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Unit 8: Thermochemistry

67	25	63	74	8	86	19
Ho	Mn	Eu	W	O	Rn	K
Holmium	Manganese	Europium	Tungsten	Oxygen	Radon	Potassium
164.93032	54.938045	151.964	183.84	15.9994	[222]	39.0983

The following pages are practice questions for this unit, and will be submitted for homework!

You must complete:

- Unit Vocabulary – **ALL QUESTIONS**
- Change That Phase! – **ALL QUESTIONS**
- *What is Heat? – **Multiple Choice Questions – ALL QUESTIONS**
- *All About That Specific Heat – **ALL QUESTIONS**
- Heat Calculations: Formulas – **ALL QUESTIONS**
- Heat Calculations: Practice – **ALL QUESTIONS**

*** Read the article titles "Heat Flow" found on the website to help you with the section ***

DUE: Friday March 20, 2020

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Unit Vocabulary

Directions: Define the following words. You can draw diagrams to enhance your definition!

- Solid:

  _____

- Liquid:

  _____

- Gas:

  _____

- Melting:

  _____

- Freezing:

  _____

- Evaporation:

  _____

- Vaporization:

  _____

- Condensation:

  _____

- Sublimation:

  _____

- Deposition:

  _____

- Heat:

  _____

- Temperature:

  _____

- Specific Heat Capacity:

  _____

- Heat of Fusion:

  _____

- Heat of Vaporization:

  _____

- Endothermic:

  _____

- Exothermic:

  _____

- System:

  _____

- Surrounding:

  _____

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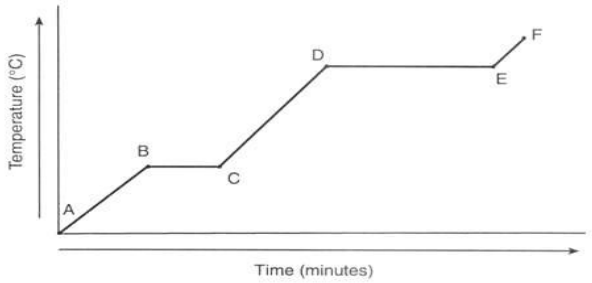
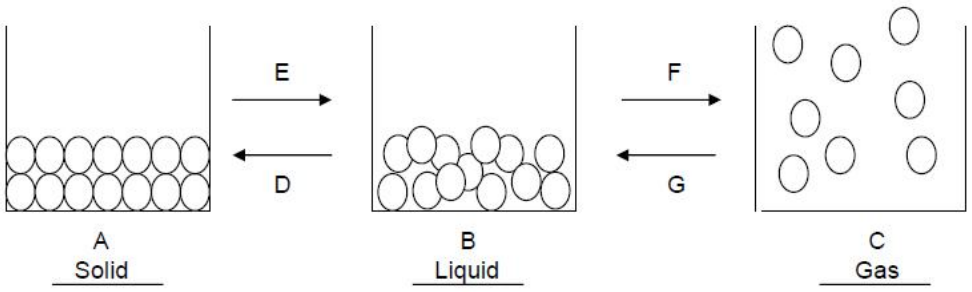
Change That Phase!

1. Identify the phase(s) represented by the following line segments in the diagram below:
   a. AB: _____
   b. BC: _____
   c. CD: _____
   d. DE: _____
   e. EF: _____



2. What line segment(s) represent the melting point? _____
3. What line segment(s) represent the boiling point? _____
4. What takes more energy: to melt this substance or to vaporize it? Give evidence to support your answer. _____
   _____
5. At what intervals is kinetic energy changing? How is it changing?
   _____
6. At what intervals is kinetic energy remaining constant? _____
7. At what intervals is potential energy changing? How is it changing?
   _____
8. At what intervals is potential energy remaining constant? _____
9. At what point will the particles be moving the slowest? _____
10. If this substance were water, at what temperature would segment BC occur? _____°C
11. If this substance were water, at what temperature would segment DE occur? _____ °C

Use the diagram below to answer questions 12 - 16



12. Which arrows in the diagram indicate the addition of energy? _____ and _____
13. Which term, endothermic or exothermic, is used to describe the situation when energy is added into a system from the surroundings? _____
14. Which arrows in the diagram indicate the release of energy? _____ and _____
15. What are the names of the phase changes that involve a release of energy to the surroundings by the system? _____ and _____
16. If a substance is a gas at room temperature, does it have strong or weak Intermolecular forces of attraction?

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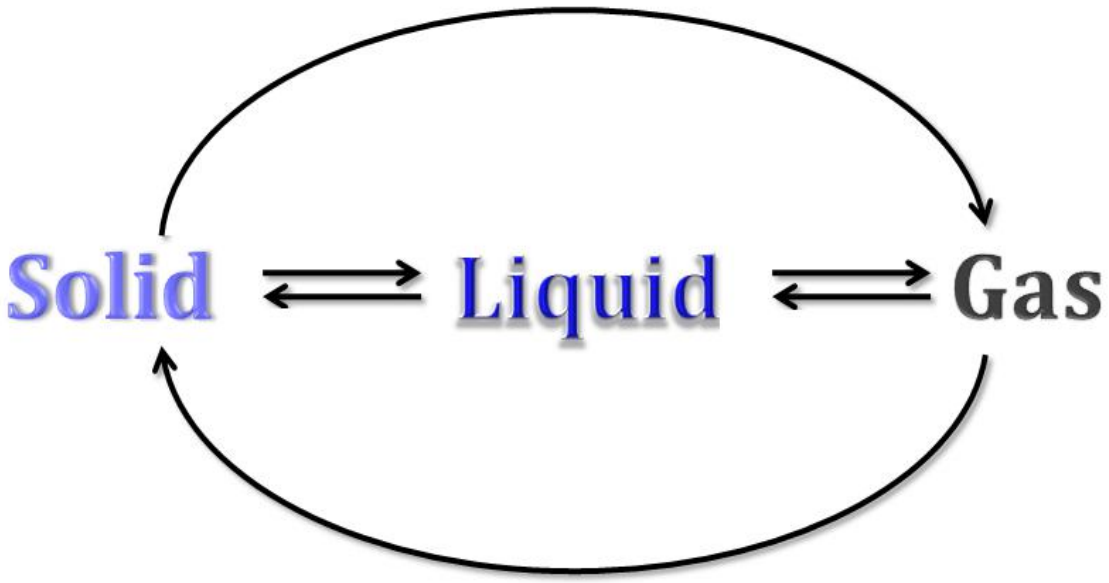
17. Fill in the following phase change diagram indicating the following: Melting, freezing, evaporation, condensation, sublimation, deposition



What is Heat? – Multiple Choice Questions

Directions: Read the attached article Heat Flow (found on the website) then answer the following questions.

1. Which statement is true?
   a. At a given temperature, the temperature value is a measure of the total kinetic energy of all the molecules.
   b. At a given temperature, all the particles have the same amount of kinetic energy.
   c. At a given temperature, the average kinetic energy of the molecules is constantly changing.
   d. At a given temperature, the temperature value is a measure of the average kinetic energy of all the molecules.

2. In which sample do the particles have the highest average kinetic energy?
   a. $H_2O(l)$ @55°C
   b. Br_2 (l) @75°C
   c. NaCl (aq) @30°C
   d. Mg(s) @17°C

3. Which sample has particles with the *lowest* average kinetic energy?
   a. 1.0g of I_2 at 50.°C
   b. 2.0g of I_2 at 30.°C
   c. 7.0g of I_2 at 40.°C
   d. 9.0g of I_2 at 20.°C

4. Object *A* at 40.°C and object *B* at 80.°C are placed in contact with each other. Which statement describes the heat flow between the objects?
   a. Heat flows from object *A* to object *B.*
   b. Heat flows from object *B* to object *A.*
   c. Heat flows in both directions between the objects.
   d. No heat flow occurs between the objects.

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5. What occurs when a 35 gram aluminum cube at 100.°C is placed in 90. grams of water at 25°C in an insulated cup?
    a. Heat is transferred from the aluminum to the water, and the temperature of the water decreases.
    b. Heat is transferred from the aluminum to the water, and the temperature of the water increases.
    c. Heat is transferred from the water to the aluminum, and the temperature of the water decreases.
    d. Heat is transferred from the water to the aluminum, and the temperature of the water increases.

6. A person with a body temperature of 37°C holds an ice cube with a temperature of 0°C in a room where the air temperature is 20.°C. The direction of heat flow is
    a. from the person to the ice, only
    b. from the person to the ice and air, and from the air to the ice
    c. from the ice to the person, only
    d. from the ice to the person and air, and from the air to the person

All About That Specific Heat

Directions: Read the attached article Heat Flow (found on the website) then answer the following questions.

1. **Fill in the Blanks:** Specific heat is defined as the amount of heat (in _____) needed to raise ____ gram of a substance ____˚C. Every substance has its own specific heat depending on the bonds and forces it has.

2. At the park, why do you tend to steer clear of metal benches and prefer wooden picnic benches? Which has a lower specific heat?

3. Explain in terms of specific heat why during the month of October on Long Island the air temperature fluctuates between 60 ˚F during the day and 40 ˚F at night yet the ocean water temperature is consistently 65 ˚F?

4. Based on the specific heat values in the table below, why do Al, Cu, Au, Fe and Hg have very low values? (What do they have in common?)

Substance	Specific Heat
Air	1.01
Aluminum	0.902
Copper	0.385
Gold	0.129
Iron	0.450
Mercury	0.140
NaCl	0.864
Ice	2.03
Water	4.18

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Heat Calculations: Equations

Manipulate the $q = mc\Delta T$ to solve for the following variables.

Solving for Heat (J)	Solving for Mass (g)	Solving for Specific Heat (J/g•C)	Solving for Temperature (°C)

Heat of Fusion and Heat of Vaporization Equations

- If you forget what the symbols in the equation mean or even the equations themselves, instead of freaking out and panicking, what should you do?

- If you forget the specific heat of water or the heat of vaporization or the heat of fusion for water, instead of freaking out and panicking, what should you do?

Heat Calculations: Practice

1. The temperature of a sample of water in the liquid phase is raised 30.0 °C by the addition of 3762 J. What is the mass of the water?

2. What is the specific heat of silver if an 80.0 gram sample is heated from 24.0 °C to 49.0 °C by adding 468.2J?

3. What is the total number of joules of heat needed to change 25 g of ice to water at 0°C?

4. When 418. joules of heat energy are added to 10.0 grams of water at 20.0 °C, what will the final temperature of the water be?

5. If the temperature of water is changed from 10.0 °C to 35.0 °C by the addition of 350.0J, how many grams were heated?

6. If the temperature of water is changed from 100.0 °C to 250.0 °C by the addition of 5000.0J, how many grams were heated?

7. If 3500.0J of energy are applied to 150.0 grams of water at 50.0 °C, what is the final temperature?

8. What is the total number of joules required to freeze a 10 g sample of water at 0°C?

9. How many Joules of energy are needed to change the temperature of 100.0 grams of water from 20.0 °C to 40.0 °C?

10. How many kilojoules of energy are needed to change the temperature of 15.0 grams of water from 35.0 °C to 75.0 °C?

11. How much energy is required to vaporize 10.00 g of water at its boiling point?

12. What is the total number of joules of heat needed to change 25 g of ice to water at 0°C?

13. Calculate the amount of energy required to heat **100. g** to the following:
    a. H_2O (s) changes to H_2O (l) at 0°C

    b. H_2O (l) changes to H_2O (s) at 0°C

    c. H_2O(l) at 10°C changes to H_2O (l) at 20°C

14. At 1 atmosphere of pressure, 25.0 g of a compound at its normal boiling point are converted to a gas by the addition of 34,400 J. What is the heat of vaporization for this compound?

15. Which involves a greater amount of energy, melting 35.0 g of solid ice at 0˚C or freezing 35.0 g of liquid water at 0˚C? Justify your answer.