Name_____ **Period**_____

Unit 2: Matter and Energy

Skills:

1. Classify Types of Matter
2. Identify Phases of Matter
3. Density Application
4. Percent Error Calculation
5. Distinguish between P + C properties
6. Distinguish Physical + Chemical changes
7. Identify methods of separation of matter
8. Apply Conservation of Matter and Energ
9. Distinguish KE and PE, endo or exothermic
10. Draw and interpret heating/cooling curve
11. Measurement of Heat

Unit 2: Vocabulary:

Complete throughout unit. Due on test day!

Word	Definition
Matter	
Mixture	
Homogenous	
Heterogeneous	
Element	Text
Compound	
Diatomic	
Potential Energy	
Kinetic Energy	
Phase Change	
Chemical Change	

Unit 2 Resources:

Skill 1: Classify Types of Matter

Chemistry: The study of _____
_____

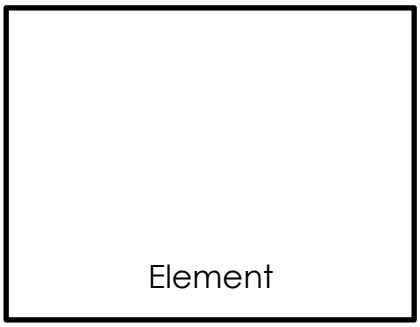
Matter: Any object that has _____ and takes up _____.

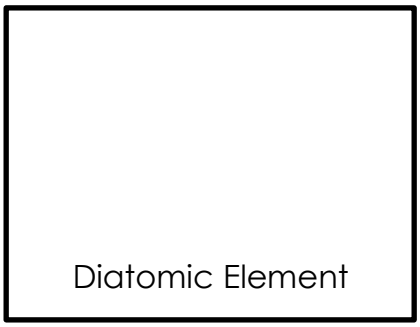
At each station around the room classify the materials as an ELEMENT, COMPOUND or MIXTURE! Record your observations and reasoning below! Be ready to share!

Station 1	**Station 2**	**Station 3**
Station 4	**Station 5**	**Station 6**
Station 7	**Station 8**	**Station 9**

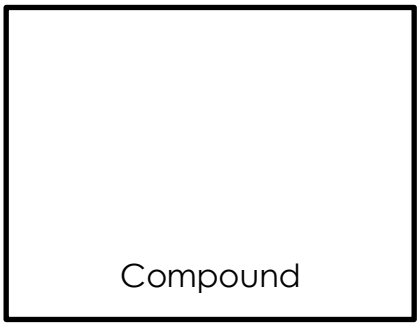
Substance: A substance is matter that has a definite and _____ composition: contains the same material composition throughout the whole sample.

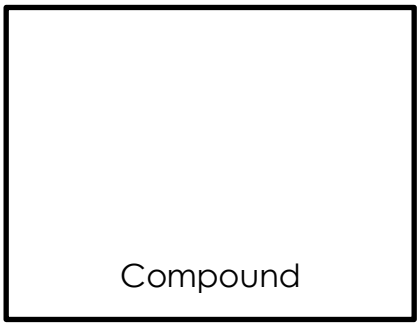
- **Element:** _____ be decomposed by chemical change.
  - Made up of atoms
  - Examples: Carbon (C), Nitrogen (N), Chlorine (Cl), Magnesium (Mg)
  - Can be diatomic: H_2, O_2, Br_2 I_2 N_2 Cl_2 F_2





- **Compound:** Combinations of elements, _____ _____ to one another.
  - Can be broken down into separate elements
  - Properties of individual elements are _____retained…Na + Cl_2 →NaCl





Mixture: NOT chemically combined…. they can be separated by physical methods!

- **Homogeneous** Also called a _____(aq) means "aqueous."
  - NaCl (aq) is sodium chloride dissolved in water.

- **Heterogeneous (mechanical mixture)** Has two or more visible separate parts
  - Salad!

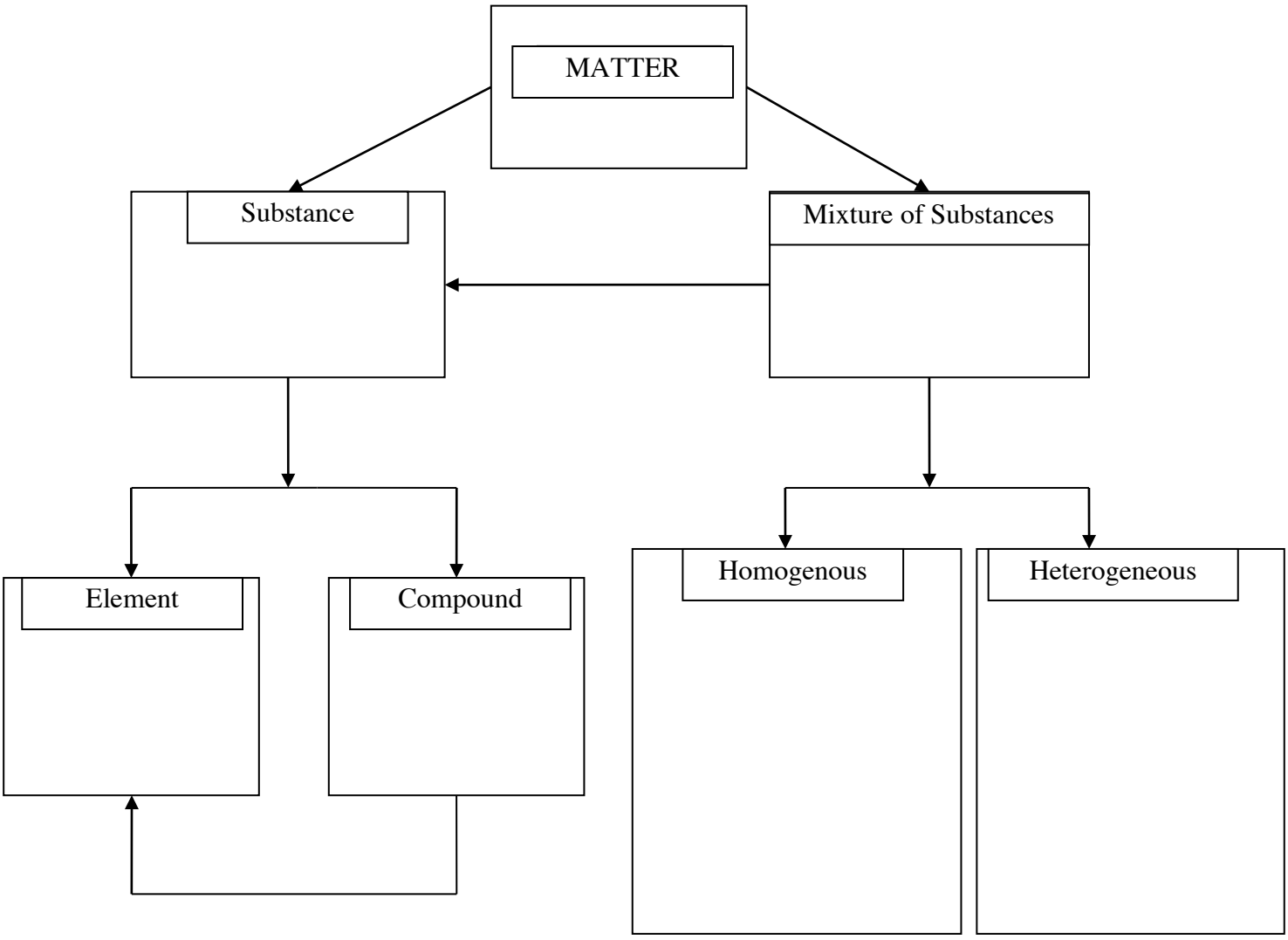
Classify the following as E (elements), C (compound) or M (mixture)

H_2 (g): _____ H_2O(l) : _____

CO_2 (aq): _____ Mg (s): _____

Air (g): _____ F_2 (g): _____

Activity: Classification of Matter…in your hands!



Practice:

1. Which formula represents a mixture?

   A) NaCl(s) B) $C_6H_{12}O_6$(s)
   C) KCl (s) D) KCl (aq)

2. An example of a heterogeneous mixture is

   A) soil B) sugar
   C) carbon monoxide D) carbon dioxide

3. A compound differs from a mixture in that a compound always has a

   A) homogeneous composition
   B) maximum of two components
   C) minimum of three components
   D) heterogeneous composition

4. A substance that is composed only of atoms having the same atomic number is classified as

   A) a compound
   B) an element
   C) a homogeneous mixture
   D) a heterogeneous mixture

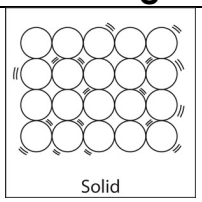
5. Which of these terms refers to matter that could be heterogeneous?

   A) element B) mixture
   C) compound D) solution

Skill 2: Identify Phases of Matter

The phase that matter is in depends on:

1.
2.

State (phase)	Symbol (subscript)	Shape	Volume	Visulize: Particle Arrangement
SOLID	(s)			
LIQUID Or aqueous	(l) or (aq)		Definite Volume	
GAS	(g)	Indefinite shape		

FYI: There are additional ones such as plasma, supercritical fluid, and degenerate gas.

Practice:

1. Which grouping of the three phases of oxygen is listed in order from left to right for increasing distance between oxygen molecules?

   A) gas, liquid, solid B) liquid, solid, gas
   C) solid, gas, liquid D) solid, liquid, gas

2. Which statement best describes the shape and volume of an $H_2O(l)$ STP?

   A) It has a definite shape and a definite volume.
   B) It has a definite shape and no definite volume.
   C) It has no definite shape and a definite volume.
   D) It has no definite shape and no definite volume.

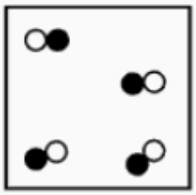
3. The arrangement of particles is most ordered in a sample of

   A) NaCl(aq) B) NaCl(*l*)
   C) NaCl(g) D) NaCl(s)

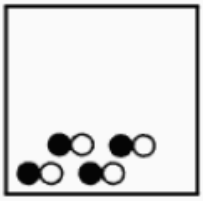
4. When a sample of $CO_2(s)$ becomes $CO_2(g)$, there is a change in

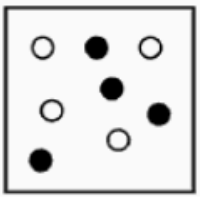
   A) bond type
   B) gram-formula mass
   C) molecular polarity
   D) particle arrangement

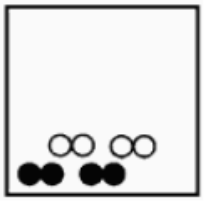
5. Given the particle diagram representing four molecules of a substance:

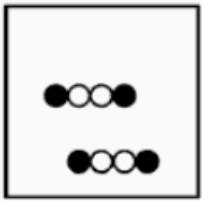


Which particle diagram best represents this same substance after a physical change has taken place?

A) 

B) 

C) 

D) 

Skill 3: Apply density formula to solve word problems

Which phase of matter will have the greatest density? Lowest?

Mass: _____

Measured in: _____

Volume: _____

Measured in: _____

Density: _____

Measured in: _____

Equation (see reference tables):

Table S: Where all known element densities are listed. Which is greatest, Silicon or Lead?

Examples:

1. A person brings in what he thinks to be a gold ring to a jewelry store. The ring has a mass of 4.5 g and a volume of 0.233 cm^3. Is this a gold ring? (Hint: find the density and compare it on Table S)

Givens:

Want:

Want:

Equation and Answer:

2. A piece of scrap metal made of ***iron*** has a volume of 305.5 cm^3. Find the mass of the iron.

Givens:

Want:

Equation and Answer:

Skill 4: Use Percent Error formula for calculation

Essential Question: Will every measurement taken be perfectly accurate and precise?

A stick of gum is about 1 gram. Estimate the mass of a penny.

Estimate: _____ g Actual: _____ g

Equation (see reference tables):

Example:
The boiling point of water is 100^0 C. You and your partner calculate it to be 99.1°C. What is the percent error?

A student finds the density of copper to be 8.218 g/cm^3. The actual density of copper is 8.960 g/cm^3. Find the percent error in her measurement.

Practice:

A) A student determines the density of zinc to be 7.56 grams per millimeter. If the accepted density is 7.13 grams per millimeter, what is the percent error of this calculation?

B) A student takes an object with an accepted mass of 200 grams and measures it using a balance, she records the mass of the object as 196.5g. What is her percent error?

Skill 5: Distinguish between physical and chemical PROPERTIES

Physical Properties	Chemical Properties
Properties of an element or compound that can be observed or measured _____ _____	The ability of an element or substance to undergo a _____ and form a _____
Examples of Physical Properties:	**Examples of Chemical Properties:**

Determine whether the following is a C (chemical) or P (physical) property

1. ___ Water boils at 100 degrees Celsius
2. ___ Water can be separated by electrolysis into hydrogen and oxygen
3. ___ Sugar is capable of dissolving in water
4. ___ Vinegar will react with baking soda
5. ___ Yeasts acts on sugar to form carbon dioxide and ethanol
6. ___ Wood is flammable

Practice:

1. An example of a physical property of an element is the element's ability to

   A) react with an acid
   B) react with oxygen
   C) form a compound with chlorine
   D) form an aqueous solution

2. At STP, which physical property of aluminum always remains the same from sample to sample?

   A) mass B) density
   C) length D) volume

3. Which is a chemical property of water?

   A) It freezes. B) It decomposes.
   C) It evaporates. D) It boils.

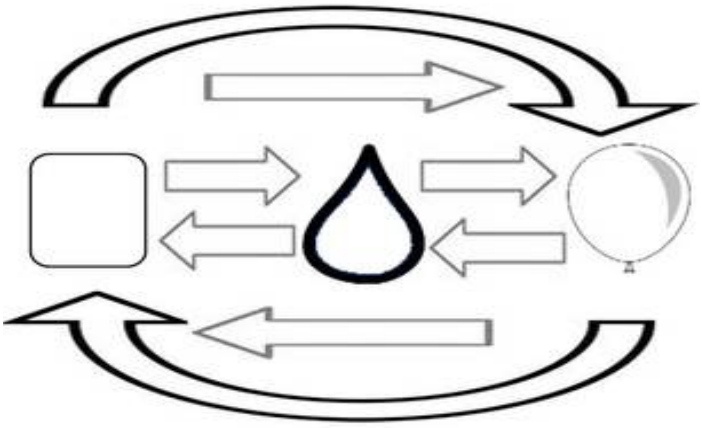
4. Which statement describes a chemical property that can be used to distinguish between compound A and compound B?

   A) A is a blue solid, and B is a white solid.
   B) A has a high melting point, and B has a low melting point.
   C) A dissolves in water, and B does not dissolve in water.
   D) A does not burn in air, and B does burn in air

5. Which statement describes a chemical property of aluminum?

   A) Aluminum is malleable.
   B) Aluminum reacts with sulfuric acid.
   C) Aluminum conducts an electric current.
   D) Aluminum has a density of 2.698 g/cm^3 at STP.

Skill 6: Distinguish between physical and chemical CHANGES

Physical Change	Chemical Change
• It does NOT change _____, it just changes _____ • A change that does NOT affect a substance's chemical composition	• Changing _____ into a _____ _____ • There will be a "evidence of chemical change"
Physical Change Phrases	**Chemical Change Phrases**
Remember: Phase changes are _____ changes! 	**<u>Evidence of Chemical Change</u>** ☐ Gas is produced ☐ Temperature _____ ☐ A substance disappears ☐ A solid is formed ☐ A color change occurs ☐ A new _____ is produced

Physical or Chemical Change: Determine whether C (chemical) or P (physical) change

1. ____ Iron rusts in damp environment
2. ____ Dry ice, solid carbon dioxide, is sublimed at room temperature.
3. ____ Gasoline burns in the presence of oxygen
4. ____ Hydrogen peroxide decomposes to water and oxygen
5. ____ Burning coal
6. ____ Cooking a steak

You **CANNOT** easily get back your original substances as something new has been formed. (Ever try to *un*-fry an egg?)

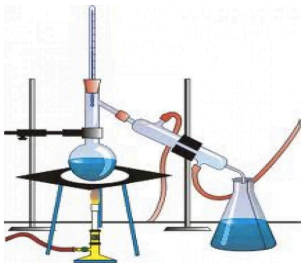
Skill 7: Identify methods of separation of matter

Differences in _____properties can be used to separate mixtures. Certain types of matter can be separated using various methods.

HETEROGENEOUS MIXTURES

1. **Filtration**: A process that separates a _____ from a liquid based on the _____of the particles.
2. **Separatory Funnel:** A process that separates two or more _____ that will not mix with each other
   - The liquid layer that is most dense will be on the _____,
   - **Think about Thanksgiving Gravy!**

HOMOGENEOUS MIXTURES

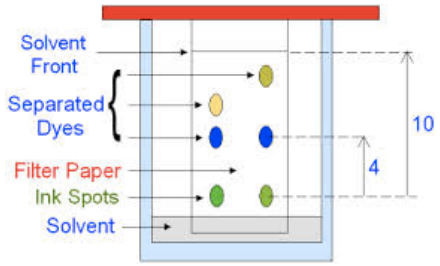


☐ **Distillation aka (Evaporation)**

A process that separates out a _____ (something DISSOLVED in water) by their _____ _____ points.

- Alcohol dissolved in water
- Salt dissolved in water
- Gasoline dissolved in water

☐ **Chromatography:** A process that separates out the components of a mixture based on the rate of _____ and molecular _____.



When a piece of filter paper is dipped into some ink and then placed into water, the water begins to rise by _____ action.

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1. By which process is a precipitate most easily separated from the liquid in which it is suspended?
   A) neutralization B) distillation
   C) condensation D) filtration
2. Which two physical properties allow a mixture to be separated by chromatography?
   A) hardness and boiling point
   B) density and specific heat capacity
   C) malleability and thermal conductivity
   D) solubility and molecular polarity
3. A beaker contains both alcohol and water. These liquids can be separated by distillation because the liquids have different
   A) boiling points B) densities
   C) particle sizes D) solubilities
4. Recovering the salt from a mixture of salt and water could best be accomplished by
   A) evaporation
   B) filtration
   C) paper chromatography
   D) density determination

Skill 8: Apply Conservation of Matter and Energy

Chemical Reaction Equation:

A chemical _____ ALWAYS results in _____ substance(s)!

$2\ H_2\ (g) + O_2\ (g) \rightarrow 2\ H_2O\ (l)$

Conservation:

Mass, energy and charge cannot be created or destroyed in a chemical reaction

Identify the reactants and the products in the chemical equations to the right!
Circle the reactants.
Box the products.

S + Fe → SFe
32g 56g X g

Silver nitrate ($AgNO_3$) and sodium chloride (NaCl) solutions before and after chemical reaction

If 30 grams of element X are reacted with 10 grams of element Y to form compound Z, what is the mass of the product?

a) 40 grams b) 20 grams c) 60 grams d) 120 grams

Aluminum metal is reacted with oxygen to form aluminum oxide. How will the mass of the aluminum oxide compare to the combined masses of the aluminum metal and oxygen that formed it?

a) Equal b) less c) More

40 grams of H_2O (g) are condensed in a closed container. How many grams of H_2O (l) will there be when this process is done?

a) 50 grams b) 40 grams c) 20 grams d) 130grams

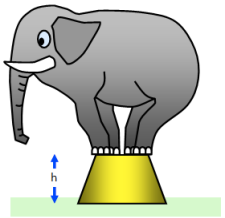
Stop and think: Is this a physical or chemical change?

1. If 50.0 grams of sodium reacts with chlorine to form 126 grams of sodium chloride. How many grams of chlorine reacted?

2. If 178.8 g of water is separated into hydrogen and oxygen gas, and the hydrogen gas has a mass of 20.0 g. What is the mass of the oxygen gas produced?

Skill 9: Distinguish between KE and PE, Endo and Exothermic

Mechanical Energy



Kinetic Energy

The energy of _____.

Moving/vibrating particle of matter!

NOT dependent on the amount of matter!
_____ is a measure of KE.

As particles move faster temperature _____.

Potential Energy

Potential Energy (U or PE):_____
_____

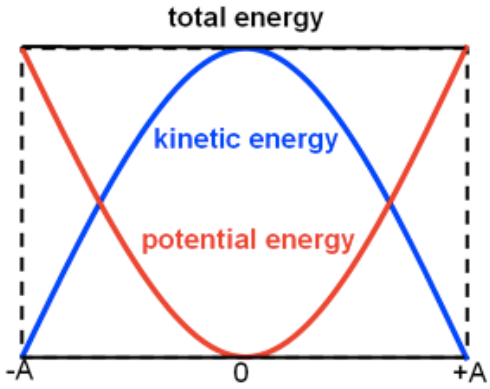
Examples:

- _____
- _____
- Chemical bonds contain energy

The amount of stuff **DOES** matter!
(Football lineman vs Mrs Kehoe…)

As potential energy _____, kinetic energy _____.

- ☐ Energy is never lost! They are connected!! (E=K+U)
- ☐ **Energy cannot be** _____ **or** _____, **only transferred**! This is called the _____ of energy.
- ☐ **Heat Transfer:** Heat always move from _____ objects to _____ objects
- ☐ **Joule:** Unit of measure for PE. 1KJ =_____J



Practice:

1. Different masses of copper and iron have the same temperature. Compared to the average kinetic energy of the copper atoms, the average kinetic energy of the iron atoms is

   (1) 273 K less (2) 200°C less (3) 273 K more (4) the same

2. As the temperature of a substance decreases, the average kinetic energy of its particles

   (1) decreases (2) increases (3) remains the same

Phase changes and Heat: Where does the heat go?

	Endothermic	Exothermic
Word Dissection!		
Definition:		
Chemical Change		
Physical Change		

Additional Practice:

1. The burning of wood is best described as an

   A) endothermic chemical change
   B) endothermic physical change
   C) exothermic chemical change
   D) exothermic physical change

2. When ammonium chloride crystals are dissolved in water, the temperature of the water decreases. What does this temperature change indicate about the dissolving of ammonium chloride in water?

   A) It is an endothermic reaction because it absorbs heat.
   B) It is an endothermic reaction because it releases heat.
   C) It is an exothermic reaction because it absorbs heat.
   D) It is an exothermic reaction because it releases heat.

3. Which phase change is endothermic?

   A) $H_2O(\ell) \rightarrow H_2O(g)$ B) $I_2(g) \rightarrow I_2(s)$
   C) $Hg(\ell) \rightarrow Hg(s)$ D) $H_2S(g) \rightarrow H_2S(\ell)$

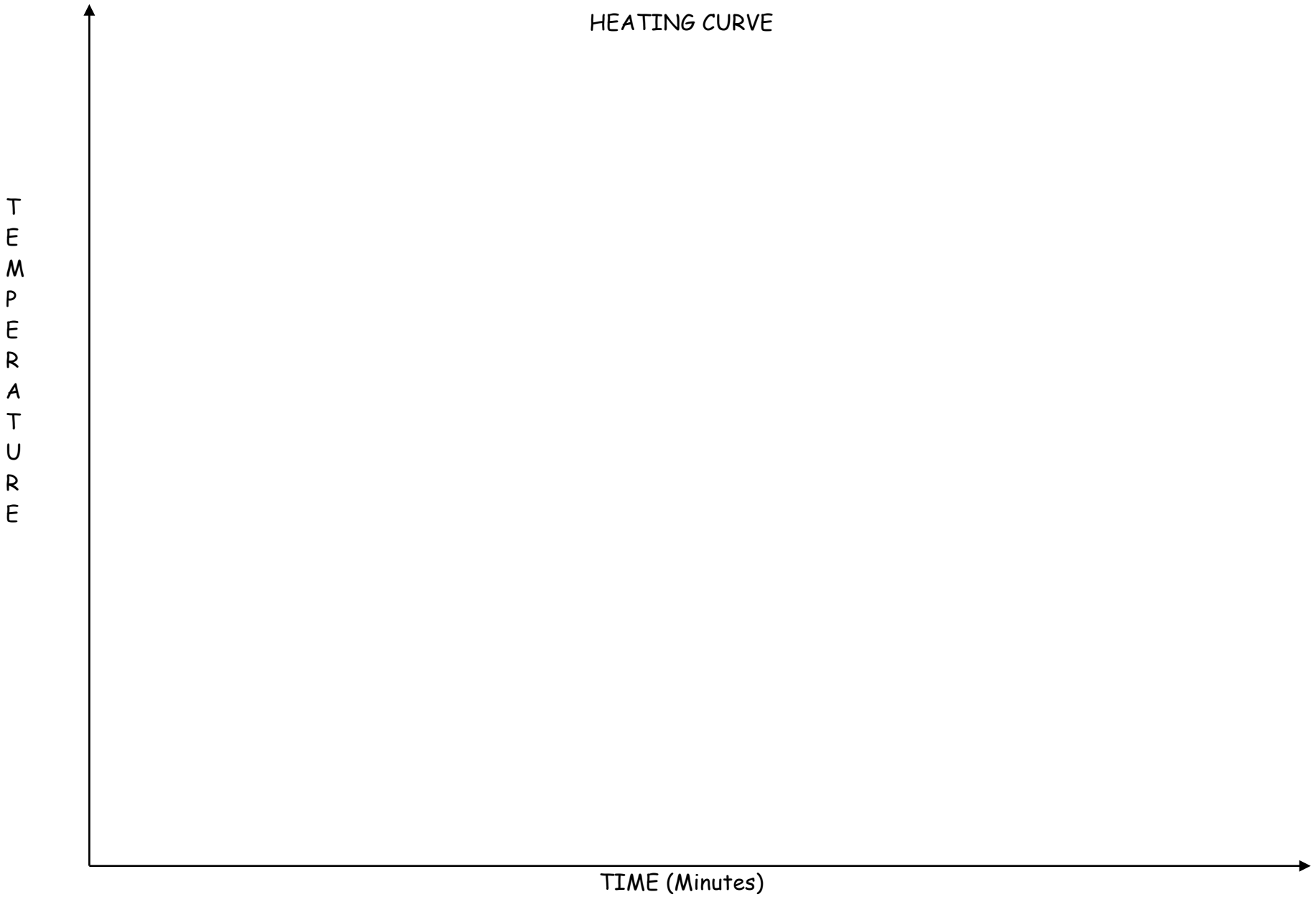
4. Which of the following best describes exothermic chemical reactions?

   A) They never release heat.
   B) They always release heat.
   C) They never occur spontaneously.
   D) They always occur spontaneously.

5. Which phase change is exothermic?

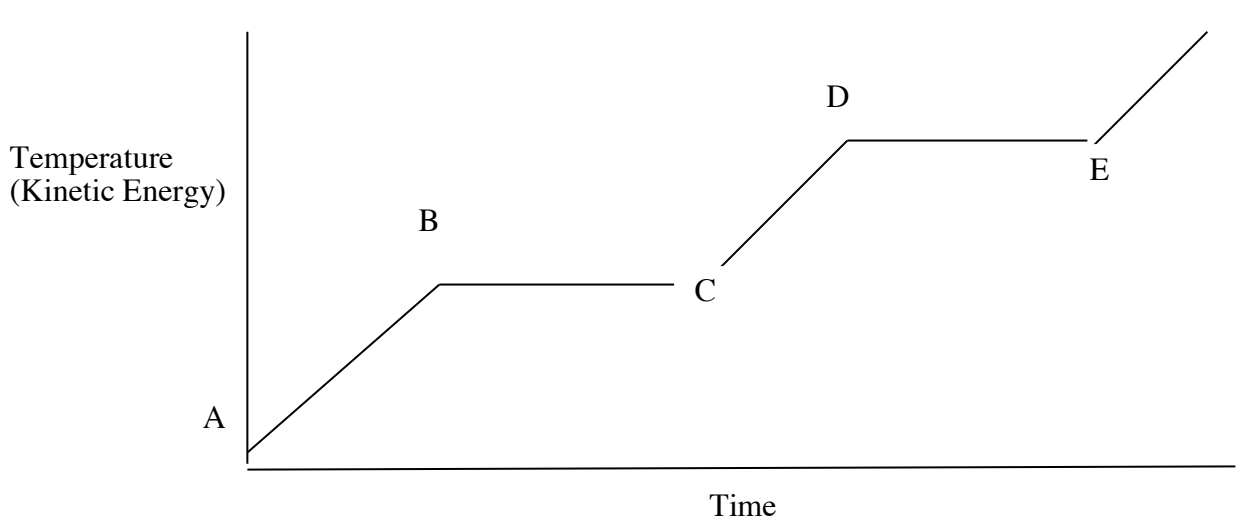
   A) $H_2O(s) \rightarrow H_2O(\ell)$ B) $H_2O(\ell) \rightarrow H_2O(s)$
   C) $H_2O(s) \rightarrow H_2O(g)$ D) $H_2O(\ell) \rightarrow H_2O(g)$

Skill 10: Draw and interpret Heating/Cooling Curves



Heating and Cooling Curves

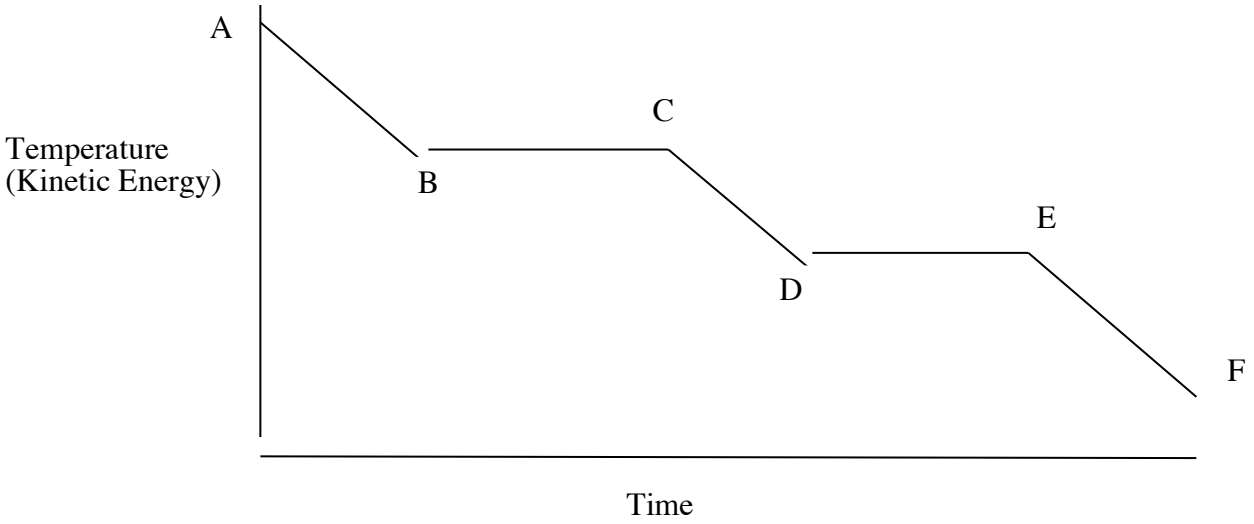
Heating Curve: _____ - Energy is being _____



Sublimation:

	A→B	B→C	C→D	D→E	E→F
Kinetic Energy					
Potential Energy					
Phase					

Cooling Curve: _____ - Energy is being _____



Deposition:

	A→B	B→C	C→D	D→E	E→F
Kinetic Energy					
Potential Energy					
Phase					

Skill 11: Measurement of Heat

Enthalpy of a Reaction: The amount of heat given off (_____) or absorbed (**endothermic**) in a reaction can be calculated in three scenarios with three different formulas

1) When there is a temperature change!
   Formula:

2) During the melting or freezing (fusion) phase change (no _____ change!)
   Formula:

3) During the evaporating or condensation (_____) phase change (no temp change!)
   Formula:

The Variables:

Specific Heat Capacity (C): _____

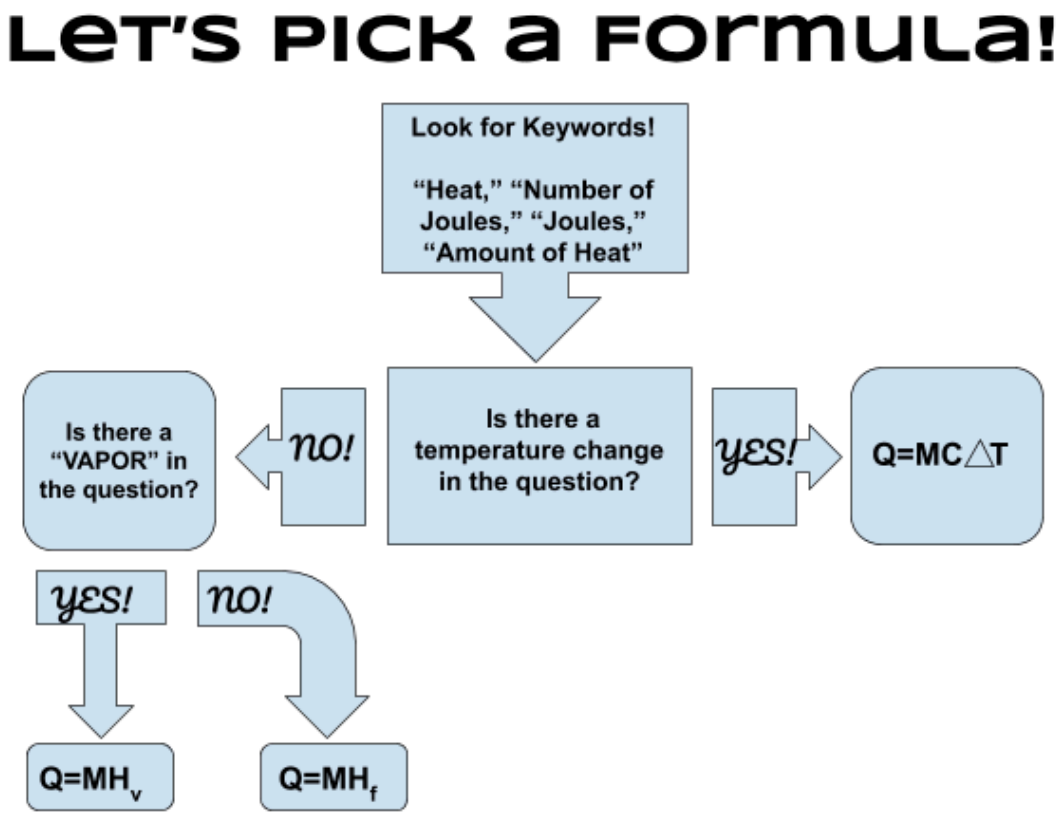
- ☐ Specific Heat for water: _____ (Found on Table _____

Heat of fusion (H_f): _____

- ☐ Heat of Fusion for water: _____ (Found on Table _____ in Ref. Tabs)

Heat of Vaporization (H_v): _____

- ☐ Heat of Vaporization for water: _____ (Found on Table _____ in Ref. Tabs)I



1) How many joules are absorbed when 50.0 g of water are heated from 30.2°C to 58.6°C?

Step 1	Step 2	Step 3	Step 4
Determine Correct formula	**Write down variables**	**Plug in variables**	**Solve**

2) How many joules are required to melt 255 g of ice at 0.00°C?

3) How many joules of heat energy are released when 50.0 g of water are cooled from 70.0 °C to 60.0 °C?

4) What is the total number of joules required to completely boil 125 g of water at 100 °C at 1 atmosphere?

5) 50.0 g of water goes from 289.6 K to 309.6 K.
   A) Is heat energy released or absorbed? B) Calculate the amount energy.

6) A 15.75-g piece of iron absorbs 1086.75 joules of heat energy, and its temperature changes from 25°C to 175°C. What is the specific heat capacity of iron?

(1) 1.0 J/g·^{0}C (2) 4.18 J/g·^{0}C
(3) 0.46 J/g·^{0}C (4) 2.76 J/g·^{0}C

7) What is the total number of joules of heat needed to change 150 g of ice to water at 0.00^{o}C?

8) How many joules of energy are required to vaporize 423 g water at 100 ^{o}C and 1 atm?

9) How many joules does it take to melt 423g of water at 100^{0}C?

10) Compare the amount of heat required to vaporize a 200.-gram sample of $H_2O(\ell)$ at its boiling point to the amount of heat required to melt a 200.-gram sample of $H_2O(s)$ at its melting point.