

Holt Modern Chemistry Review

CHAPTER 10: STATES OF MATTER

The following pages contain the bulk (but not all) of the information for the chapter 10 test. Focus on this content, but make sure to review class notes, activities, handouts, questions, etc. If you study this document and NOTHING else, you should at least be able to PASS the test.

***** *Test items will be recall, examples, and/or application of this content.* *****

OUTCOMES

- Collaborate with peer(s) to understand chemistry content (**C C**)
- Communicate chemistry content to teacher and peer(s) (**E C**)
- **10.1-10.3:** Differentiate between intermolecular forces of solid, liquids, and gases (**F & PK**)
- **10.4:** Interpret phase diagrams and determine the triple point (**T & R**)

10.1: THE KINETIC-MOLECULAR THEORY OF MATTER

- **Vocabulary**
 - **ideal gas** – an imaginary gas whose particles are infinitely small and do not interact with each other
 - **diffusion** – the movement of particles from regions of higher density to regions of lower density
 - **real gas** – a gas that does not behave completely like a hypothetical ideal gas because of the interactions between the gas molecules
- **Chapter Highlights**
 - The kinetic-molecular theory of matter can be used to explain the properties of gases, liquids, and solids.
 - The kinetic-molecular theory of gases describes a model of an ideal gas.
 - Gases consist of large numbers of tiny, fast-moving particles that are far apart relative to their size.

10.2: LIQUIDS

- **Vocabulary**
 - **fluid** – a nonsolid state of matter in which the atoms or molecules are free to move past each other, as in a gas, liquid, or plasma
 - **surface tension** – the force that acts on the surface of a liquid and that tends to minimize the area of the surface
 - **vaporization** – the process by which a liquid or solid changes to a gas
 - **evaporation** – the change of state from a liquid to a gas
 - **freezing** – the change of state in which a liquid becomes a solid as energy as heat is removed
- **Chapter Highlights**
 - The particles of a liquid are closer together and more ordered than those of a gas and are less ordered than those of a solid.
 - Liquids have a definite volume and a fairly high density, and they are relatively incompressible. Like gases, liquids can flow and thus are considered to be fluids.

10.3: SOLIDS

- **Vocabulary**
 - **crystal** – a solid whose atoms, ions, or molecules are arranged in a regular, repeating pattern; for example, table salt
 - **crystalline solid** – a solid that consists of crystals; for example, emerald, quartz, and ice
 - **amorphous solid** – a solid in which the particles are not arranged with periodicity or order; for example, glass, polymers, and gels.
 - **melting** – the change of state in which a solid becomes a liquid by adding energy as heat or changing pressure
 - **melting point** – the temperature and pressure at which a solid becomes a liquid
 - **supercooled liquid** – a liquid that is cooled below its normal freezing point without solidifying
- **Chapter Highlights**
 - The particles of a solid are not nearly as free to move about as those of a liquid or a gas are.
 - Solids have a definite shape and may be classified into two types: crystalline or amorphous. They have a definite volume and are generally nonfluid.
 - Crystalline solids are the most common type of solid. They are characterized by a regular crystalline organization of atoms that have a highly ordered structure. A crystal structure is the total three-dimensional array of points that describes the arrangement of the particles of a crystal.
 - Unlike crystalline solids, amorphous, or non-crystalline, solids do not have a highly ordered structure or a regular shape. Accordingly, they lack the elasticity, distinct melting points, and other properties of crystalline solids.

10.4: CHANGES OF STATE

- **Vocabulary**
 - **phase** – in chemistry, one of the four states or conditions in which a substance can exist: solid, liquid, gas, or plasma; a part of matter that is uniform
 - **condensation** – the change of state from a gas to a liquid
 - **equilibrium** – in chemistry, the state in which a chemical process and the reverse chemical process occur at the same rate such that the concentrations of reactants and products do not change; in physics, the state in which the net force on an object is zero
 - **volatile liquid** – a liquid that evaporates readily or at a low temperature; for example, isopropyl alcohol, which is in hand sanitizer
 - **boiling** – the conversion of a liquid to a vapor within the liquid as well as at the surface of the liquid at a specific temperature and pressure; occurs when the vapor pressure of the liquid equals the atmospheric pressure
 - **boiling point** – the temperature and pressure at which a liquid and a gas are in equilibrium

- **freezing point** – the temperature at which a solid and liquid are in equilibrium at 1 atm pressure; the temperature at which a liquid substance freezes
- **sublimation** – the process in which a solid changes directly into a gas (the term is sometimes also used for the reverse process)
- **deposition** – the change of state from a gas directly to a solid
- **phase diagram** – a graph of the relationship between the physical state of a substance and the temperature and pressure of the substance
- **triple point** – the temperature and pressure conditions at which the solid, liquid, and gaseous phases of a substance coexist at equilibrium
- **critical temperature** – the temperature above which a substance cannot exist in the liquid state
- **critical pressure** – the lowest pressure at which a substance can exist as a liquid at the critical temperature
- **critical point** – the temperature and pressure at which the gas and liquid states of a substance become identical and form one phase

Chapter Highlights

- A liquid in a closed system will gradually reach a liquid-vapor equilibrium as the rate at which molecules condense equals the rate at which they evaporate.
- When two opposing changes occur at equal rates in the same closed system, the system is said to be in dynamic equilibrium.

10.5: WATER

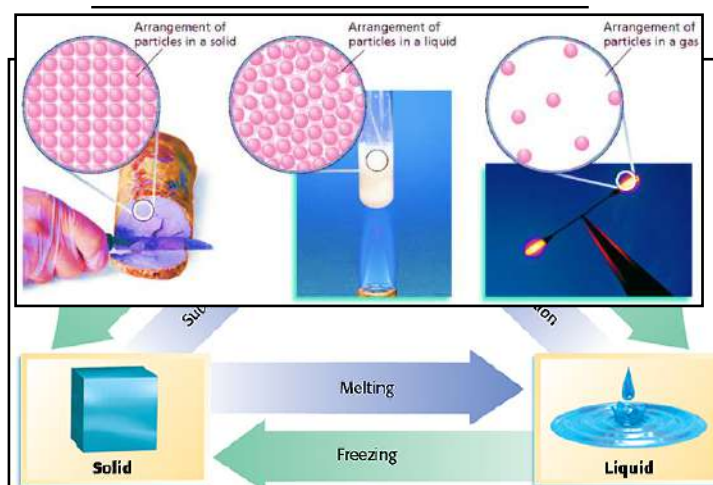
Chapter Highlights

- Water is a polar covalent compound.
- The structure and the hydrogen bonding in water are responsible for its relatively high melting point, molar enthalpy of fusion, boiling point, and molar enthalpy of vaporization.

STATES OF MATTER:

SOLID	LIQUID	GAS
definite volume	definite volume	indefinite volume
definite shape	indefinite shape	indefinite shape
strong intermolecular (attractive) forces	moderately strong intermolecular (attractive) forces	weak intermolecular (attractive) forces
not compressible	moderately compressible	highly compressible
particles move in place	moderate amount of particle movement	high amount of particle movement

ARRANGMENT OF PARTICLES:

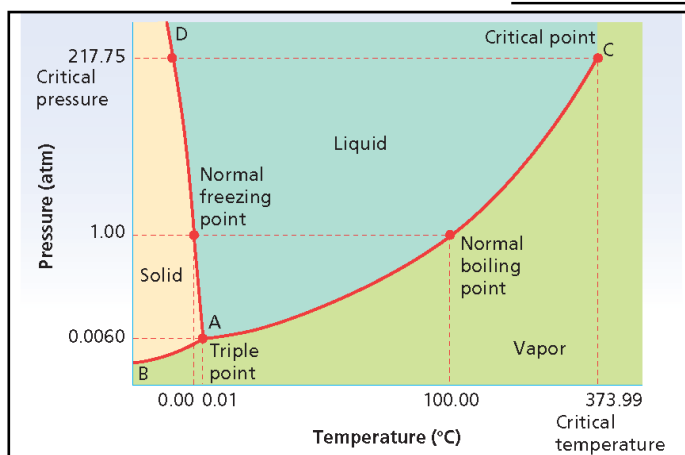


PHASE CHANGES:

Change of state	Process	Example
Solid → liquid	melting	ice → water
Solid → gas	sublimation	dry ice → CO ₂ gas
Liquid → solid	freezing	water → ice
Liquid → gas	vaporization	liquid bromine → bromine vapor
Gas → liquid	condensation	water vapor → water
Gas → solid	deposition	water vapor → ice

CHANGES OF STATE:

PHASE DIAGRAM FOR WATER:



- At -5 °C and 1 atm, in which state is the substance?
 - Solid
- At 200 °C and 0.0060 atm, in which state is the substance?
 - vapor (or gas)
- At 100 °C and 217.75 atm, in which state is the substance?
 - liquid