

CHM 111**Chapter 11 study guide / learning objectives**

Chapter 11 in your textbook deals with two states (or phases) of matter - solid and liquid. You are required to know the differences between solids, liquids, and gases. You need to know the important properties of liquids and solids and how those properties relate to the forces that bind the liquids and solids together. You also need to know something about the nature of these forces.

We will not cover sections 11.8 through 11.10 of the textbook. These sections discuss in some detail the structure of crystalline solids. We will discuss the nature of crystalline solids in brief, as presented in section 11.7. If you are majoring in civil, mechanical, or chemical engineering, you should read through sections 11.8-11.10, since these majors often require a course discussing the properties of materials.

At the end of chapter 11, you should be able to:

[Definitions / Terminology]

- Define terms related to the three phases of matter: **solid, liquid, gas, compressible, fluid, kinetic theory, intermolecular forces, phase transition, vapor pressure.**
- Define the six phase transitions and give examples: **melting, sublimation, freezing, vaporization, deposition, condensation, heat of fusion, heat of vaporization.**
- Define the **triple point** and the **critical point (critical temperature and critical pressure).**
- Define a **supercritical fluid.**
- Define terms related to liquid properties: **surface tension, capillary action, viscosity, boiling point.**
- Define terms related to intermolecular forces: **London forces, dipole-dipole interactions, van der Waals forces, hydrogen bonds.**
- Define terms related to solid properties: **hardness, melting point, malleable, conductivity, defect.**

[Solids, liquids, and gases]

- Distinguish between the three phases and list unique things about each.
- Briefly describe the kinetic theory of gases - including the definition of temperature.
- Describe the structure of liquids and solids.
- Explain any **phase transition** in terms of what happens at the molecular level. You have several examples (melting and boiling) in your notes.
- Distinguish between **endothermic** and **exothermic** phase transitions.
- Describe what happens to the temperature of a substance before, during, and after a phase transition.
- Calculate the heat evolved in or heat required for a phase transition.

[Phase diagrams]

- Label a **phase diagram**, showing the solid, liquid, gas, and supercritical fluid regions.
- Label the triple point and critical point.
- Label the phase transitions.
- Describe the **difference** between the phase diagram for water and for most other substances.

{Liquids}

- Describe the **general properties** of liquids - compressibility, density, fluidity.
- Explain **surface tension** in terms of intermolecular forces.
- Explain **capillary action** in terms of intermolecular forces.
- Explain **viscosity** in terms of intermolecular forces and molecular structure.
- Describe the **three types of intermolecular force** we discussed in class: London forces, dipole-dipole interactions, van der Waals forces, hydrogen bonds - and how they affect liquid properties like surface tension, boiling point, vapor pressure, and viscosity.
- From the **Lewis structure** of a molecule, describe the intermolecular forces present in the liquid phase.
- Rank a series molecules by property (example: rank from highest boiling point to lowest) using your knowledge of intermolecular forces.

[Solids]

- Describe the **general properties** of solids - compressibility, density, fluidity.
- Classify solids by the **kind of force that holds them together**: molecular solids, metallic solids, ionic solids, covalent network solids.
- Classify solids by **structure**: amorphous solids and crystalline solids.
- Describe a **simple crystal lattice** and define the unit cell.
- **Estimate the properties** of a solid (hardness, melting point, conductivity) based on the type of force that holds the solid together.

[Practice]

- 11.29, 11.37, 11.39, 11.53, 11.61, 11.63, 11.65, 11.69, 11.71, 11.73, 11.75, 11.77, 11.79, 11.81