element symbol (Lewis Model)
- Predict the type of ion an element will form based on where it is in the periodic table
- Recognize the shape of atomic orbitals

- Predict the number of electrons that different orbitals and subshells can hold

### **Chemical bonding**

- Predict if the bond between two atoms is an ionic, covalent or a metallic bond
- Use electronegativity to determine if a bond is polar or non-polar

### **Chemical formulas and Nomenclature**

- Predict the formula of an ionic compound formed from two ions
- Identify the ions from a formula
- Use rules of nomenclature to name ionic and molecular compounds and acids to write names or formulas

### **Mass and mole relationships**

- Use a chemical formula to predict relative amounts of an element in the formula
- Calculate the molar mass given a formula
- Convert between molar mass, grams and moles

### **Stoichiometry**

- Balance chemical equations
- Use mole ratios from chemical equations to calculate mole amounts of reactants and products
- Perform basic stoichiometric calculations using gram amounts of substances and a balanced chemical equation

### **Solutions, molar concentration and dilution**

- Calculate the molar mass given a molecular or ionic compound formula
- Convert between moles, molar concentration and volume of solution
- Convert between grams, moles, molar concentration and volume of solution
- Perform dilution calculations

### **Enthalpy Conventions**

- Define exothermic and endothermic reactions
- Define the sign of the enthalpy change for exothermic and endothermic reactions
- Predict if heat is absorbed or released during exothermic and endothermic reactions
- Predict if the temperature of the system increases or decreases during exothermic and endothermic reactions

### **Dimensional analysis, unit conversions and significant figures**

- Perform conversions between different unit systems
- Use appropriate significant figures in calculations and measurements
- Calculate the density of a substance from mass and volume information