Regents Chemistry:

Practice Packet Unit 3: Heat

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Review (Things you need to know in order to understand the new “stuff”)**

***Particle Diagrams***

Draw a particle diagram of a compound of CO2, using black solid circles to represent the C and empty circles to represent the O. Draw at least five molecules of CO2 in the box below:

***Temperature and Conversions:***

1) Convert -83ºC to Kelvin

2) Convert 167 K to Celsius

3) What is the lowest possible temperature in Kelvin? \_\_\_\_\_\_\_\_\_\_

4) What is the lowest possible temperature in ºC? \_\_\_\_\_\_\_\_\_

5) Using the temperature conversion formula on Table T in your Reference Tables, convert the following temperatures to either Celsius or Kelvin.

|  |  |
| --- | --- |
|  |  383 K |
|  80. ºC |  |
|  |  323 K |
|  10. ºC |  |
|  - 10. ºC |  |
|  |  243 K |

6) Overnight, the temperature drops by 30.oC. What is the drop in the Kelvin temperature?

a) 30. K b) 243 K c) 303 K d) 273 K

7) Perform the following Conversions:

a.) 20. kJ to J

b.) 100. J to kJ

c.) 500g to kg

d.) 46kg to g

For the following problems solve for x:

8) 500. = (50.0) (4.18) (x)

9) 2,400 = (x) (4.18) (20.0)

10) 33,400 = (334) (x)

11) 22, 600 = x (2,260)

**Lesson 1: What is Heat?**

***Objective:***

* ***Describe the different types of energy.***
* ***Define heat as a measure of kinetic or thermal energy.***
* ***Understand the difference between temperature (a measurement of the average kinetic energy of the particles in a sample of material) and heat (the total kinetic energy associated with a sample).***
* ***Determine the direction of heat flow between two objects***
* ***Describe the types of energy involved in exothermic and endothermic chemical or physical changes***

1.) Which statement is true?

(1) At a given temperature, the temperature value is a measure of the total kinetic energy of all the molecules.

(2) At a given temperature, all the particles have the same amount of kinetic energy.

(3) At a given temperature, the average kinetic energy of the molecules is constantly changing.

(4) At a given temperature, the temperature value is a measure of the average kinetic energy of all the molecules.

2.) Which is not a form of energy?

 (1) light (2) temperature (3) electricity (4) heat

3.) Which term is defined as a measure of the average kinetic energy of the particles in a sample of matter?

(1) activation energy (2) potential energy (3) temperature

4.) In which sample do the particles have the highest average kinetic energy?

(1) H2O(l) @55oC (2 )Br2 @75oC (3) NaCl(aq) @30oC (4) Mg(s) @17oC

5.) Which sample has particles with the *lowest* average kinetic energy?

(1) 1.0g of I2 at 50.°C (2) 2.0g of I2 at 30.°C

(3) 7.0g of I2 at 40.°C (4) 9.0g of I2 at 20.°C

6.) The average kinetic energy of water particles increases when:

(1) H2O (l) changes to H2O (s) at 0 oC

(2 H2O (s) changes to H2O (l) at 0 oC

(3) H2O (l) at 10 oCchanges to H2O (l) at 20 oC
(4) H2O (l) at 20 oCchanges to H2O (l) at 10 oC

7.) 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?

(1) Heat flows from object *A* to object *B.*(2) Heat flows from object *B* to object *A.*(3) Heat flows in both directions between the objects.

(4) No heat flow occurs between the objects.

8.) 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?

(1) Heat is transferred from the aluminum to the water, and the temperature of the water decreases.

(2) Heat is transferred from the aluminum to the water, and the temperature of the water increases.

(3) Heat is transferred from the water to the aluminum, and the temperature of the water decreases.

(4) Heat is transferred from the water to the aluminum, and the temperature of the water increases.

9.) 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

(1) from the person to the ice, only
(2) from the person to the ice and air, and from the air to the ice
(3) from the ice to the person, only
(4) from the ice to the person and air, and from the air to the person

10.) Explain what happens to an ice cube in your hand if you are in a room that has a temperature of 20.°C.

2CH3OH(*l*) + 3O2(g) 🡪 2CO2(g) + 4H2O(*l*) + 1452kJ

1. Which statement correctly describes the reaction above.
2. It is endothermic and energy is absorbed.
3. It is endothermic and energy is released.
4. It is exothermic and energy is absorbed.
5. It is exothermic and energy is released.

12) In the reaction: N2(g) + 2O2(g) + 66.4kJ 🡪 2NO2(g), the reaction

 (a) is exothermic and thermal energy is converted to chemical energy

 (b) is exothermic and chemical energy is converted to thermal energy

 (c) is endothermic and thermal energy is converted to chemical energy

 (d) is endothermic and chemical energy is converted to thermal energy

13) Are the following endo- or exothermic? (use the formula given or Table I)

 25.69kJ + NH4NO3(s) 🡪 NH4+(aq) + NO3-(aq) \_\_\_\_\_\_\_\_\_\_\_

CH4(g) + 2O2(g) 🡪 CO2(g) + 2H2O(*l*) \_\_\_\_\_\_\_\_\_\_\_

CO2(s) + heat 🡪 CO2(g) \_\_\_\_\_\_\_\_\_\_\_

H2(g) + I2(g) 🡪 2HI(g) \_\_\_\_\_\_\_\_\_\_\_

2HI(g) 🡪 H2(g) + I2(g) \_\_\_\_\_\_\_\_\_\_\_

 *Remember reverse the reaction, reverse the sign!*

14) Consider the following change:

H2O(s) + heat 🡪 H2O(l)

Is it endothermic or exothermic? (do I have to put heat in or is heat released?)\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Will the temperature of the surroundings increase or decrease? (think about the drink into which you deposit the ice cube) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Describe the heat flow between the surroundings (the drink initially at room temperature or 25°C) and the ice (at 0°C). \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

15) Using the analysis in question 14 above, are these endo or exothermic and will the surroundings increase or decrease in temperature?

 Dissolving KNO3 \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Burning CH4 in O2 \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**ASSESS YOURSELF ON THIS LESSON: \_\_\_\_\_\_\_\_\_/24**

If you missed more than 5, do the Additional Practice.

**ADDITIONAL PRACTICE LESSON 1**

1. Complete the following statement:

**Heat flows from what’s \_\_\_\_\_\_\_\_\_\_ to what’s \_\_\_\_\_\_\_\_\_\_.**

2.) Which sample has particles with the *lowest* average kinetic energy?

(1) 10. g of H2O(s) at -30.°C (2) 10. g of Br2(l) at -6.°C

(3) 5.0 g of H2O(s) at 220. K (4) 5.0 g of Br2(s) at 225 K

3.) A person with a body temperature of 37°C holds an coffee cup with a temperature of 82°C in a room where the air temperature is 28.°C. The direction of heat flow is

(1) from the coffee to the person, only.
(2) from the coffee to the person and air, and from the air to the coffee.
(3) from the coffee to the person and air, and from the person to the air.

(4) from the coffee to the person and air, and from the air to the person.

4.) Which term represents a form of energy?

(1) heat (2) temperature (3) kilojoule (4) degree

5.) What is Average kinetic Energy?

5. Copy the balanced equation from Table I for the following reactions and insert heat as a reactant or product:

 a. The formation of H2O(g) from its elements \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 b. The formation of C2H6 from its elements \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 c. The *decomposition* of C2H6 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 d. The dissolving of NH4Cl \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6. Which of the reactions is question 5 above are endothermic?

**ASSESS YOURSELF ON THIS ADDITIONAL PRACTICE: \_\_\_\_\_\_\_\_\_/9**

If you missed more than 2 you should see me for extra help and/or re-watch the lesson video assignment

**Lesson 2: Calculating Heat**

***Objective:***

* ***Calculate heat, specific heat, mass, and change in temperature for a given sample of matter.***

**Identify the following terms with units: q: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ c: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

 **m: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ΔT: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Write the heat formula which contains the above four variables:**

***Answer the following questions using the heat formula. Write out the formula and circle the variable you are solving for. Include a numerical set up and your final answer (boxed) with units.***

1. A 5.00 gram sample of water is heated so that its temperature increases from 10.0°C to 15.0°C. What is the total amount of energy absorbed by the water?
2. When a sample of 25.0 g of water is cooled from 20.0°C to 10.0°C, what is the number of Joules of energy released?
3. A sample of water is heated from 10.0°C to 15.0°C by adding 125.58 Joules of heat. What is the mass of the water?

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. When 418. Joules of heat energy are added to 10.0 grams of water at 20.0 °C.

* 1. What is the change in the temperature of the water?
	2. What will the final temperature of the water be?
1. The temperature of 50.0 grams of liquid water was raised to 50.0 °C by the addition of 500. Joules of heat. What was the initial temperature of the water?

**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.**

1. 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?
2. What is the specific heat of copper if a 75.0 gram sample of copper is heated from 20.0C to 24.0C by adding 117J?
3. At the park, why do you tend to steer clear of metal benches and prefer wooden picnic benches? Which has a lower specific heat?
4. 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?

**ASSESS YOURSELF ON THIS LESSON: \_\_\_\_\_\_\_\_\_/10**

If you missed more than 3, do the Additional Practice.

**ADDITIONAL PRACTICE LESSON 2**

1. How many Joules of energy are needed to change the temperature of 100.0 grams of water from 20.0C to 40.0C?
2. How many joules of heat energy are released when 50.0 grams of water are cooled from 70.0°C to 60.0°C?

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

4. How many grams of water will absorb a total of 2400 joules of energy when the temperature changes from 10.0 °C to 30.0 °C?

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

6. What is the specific heat of a substance if 100.0g absorbs 1500J and the temperature increases by 10.0°C?

**ASSESS YOURSELF ON THIS ADDITIONAL PRACTICE LESSON: \_\_\_\_\_\_\_\_\_/6**

If you missed more than 2 you should see me for extra help and/or re-watch the lesson video assignment

**LESSON 3: PHASE CHANGES AND HEAT**

***Objective:***

* ***Describe the structure and arrangement of particles associated with each physical state (solid, liquid, gas)***
* ***Explain phase changes in terms of the changes in potential and kinetic energy and intermolecular distance.***
* ***Identify a phase change (fusion (melting), solidification (freezing), vaporization (boiling, evaporation), condensation, sublimation, and deposition) as either endo or exothermic.***

****

1. Which arrows in Model 1 indicate the addition of energy? \_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_

2. Which term, endothermic or exothermic, is used to describe the situation when energy is added into a system from the surroundings (the system absorbs energy)? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What are the names of the phase changes that involve the absorption of energy from the surroundings by the system? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. Which arrows in Model 1 indicate the release of energy? \_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_

1. What are the names of the phase changes that involve a release of energy to the surroundings by the system? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. In terms of particle attraction, explain why some substances such as water are liquids at room temperature, while others, such as oxygen, are in the gas phase at room temperature.

7. Which physical changes are endothermic?

 a) melting and freezing

 b) melting and evaporating

 c) condensation and sublimation

 d) condensation and deposition

8. Which sample of matter sublimes at room temperature and standard pressure?

 a) Br2(l)

 b) Cl2 (g)

 c) CO2(s)

 d) SO2 (aq)

9. Which phase change is exothermic?

 a) H2O(l) 🡪 H2O (g)

 b) I2(s) 🡪 I2 (g)

 c) Hg (l) 🡪 Hg (s)

 d) Al (s) 🡪 Al (l)

**ASSESS YOURSELF ON THIS LESSON: \_\_\_\_\_\_\_\_\_/9**

If you missed more than 3, do the Additional Practice.

1.

2.

3.

**ASSESS YOURSELF ON THIS LESSON: \_\_\_\_\_\_\_\_\_/3**

If you missed more than 3, do the Additional Practice.

1. **LESSON 4: INTERPRETING HEATING AND COOLING CURVES**

\_\_\_\_\_\_\_\_\_\_\_\_\_thermic

***Objective:***

* ***Qualitatively interpret heating and cooling curves in terms of changes in kinetic and potential energy, and phase changes.***
* ***Describe the states of the elements at STP***

*Label the phase change diagram below to answer the questions that follow*.



1. Identify the phase(s) represented by the following line segments:
	1. AB \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ d. DE \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	2. BC \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ e. EF \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	3. CD \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
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. What is the first temperature where you could see one drop of a liquid? \_\_\_\_\_\_\_\_\_\_\_
6. What is the first temperature where you could see the last crystal of a solid? \_\_\_\_\_\_\_\_\_\_\_
7. What is the first temperature where you could see one bubble of a gas? \_\_\_\_\_\_\_\_\_\_\_
8. During which segments is the temperature rising? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
9. What type of energy (kinetic or potential) is changing in the system during the line segments mentioned in question 8? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
10. During which line segments is there no change in temperature? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
11. During which segments are there phase changes occurring? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
12. What type of energy (kinetic or potential) is changing in the system during the line segments mentioned in question 11? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
13. At what point will the particles be moving the slowest? \_\_\_\_\_\_\_\_\_\_\_\_\_\_
14. If this substance were water, at what temperature would segment BC occur? \_\_\_\_\_oC
15. If this substance were water, at what temperature would segment DE occur? \_\_\_\_\_ oC

Determining Phase of an Element:

16. Where can you find STP conditions in your Reference Table? Table

17. Standard temperature = oC or K

18. Standard pressure = kPa or atm

19. At 0°C, what state would each of the following elements be in:

a. Hydrogen \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. Lithium \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c. Bromine \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

20. At *STP*, which list of elements contains a solid, a liquid, and a gas?

(1) Hf, Hg, He (3) Ba, Br2, B

(2) Cr, Cl2, C (4) Se, Sn, Sr

21.At which Celsius temperature does lead change from a solid to a liquid?

 a) 873°C

 b) 600.°C

 c) 327°C

 d) 0. °C

**ASSESS YOURSELF ON THIS LESSON: \_\_\_\_\_\_\_\_\_/29**

If you missed more than 6, do the Additional Practice.

**ADDITIONAL PRACTICE LESSON 4:**

Use the following diagram to answer questions 1-2.

200

150

100

50

0

-50

-100

0 1 2 3 4 5 6 7 8 9

Time (min)

T

e

m

p

 (oC)

a

b

c

d

e

1. Is heat being added or removed from this substance? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Which segment represents the point during which the gas is turning into a liquid (g → l)? \_\_\_\_\_
3. Which segment represents the point during which the liquid is turning into a solid (l → s)? \_\_\_\_\_
4. What term do we use for what the substance is doing between minutes 1 and 3? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
5. What state of matter is the substance in at the end of segment b? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

… (just beginning of segment c)

1. How long did it take for the substance to condense completely? \_\_\_\_\_\_\_\_\_\_\_\_

 …(from the beginning of the condensation process to the end)

1. This graph likely represents a cooling curve for water? (True or False) \_\_\_\_\_\_\_\_\_\_
2. What term do we use for what the substance is doing between minutes 6 and 7? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

9. What phase/state of matter would you have the lowest kinetic energy? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

C*omplete the table below*:

1. What phase/state of matter is the substance in during segment:

|  |  |
| --- | --- |
| a |  |
| c |  |
| e |  |

11. What is the phase of each element below at STP?

 a. Bromine \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 b. Gallium \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 c. Xenon \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**ASSESS YOURSELF ON THIS ADDITIONAL PRACTICE LESSON: \_\_\_\_\_\_\_\_\_/15**

If you missed more than 3 you should see me for extra help and/or re-watch the lesson video assignment.

**Lesson 5: Calculating Heat of Phase Changes**

***Objective:***

* ***Calculate heat of phase changes using q=mHf and q=mHv***

**Directions:** Read and answer each of the following questions. Make sure to show all work:  ***Write out the formula and circle the variable you are solving for. Include a numerical set up and your final answer (boxed) with units.***

1. What is the total number of joules required to freeze a 10.0 g sample of water at 0°C?
2. How much energy is required to vaporize 10.00 g of water at its boiling point?
3. What is the total number of kilojoules of heat needed to change 25 g of ice to water at 0°C?
4. Calculate the amount of energy required to heat 100.g of the following:
	1. H2O(s) changes to H2O(l) at 0°C
	2. H2O(l) changes to H2O (s) at 0°C
	3. H2O(l) at 10.°C changes to H2O(l) at 20.°C
5. What is the total number of kilojoules of heat needed to change 25 g of ice to water at 0°C?
6. In question 5, is heat being absorbed or released? Is this process endothermic or exothermic?
7. 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?
8. 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.

**ASSESS YOURSELF ON THIS LESSON: \_\_\_\_\_\_\_\_\_/10**

If you missed more than 3, do the Additional Practice.

**ADDITIONAL PRACTICE LESSON 5**

1. What is the total number of joules required to freeze a 100. g sample of water at 0°C?
2. What is the total number of joules of heat needed to melt 35 g of ice to water at 0°C?
3. How much energy is required to vaporize 10.0 grams of water at its boiling point?
4. What is the total number of kilojoules required to completely boil 100.0 g of water at 100.0 OC and at 1 atmosphere?
5. What is the heat of vaporization of a liquid that requires 3200. J of energy to completely boil a 24 gram sample?

**ASSESS YOURSELF ON THIS ADDITIONAL PRACTICE LESSON: \_\_\_\_\_\_\_\_\_/5**

If you missed more than 1 you should see me for extra help and/or re-watch the lesson video assignment

**Unit 3 Practice/Review**

1. Label the line segments with their phase(s).
2. What is this substance’s melting point? \_\_\_\_\_\_\_\_\_
3. What is this substance’s boiling point? \_\_\_\_\_\_\_\_\_\_
4. Does this represent an endothermic or exothermic reaction?
5. Heat is being released at 60.0 kilojoules per minute.

How much heat is released when the substance freezes?

1. If this curve represents the temperature of 10.0g of the substance, what is the substance’s Heat of Fusion?
2. Label the point with the most kinetic energy with a star.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Draw six particles of this substance as it looks for the

first line segment in the box below.

1. Draw six particles of this substance as it looks for the

last line segment in the box below.

1. At which point is the potential energy the highest? Label it with a star.
2. What is the boiling point of this substance? \_\_\_\_\_\_\_\_\_\_\_\_\_
3. What is the melting point of this substance? \_\_\_\_\_\_\_\_\_\_\_\_\_
4. Draw and label a heating curve for your element, starting below the melting point and continuing to above your boiling point (if Helium, start below your boiling point (BP); if Carbon, use MP=BP=3915K)

Heating Curve for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Use your graph to answer the following:

1. What is your phase at -100°C? \_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. What is your phase at 0°C? \_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. What is your phase at 1000°C? \_\_\_\_\_\_\_\_\_\_\_\_\_\_

14. How much energy does it take to melt 6.0 g of ice at 0°C?

15. If 576J of energy are removed from a 10.0g sample of water at 20.0°C, what will the final temperature of the water be?

16. A student conducts an experiment to determine the specific heat capacity of nickel. During the experiment, the 32.38 g sample of nickel increases by 33.5 C when 436 J are transferred to it. *(Don’t forget formula, variables, and numerical set up).*

a) Solve for the specific heat capacity of nickel.

b) Solve for the student’s percent error, given an actual specific heat capacity for nickel of .440 J/gK

17. How much energy does it take to change the temperature of a 5.0g piece of aluminum from 10.0°C to 20.0°C? (Specific heat capacity of aluminum is .900 J/gK)

18. How much heat does it take to change 25 grams of H2O(s) from -20 °C to 80°C. (Hint you have to do three equations) *The specific heat of ice is 2.01 J/g°C.*

Vocabulary:

Boiling: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Calorimetry:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Condensing: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Deposition: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Endothermic: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Evaporating: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Exothermic: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Freezing: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Heat: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Heat of Fusion:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Heat of Vaporization: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Kinetic Energy: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Melting: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Potential Energy:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Specific Heat: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Sublimation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Temperature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_