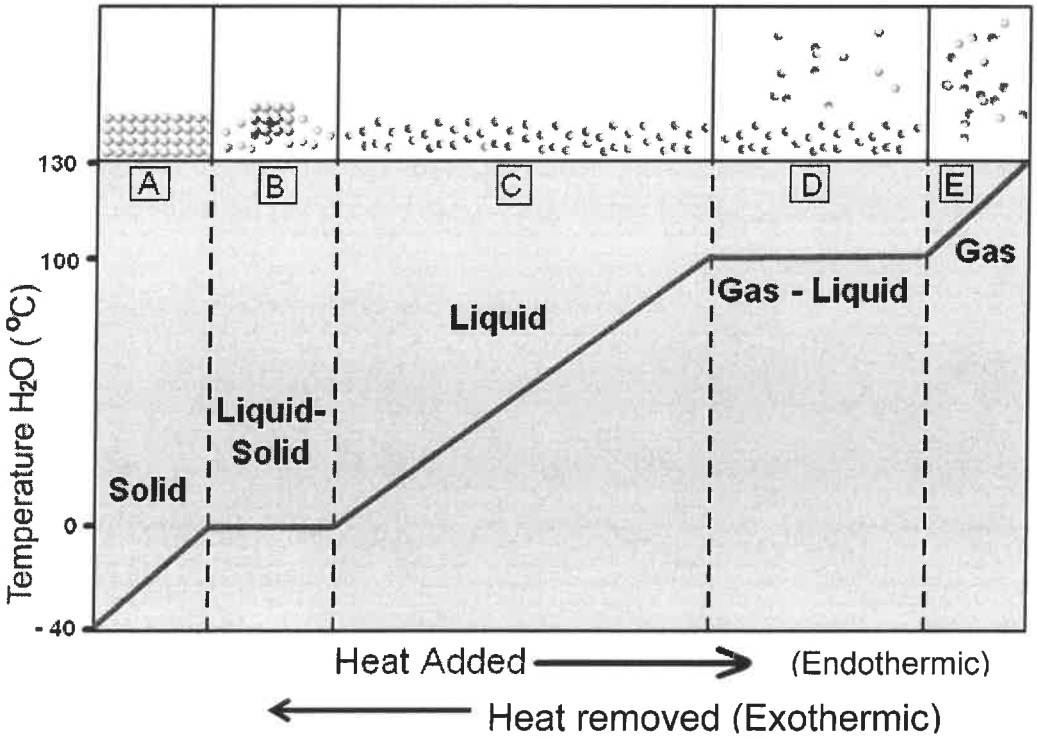
Name: _____

Energy Curve Worksheet

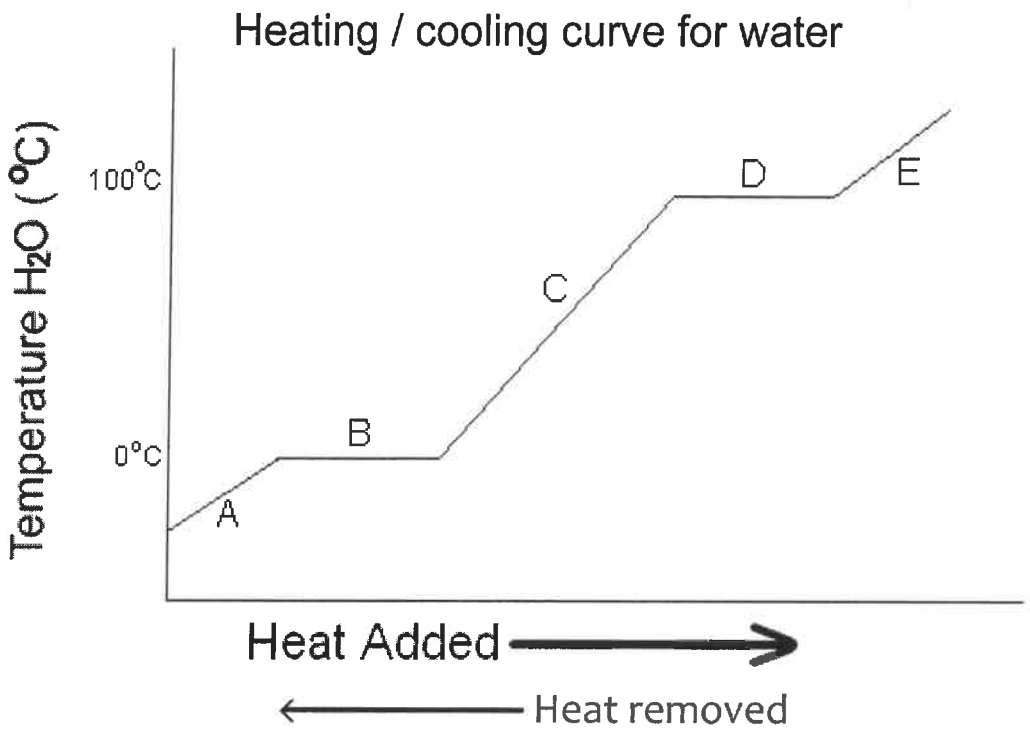
Below is a diagram showing a typical *heating/cooling curve* for water. It reveals a wealth of information about the structure and changes occurring in water as it is heated or cooled through all three phases of matter at different temperatures. At the top of the diagram are pictures representing the typical particle arrangement as substances change through their states.



Identify by letters (A-E) in which section the following are found:

1._____ Solid getting warmer
2._____ Liquid getting warmer
3._____ Gas getting warmer
4._____ Freezing/ Solidifying
5._____ Melting/ Liquefying
6._____ Boiling point
7._____ Boiling (Vaporization)
8._____ Particles farthest apart
9._____ Weakest IMF
10._____ Particles are rigid & compressed
11._____ Particles closest together
12._____ All particles able to move past each other in fluid motion
13._____ Condensation occurs
14._____ Strongest IMF
15._____ Particle motion is stationary
16._____ Particles are most chaotic and disordered. Have the most **entropy.**

Answer the following questions based on the energy curve below.



1. Is boiling an exothermic or endothermic process? _____
2. Is freezing an exothermic or endothermic process? _____
3. Is melting an exothermic or endothermic process? _____
4. When heat energy is released from the system, what physical change occurs at D?

   _____
5. When heat energy is released from the system, what physical change occurs at B?

   _____
6. When heat energy is added to the system, what physical change occurs at B?

   _____
7. During which interval(s) is the KE increasing (KE is energy of motion…think, what is the relationship between energy, temperature and motion? _____
8. During which interval does the substance have the weakest IMF? _____
9. During which interval does the substance have strongest IMF? _____
10. If the particles are not moving faster (temperature is not increasing) during B & D, then what is the energy absorbed for? _____

Name: _____

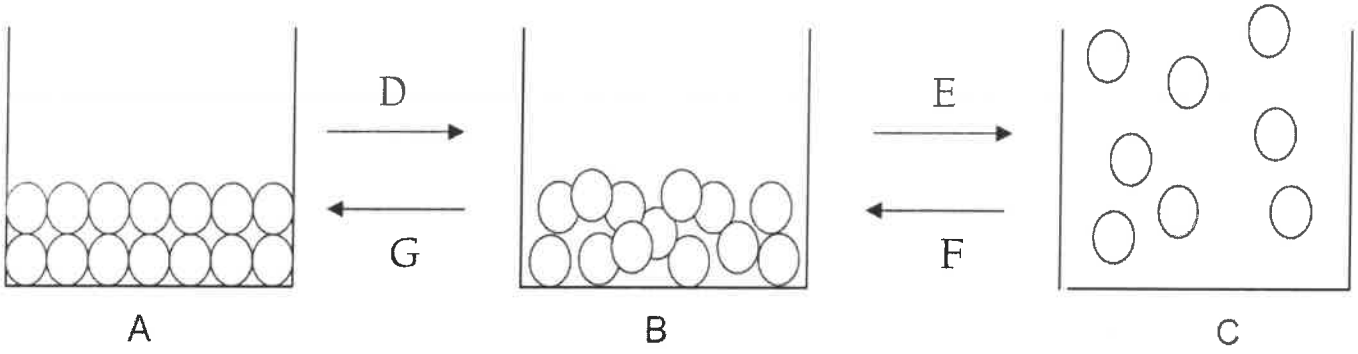
Physical Behavior of Matter
Heating and Cooling Curves

OBJECTIVES:

- Be able to distinguish between molecules in each phase of matter
- Predict phases of matter by location on a heating/cooling curve graph
- Create a cooling curve when given data and identify phase changes, E changes

Model 1 represents molecules in the three phases of matter. Based on what you already know about these phases, complete the table that follows. A word bank has been provided for the last column.

MODEL 1: PHASE CHANGE PARTICLE DIAGRAM



Word Bank for Column 3:

Gas Melting/Fusion Vaporization Solid Freezing Liquid Condensation

COLUMN 1	COLUMN 2	COLUMN 3
	DESCRIBE THE PARTICLE DIAGRAM	WHAT **PHASE** IS THIS?
PARTICLE DIAGRAM A		
PARTICLE DIAGRAM B		
PARTICLE DIAGRAM C		
	IS HEAT BEING ADDED OR RELEASED (TAKEN AWAY)?	WHAT **PROCESS (PHASE CHANGE)** IS OCCURING?
ARROW D (FROM A TO B)		
ARROW E (FROM B TO C)		
ARROW F (FROM C TO B)		
ARROW G (FROM B TO A)		

Look at the word ENDOTHERMIC. Based on the prefix endo-, do you think energy is being added (entering), or being released (exiting)? _____

Which phase change processes indicate an ENDOTHERMIC reaction? _____

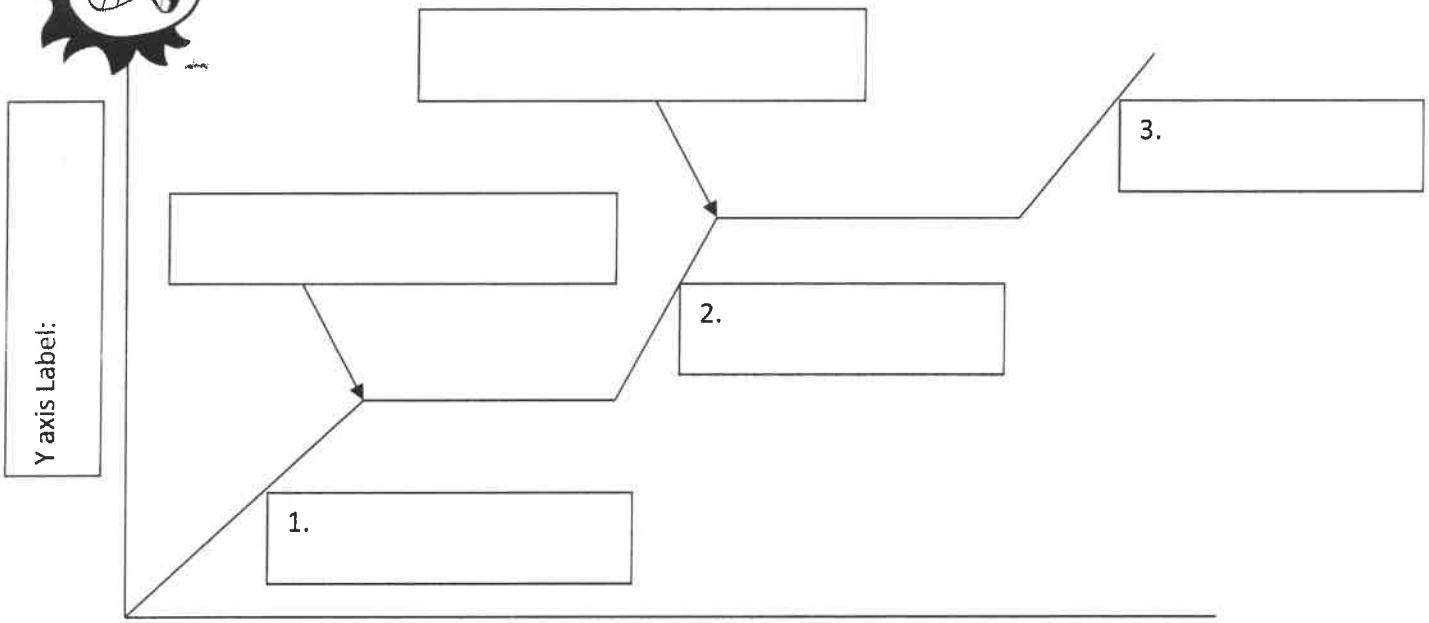
Look at the word EXOTHERMIC. Based on the prefix exo-, do you think energy is being added (entering), or being released (exiting)? _____

Which phase change processes indicate an EXOTHERMIC reaction? _____

MODEL 2: HEATING CURVE GRAPH

The following graph shows what happens to water as it goes from ice to liquid water to water vapor. Use the word bank and heating curve graph below to identify these phases and phase changes.

WORD BANK			
Temperature	Time		Melting/Freezing Point
Solid	Liquid	Gas	Boiling/Vaporization Point



Now draw a particle diagram for locations 1, 2, and 3 on the heat curve. **Remember that you are drawing these particle diagrams for WATER**

Particle diagram #1

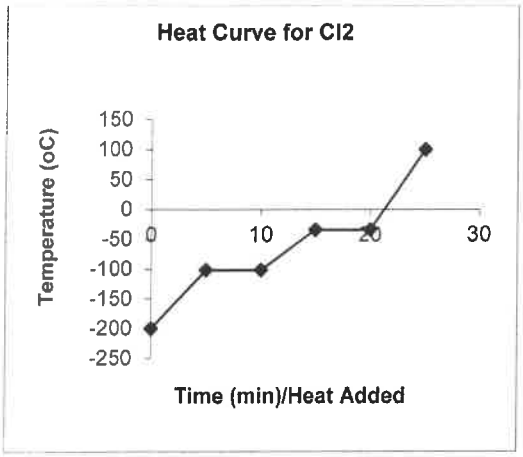
Particle diagram #2

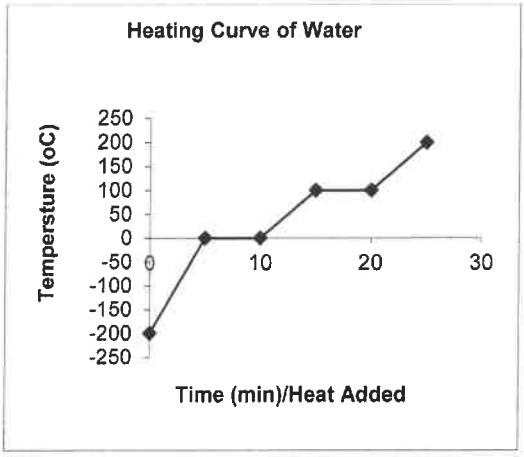
Particle diagram #3

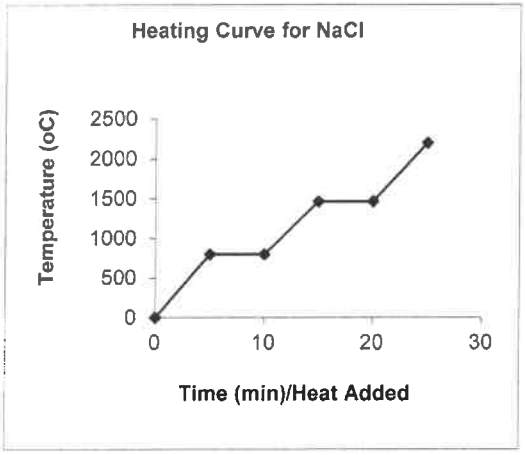
How do the particles in a solid, liquid and gas differ? _____

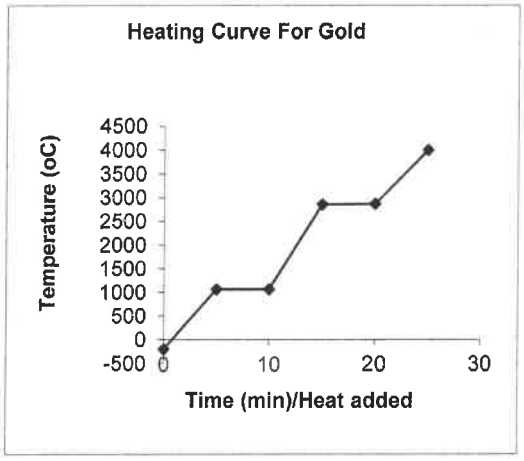
_____

Here are the heating curves for 4 different substances. Use these curves to answer the questions that follow.









1. Which substance does have the highest boiling point? _____
   What is that boiling point of this substance? _____
2. At what temperature range is NaCl a solid? _____
3. What is the melting point for Cl_2? _____
4. Which substance is a liquid at room temperature? _____
5. What phase is Cl_2 in at room temperature? _____
6. What is NaCl's boiling point? _____
7. What phase is water in at -100°C? _____
8. What temperature is Cl_2 at after being heated for 20 minutes? _____
9. Draw a particle diagram for Cl_2 at temperature of 50°C.

10. Draw a particle diagram of NaCl at a temperature of 500°C.

You will now take what you have learned and infer that knowledge to create a Cooling Curve. A cooling curve is simply the opposite of a heating curve- instead of temperature INCREASING, it is DECREASING. Use the information below to create this Cooling Curve for the unknown substance.

-A sample of a substance is cooled from a temperature of 250°C to 10°C over a period of two hours.
-The boiling point of the substance is 175°C and the melting point is 22°C.

Now clearly label the following items in the appropriate locations.
(KE= kinetic energy, PE= potential energy)

Solid	Liquid	Gas
Condensation	Boiling	Freezing Point
Melting Point	Fusion	KE changing
KE not changing	PE changing	PE not changing

BIG IDEA

- As temperature decreases, substances go from the _____ to the _____ to the _____ phase. This shows an decrease in _____ energy.

- Potential energy increases when a substance is _____ and _____. These are _____ reactions because energy is being released.