

#### 4.1 Atomic Theory and Bonding

- An \_\_\_\_\_ is the smallest particle of an element that still has the properties of that element
  - ♦ 50 million atoms, lined up end to end = 1 cm
  - ♦ An atom = \_\_\_\_\_ + \_\_\_\_\_ + \_\_\_\_\_
  - ♦ Atoms join together to form \_\_\_\_\_
  - ♦ A compound is a pure substance that is composed of two or more atoms combined in a specific way.
  - ♦ Oxygen and hydrogen are atoms/elements; \_\_\_\_\_ is a compound.
  - ♦ A chemical change occurs when the arrangement of atoms in compounds changes to form new compounds.

#### Atomic Theory

- Atoms are made up of smaller particles called \_\_\_\_\_.
- The \_\_\_\_\_ is at the centre of an atom.
  - ♦ The nucleus is composed of \_\_\_\_\_ and \_\_\_\_\_.
  - ♦ \_\_\_\_\_ exist in the space surrounding the nucleus.
  - ♦ # of protons = # of electrons in every atom
  - ♦ Nuclear charge = charge on the nucleus = # of protons
  - ♦ \_\_\_\_\_ = # of protons = # of electrons

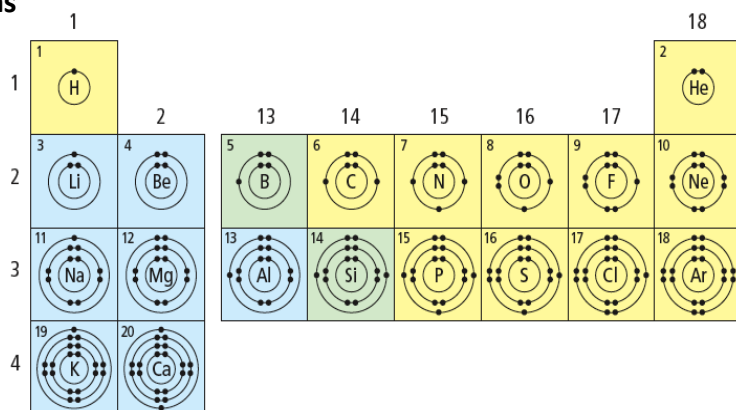
#### Organization of the Periodic Table

- In the periodic table elements are listed in order by their atomic number.
  - ♦ \_\_\_\_\_ are on the left (the transition metals range from group 3 to group 12), non-metals are on the right, and the metalloids form a “staircase” toward the right side.
  - ♦ Rows of elements (across) are called \_\_\_\_\_.
    - All elements in a period have their electrons in the same general area around their nucleus.
  - ♦ Columns of elements are called \_\_\_\_\_ or \_\_\_\_\_.
    - All elements in a family have similar properties and bond with other elements in similar ways.
    - Group 1 = \_\_\_\_\_
    - Group 2 = \_\_\_\_\_
    - Group 17 = \_\_\_\_\_
    - Group 18 = \_\_\_\_\_

## The Periodic Table

- Periodic Table and Ion Formation
- Atoms \_\_\_\_\_ and \_\_\_\_\_ electrons to form bonds.
  - ♦ The atoms become electrically charged particles called \_\_\_\_\_.
  - ♦ \_\_\_\_\_ lose electrons and become positive ions (cations).
    - Some metals (multivalent) lose electrons in different ways.
    - For example, iron, Fe, loses either two ( $\text{Fe}^{2+}$ ) or three ( $\text{Fe}^{3+}$ ) electrons
  - ♦ \_\_\_\_\_ gain electrons and become negative ions (anions).
  - ♦ Atoms gain and lose electrons in an attempt to have the \_\_\_\_\_ of valence electrons (electrons farthest from the nucleus) as the nearest noble gas in the periodic table.

## Bohr Diagrams



- Bohr diagrams show how many electrons appear in each electron shell around an atom.
  - ♦ Electrons in the outermost shell are called \_\_\_\_\_
  - ♦ Think of the shells as being 3-D like spheres, not 2-D like circles.

## Patterns of Electron Arrangement in Periods and Groups

- Electrons appear in shells in a very predictable manner.
- There is a maximum of \_\_\_\_\_ electrons in the first shell, \_\_\_\_\_ in the 2nd shell, and \_\_\_\_\_ in the 3rd shell.
  - ♦ The period number = the number of shells in the atom.
  - ♦ Except for the transition elements, the last digit of the group number = the number of electrons in the valence shell.

## Forming Compounds

- When two atoms get close together, their valence electrons \_\_\_\_\_.
  - If the valence electrons can combine to form a low-energy bond, a \_\_\_\_\_ is formed.
  - Each atom in the compound attempts to have the \_\_\_\_\_ number of valence electrons as the nearest noble gas.
  - Metals may lose electrons and non-metals may gain electrons (ionic bond), or atoms may share electrons (covalent bond).
- \_\_\_\_\_ bonds form when electrons are transferred from positive ions to negative ions.
- \_\_\_\_\_ bonds form when electrons are shared between two non-metals.
  - Electrons stay with their atom but overlap with other shells.
- Ionic bonds are formed between positive ions and negative ions.
  - Generally, this is a \_\_\_\_\_ (+) and a \_\_\_\_\_ (-) ion.
  - For example, lithium and oxygen form an ionic bond in the compound  $\text{Li}_2\text{O}$ .
  - \_\_\_\_\_ bonds are formed between two or more non-metals.
  - Electrons are shared between atoms.

## Lewis Diagrams

	1								18
1	1 H •								2 He ••
	2	13	14	15	16	17			
2	3 Li •	4 Be •	5 • B •	6 • C • •	7 • N •• •	8 • O •• •	9 • F •• •	10 • Ne •• ••	
3	11 Na •	12 Mg •	13 • Al •	14 • Si • •	15 • P •• •	16 • S •• •	17 • Cl •• •	18 • Ar •• ••	

- Lewis diagrams illustrate chemical bonding by showing only an atom's valence electrons and the chemical symbol.
  - \_\_\_\_\_ representing electrons are placed around the element symbols at the points of the compass (north, east, south, and west).
  - Electron dots are placed singly until the fifth electron is reached then they are paired.

### **Lewis Diagrams of Ions**

- Lewis diagrams can be used to represent \_\_\_\_\_
  - ♦ For positive ions, one electron dot is removed from the valence shell for each positive charge.
  - ♦ For negative ions, one electron dot is added to each valence shell for each negative charge.
  - ♦ \_\_\_\_\_ are placed around each ion to indicate transfer of electrons.

### **Lewis Diagrams of Covalent Bonds**

- Lewis diagrams can also represent covalent bonds.
  - ♦ Like Bohr diagrams, valence electrons are drawn to show sharing of electrons.
  - ♦ The shared pairs of electrons are usually drawn as a \_\_\_\_\_.

**Colour code periodic table. See page 172**

**Bonding Assignment**

**Pg 60-63 in workbook**