Name: _____ Period: _____ Score: _____

WORKBOOK 38: PHASE CHANGES

STATE CONTENT STANDARDS

- Workbook 38 is the second in the series for Unit 4
- Standard Set 7: Energy is exchanged or transformed in all chemical reactions and physical changes of matter.
- 7. c. Students know energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts.

TEXTBOOK CORRELATION

- Workbook 38 correlates to chapter 14: sections 14.2, 14.3 and 14.4

MAJOR CONCEPTS

- Students know phase changes are physical changes
- Students know the parts to a phase diagram
- Students know the parts to a heating curve

VOCABULARY

Using the textbook and other sources, define each vocabulary word in your own words. Provide a sketch or drawing of the idea.

Word	**Definition**	**Sketch or Drawing**
Condensation		

Name: _____ Period: _____ Score: _____

Word	Definition	Sketch or Drawing
Deposition		
Evaporation		
Heating / Cooling curve		
Molar heat of fusion		

Name: _____ Period: _____ Score: _____

Word	Definition	Sketch or Drawing
Molar heat of vaporization		
Normal boiling point		
Normal freezing point		
Sublimation		

Name: _____ Period: _____ Score: _____

Word	Definition	Sketch or Drawing
Vaporization		

READING

Chapter 14.2, 14.3, and 14.4

Part I: Important Concepts (List seven important ideas found during the reading)

Section 14.2

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

Section 14.3

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

Name: _____ Period: _____ Score: _____

Section 14.4

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

Part II: Summaries

Using one paragraph per section, summarize the three sections you just read.

Section 14.2

_____
_____
_____
_____
_____
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_____
_____

Section 14.3

_____
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Name: _____ Period: _____ Score: _____

Section 14.4

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READING GUIDE

Complete Reading Guide 38

Section 14.2

1. Approximately 97% of the earth's water is found in the _____.

2. The liquid range of water occurs between the temperatures _____ and _____.

3. At 1atm pressure, liquid water always changes to gaseous water at 100°C, the _____ _____ _____ for water.

4. Draw the heating/cooling curve for water:

5. Liquid and solid water can co-exist indefinitely if the _____ is _____ at 0°C.

6. The _____ of water when it freezes explains why ice cubes _____.

Section 14.3

7. Changes of state are _____ changes.

8. No _____ _____ are broken during the changes of state.

9. The energy required to melt 1 mol of a substance is called the _____ _____ of _____.

10. The energy required to change 1 mol of liquid to its vapor is called the _____ _____ of _____.

Section 14.4

11. The process of liquid molecules escaping to the liquid's surface and form a gas is called _____ or _____.

12. The process by which vapor molecules form a liquid is called _____.

13. The vapor pressure of a liquid at a given temperature is determined by the _____ _____ that act among the molecules.

14. The temperature of a substance reflects the _____ kinetic energy of the components of that substance.

15. Because of the strong hydrogen bonding among its molecules in the liquid state, _____ has an usually large heat of vaporization.

16. The process by which vapor molecules form a liquid is called _____.

Name: _____ Period: _____ Score: _____

17. The pressure of the vapor present at the equilibrium with its liquid is called _____ _____ _____ or more commonly the _____ _____ of the liquid.

18. The vapor pressure of a liquid is determined by the _____ _____ that act among the molecules.

MIND MAP

Complete a mind map using the vocabulary and major concepts in the reading

Name: _____ Period: _____ Score: _____

LECTURE NOTES

Combine your notes from class with the notes on TheChemBook. Use the Cornell Notes Strategy to review your notes each night (5 min.).

Vapor Pressure and Changes of State

I. Vaporization (Evaporation)

A. The escape of molecules from the surface to form a gas.

B. Vaporization is always endothermic

1. Heat of vaporization (Enthalpy of vaporization) is the energy required to vaporize one mole of liquid at 1 atm.

II. Vapor Pressure

A. Pressure of the vapor present at equilibrium

III. Boiling and Condensation

A. Boiling

1. The conversion of a liquid to a vapor within the liquid as well as at its surface. It occurs when the equilibrium vapor pressure of the liquid equals the atmospheric pressure

B. Boiling Point

1. The temperature at which the equilibrium vapor pressure of the liquid equals the atmospheric pressure

a. Water boils at 10 ^{0}C at 1 atm pressure

b. Water boils above 100 ^{0}C at higher pressures

c. Water boils below 100 ^{0}C at lower pressures

C. Condensation

1. The conversion of a gas to a liquid by the removal of energy

Name: _____ Period: _____ Score: _____

IV. Freezing and Melting

A. Freezing Point

1. The temperature at which the solid and liquid are in equilibrium at 1 atm

2. For pure crystalline solids, the melting point and freezing point are the same

3. Temperature remains constant during a phase change

V. Sublimation and Deposition

A. Sublimation is the change of state from a solid directly to a gas

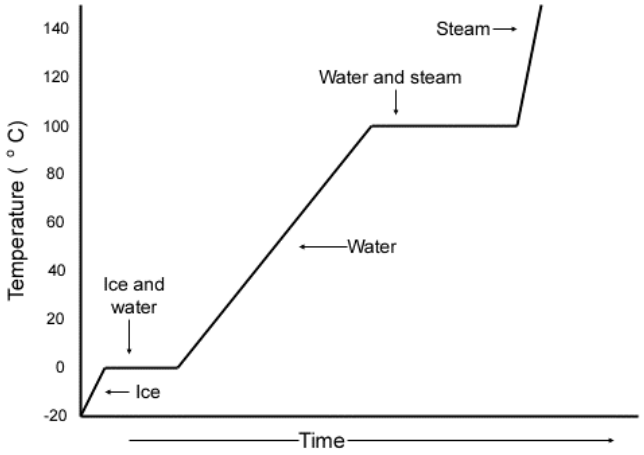
1. Dry ice → Gaseous CO_2

2. Reasons for sublimation

   a. Solids have very low vapor pressure

B. Deposition is the change of state from a gas directly to a solid

Heating Curve



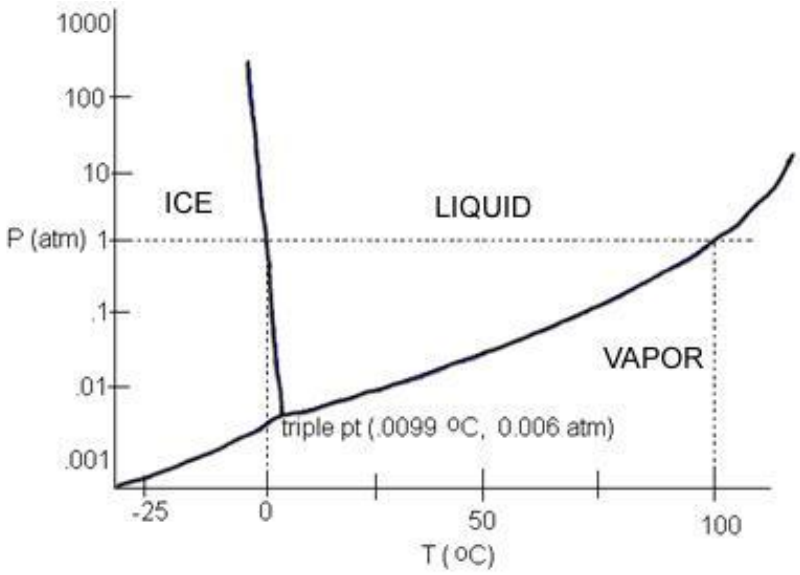
1. The temperature remains constant during a phase change

2. Chemical bonds are not being broken during phase changes

Name: _____ Period: _____ Score: _____

Phase Diagrams

A. A graph of pressure versus temperature that shows the conditions under which the phases of a substance exist (notice that pressure is on a logarithmic scale)



B. Triple Point
   i. All three phases exist together in equilibrium
   ii. The temperature and pressure conditions at which the solid, liquid, and vapor of the substance can coexist at equilibrium

C. Critical Temperature
   i. The temperature at above which the substance cannot exist in the liquid state, regardless of pressure
      1. For water, the critical temperature is 373.99 ^{0}C

D. Critical Pressure
   i. The lowest pressure at which the substance can exist as a liquid at the critical temperature
      1. For water, the critical pressure is 217.75 atm

E. Critical Point
   i. The point on the graph describing simultaneously the critical temperature and the critical pressure
      1. P = 217.75 atm Temperature = 373.99 ^{0}C
   ii. For pure crystalline solids, the melting point and freezing point are the same
   iii. Temperature remains constant during a phase change

F. Sublimation and Deposition

i. Sublimation is the change of state from a solid directly to a gas

1. Dry ice → Gaseous CO_2

ii. Deposition is the change of state from a gas directly to a solid

Part I. Freezing and Melting

A. Molar Heat of Fusion

1. The amount of heat energy required to melt one mole of solid at its melting point

B. Molar Heat of Solidification

1. The amount of heat energy released when one mole of a liquid freezes to a solid at its freezing point

Part II. Vaporization and Condensation

A. Molar Heat of Vaporization

1. The amount of heat energy required to vaporize one mole of a liquid at its boiling point

B. Molar Heat of Condensation

2. The amount of heat energy released when one mole of a vapor condenses to a liquid at its condensation point

3. Strong attractive forces between particles result in high molar heat of vaporization/condensation for water

Part III. Heat of Solution

A. Definition

1. Heat released or absorbed as a solute associates with the solvent during the formation of a solution

B. Molar Heat of Solution

1. Enthalpy change associated with the dissolving of one mole of a solute

Name: _____ Period: _____ Score: _____

SUMMARY TABLES

List the important parts to a phase diagram.

-
-
-
-
-
-
-
-
-
-

QUESTIONS AND PROBLEMS

1. Why are changes of state considered to be physical changes and not chemical changes?

_____
_____
_____

2. Why doesn't the temperature of a substance change during melting?

_____
_____
_____

3. Why does ice float on liquid water? Why is this unusual?

_____
_____
_____

4. Which type of force (intramolecular or intermolecular) must be overcome to melt a solid or vaporize a liquid?

_____
_____
_____

5. What is vapor pressure?

_____
_____
_____

6. What do chemists mean when they use the term *dynamic equilibrium*?

_____
_____
_____

EXAM PREPARATION

Explain the steps you have taken to prepare for a quiz or exam on this material.

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