

Phase Changes Worksheet

KEY

Heat of Vaporization - 40.77 kJ/mol

Name _____

Heat of Fusion - 6.01 kJ/mol

Important Things to Know - Do Not Skip Over these 2 Sections

READ and REMEMBER

Kinetic Theory of Matter:

- Molecules are always moving. This is known as the kinetic theory of matter.
- We measure this kinetic energy with a thermometer as temperature.
- The greater the material's internal energy, the higher the temperature of that material.
- Heat is the energy flow between objects of different temperature.
- Heat and temperature are NOT the same.

Phases of Matter:

Solid

- matter that has definite volume and shape.
- The particles of a solid have high attraction for each other so are packed together tightly and vibrate in position.

Liquid

- matter that has definite volume but not shape.
- The particles of a liquid have high attraction for each other so are tightly packed but have more energy than solids so they tumble past each other enabling liquids to flow

Gas

- matter that has indefinite volume or shape.
- Gases exist as single particles with no attraction for each other and move rapidly in straight line colliding with each other or the inside of the container that they will spread out and fill.

Phase Change Descriptions:

Melting

the change from S to L

Freezing

the change from L to S

Vaporization
~~Evaporation~~

the change from L to G

Condensation

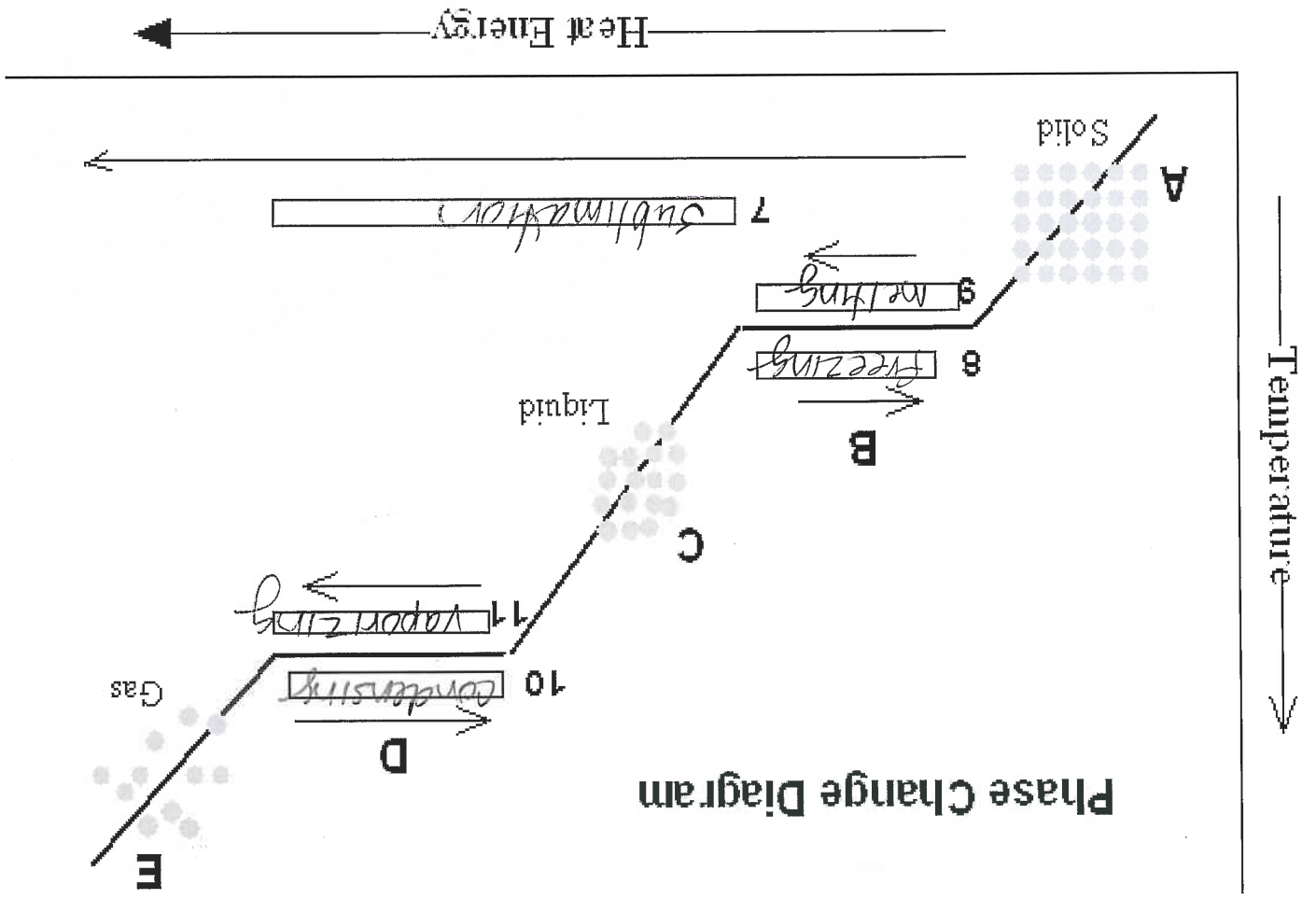
the change from G to L

Sublimation

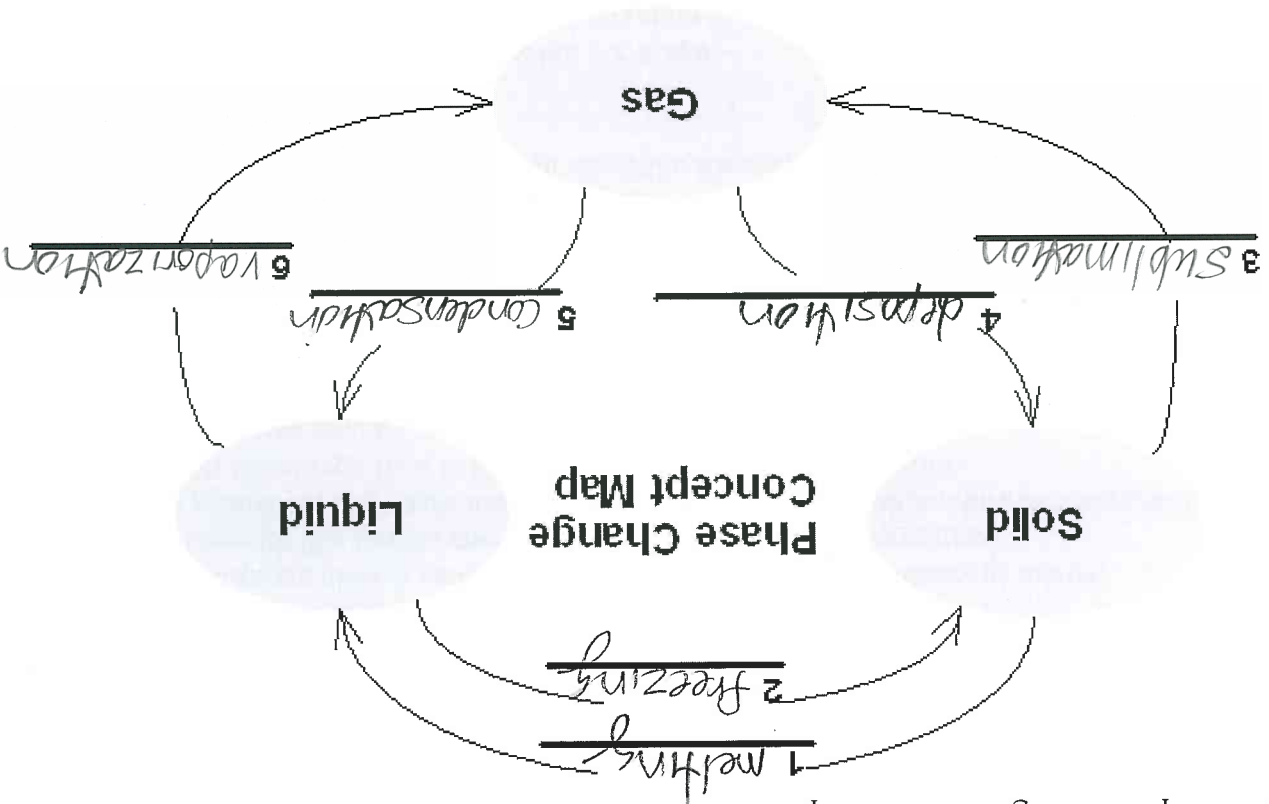
the change from S to G

Deposition

the change from G to S



Phase Change Diagram



Fill in the phase changes in the blank provided.

Heat of Fusion and Vaporization Calculations
 60.1 kJ/mol
 46.7 kJ/mol
 condensation
 solidification

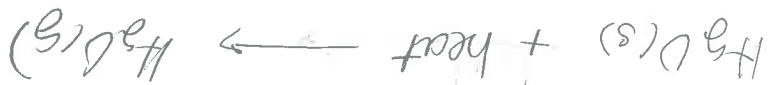
Remember: Heat energy can be "spent" on only one job at a time. Either it will cause a change in temperature or change of state.

1. Is melting endothermic or exothermic? Explain.
 energy is added to solid for it to melt

2. Is vaporization endothermic or exothermic? Explain.
 energy is added to liquid for it to vaporize

3. Describe the process of sublimation and give an example. Is sublimation endothermic or exothermic?

Explain.
 sublimation is the process of a solid changing to a gas by passing the liquid phase. - Iodine, snow during late winter
 Endothermic - energy is absorbed by solid during sublimation
 4. Write a chemical equation for the sublimation of water.



5. Calculate the amount of heat needed to melt 35.0 g of ice at 0°C. Express your answer in Joules.

$$\frac{35.0 \text{ g H}_2\text{O}}{18.02 \text{ g H}_2\text{O}} \times \frac{6.01 \text{ kJ}}{1 \text{ mol H}_2\text{O}} = 11.7 \text{ kJ}$$

11,700 Joules

6. How much energy is released to the environment by 50.0 grams of condensing water vapor?

$$\frac{50.0 \text{ g H}_2\text{O}}{18.02 \text{ g H}_2\text{O}} \times \frac{46.7 \text{ kJ}}{1 \text{ mol H}_2\text{O}} = 131 \text{ kJ}$$

condensation

7. How much energy is required to melt a 20.0 lb bag of ice at 0°C? A pound (lb.) of ice is equivalent to 0.4536 kg.

$$\frac{20.0 \text{ lb}}{2.205 \text{ lb/kg}} = 9.07 \text{ kg} \times \frac{1000 \text{ g}}{1 \text{ kg}} = 9070 \text{ g H}_2\text{O}$$

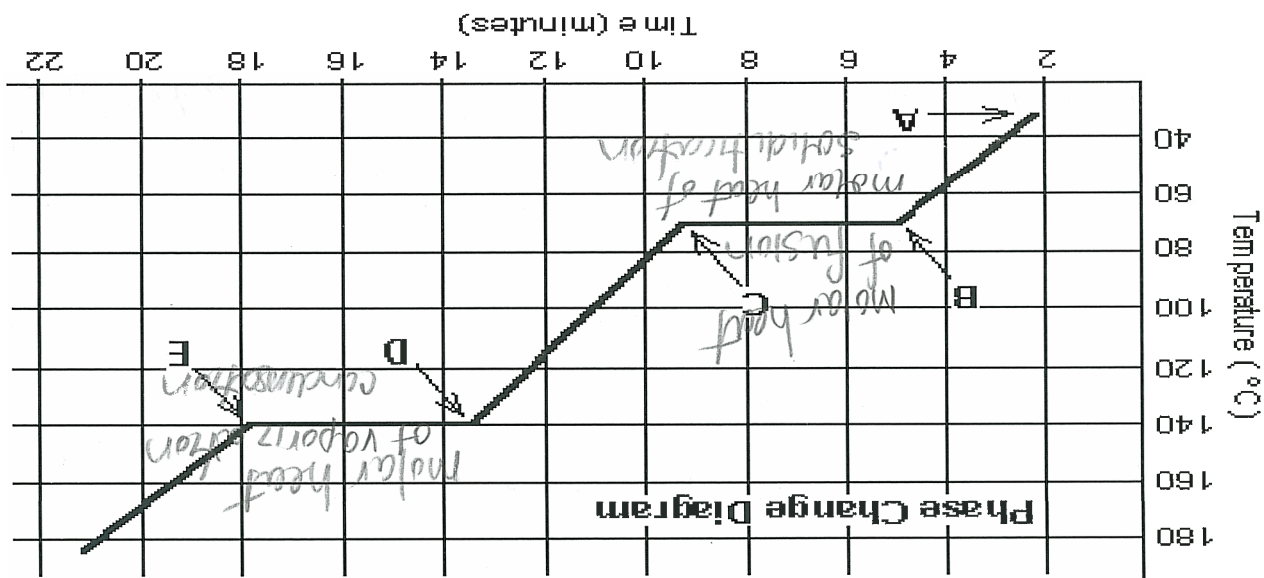
$$\frac{9070 \text{ g H}_2\text{O}}{18.02 \text{ g H}_2\text{O}} \times \frac{6.01 \text{ kJ}}{1 \text{ mol H}_2\text{O}} = 3035.7 \text{ kJ}$$

fusion

3036 kJ

Phase Change Worksheet

The graph was drawn from data collected as 1 mole of a substance was heated at a constant rate. Use the graph to answer the following questions.



Use the phase change diagram above to answer the following questions.

1. Describe what is occurring from:

A to B - temperature of solid increases.

B to C - solid begins to melt at B; melting completed at C.

C to D - temperature of liquid increases.

D to E - at D liquid begins to vaporize (boil) changing to a gas; vaporization completed at E.

2. The energy required to convert one mole of substance from a solid to liquid is called the **molar heat of fusion**. Label this on the diagram.

3. **Molar heat of solidification** is the amount of heat energy removed from one mole of substance in order to change it from a liquid to a solid. Label this on the diagram.

+) **Molar heat of vaporization** - the heat energy required to convert 1 mole of substance from liquid to gas.

5) **Molar heat of condensation** - the heat energy needed to convert 1 mole of substance from gas to liquid.

melt ice

$$\textcircled{5} \quad \frac{0.360 \text{ g H}_2\text{O} \mid 1 \text{ mol H}_2\text{O} \mid 6.01 \text{ kJ}}{18.02 \text{ g H}_2\text{O} \mid 1 \text{ mol H}_2\text{O}} = 76.71 \text{ kJ}$$

$$\textcircled{1} \quad Q = sm\Delta T \quad Q = (4.184)(0.360)(100^\circ\text{C}) = 138.6 \text{ J}$$

(heat ice from -100°C to 0°C)

Heat of fusion 6.01 kJ/mol
 Challenge: Calculate the amount of heat needed to convert 230.0 g of ice at -10°C to water at 0°C . (two calculations!).
 Ice 0°C to -100°C
 specific heat calculation $\Delta T = 0 - -10 = 10$
 use first f

$$\textcircled{8} \quad \frac{190.0 \text{ g H}_2\text{O} \mid 1 \text{ mol H}_2\text{O} \mid 40.7 \text{ kJ}}{18.02 \text{ g H}_2\text{O} \mid 1 \text{ mol H}_2\text{O}} = 729 \text{ kJ}$$

vaporization

