

Answers to Physical Properties Worksheet

1. **Macromolecule:** extremely large and hard to determine number of atoms or ions bonded together to form a “molecule” that may be large enough to see, atoms are arranged in a regularly repeating crystal lattice (looks endless)

Discrete Covalent Molecules: a small and specific number of atoms bonded together covalently to form a small molecule “true molecules”

Macromolecules are formed by intramolecular ionic, covalent or metallic bonds.

eg. NaCl (sodium chloride), C_n (diamond), SiO_2 (silicon dioxide - sand), Al (aluminum)

A large but equal number of Na^{1+} and Cl^{1-} ions are present in NaCl

2. **Only** covalent bonding can make discrete molecules.

H_2O - three atoms

NH_3 - four atoms

$C_6H_{12}O_6$ - 24 atoms

3. **Molecular Formula:** states the exact number and

type of atoms in a discrete covalent molecule

Empirical Formula: states the simplest ratio of ions or atoms found in a macromolecule (or a discrete covalent molecule)

macromolecule - empirical formula only

discrete covalent molecule - molecular formula preferred, empirical formula acceptable

4. The stronger the forces of attraction that hold a substance together, the higher the melting/boiling point will be.

Macromolecules are held together by intramolecular forces (i.e. ionic, covalent or metallic bonding). In order to melt/boil a macromolecule, these forces must be overcome to make particles small enough to be a liquid or gas.

Solids composed of discrete covalent molecules (known as molecular solids) have small molecule units (intramolecular covalent forces hold the molecule together). These molecules are held together by much weaker intermolecular forces. Only the intermolecular forces need be overcome to separate the molecules which are already small enough to form a liquid or gas.

Since intramolecular forces are 10 to 100 times stronger than intermolecular forces, much more energy is required to melt/boil (higher temperature required).

5. H₂O: polar discrete covalent molecule, relatively strong intermolecular force due to attraction between δ^+ and δ^- regions on adjacent water molecules

O₂, N₂, CH₄: non-polar discrete covalent molecules, weaker intermolecular forces

Weaker intermolecular forces means less heat energy (lower temperature) is required to melt/boil.

6. Cleavage is the property exhibited by a substance when it can fracture along a plane of particles in the crystal lattice resulting in smooth planes surfaces.

Only crystals (substances in which particles arrange themselves in a regularly repeating crystal lattice) exhibit the property of cleavage i.e. ionic solids, covalent network solids, (and some polar molecular solids).

7. Metallic ions are able to slip past each other without interrupting the attraction to free moving electrons, the metallic bond is flexible or moveable.

Any solid that has a rigid crystal lattice cannot bend like a metal, the atoms or ions are locked into place, sufficient stress breaks the lattice and the bonds (shatters or cleaves).

8. Free moving charged particles must be present for conduction to occur.

Metals have free moving electrons.

Ionic solutions have free moving ions, in solid ionic compounds the ions are locked into a crystal lattice.

Covalent network solids have no free moving charged particles (electrons are confined to covalent bonds).

Solutions of discrete covalent molecules have no charged particles.