Date:

Name _ANSWER KEY____

#2 Matter & Energy

Quantitative Chemistry

Student Learning Map

Unit EQ: What are matter and energy, and how are they important to Chemistry?

Key Learning: The universe is composed of multiple types of matter and energy.

UNIT CONCEPT:

1. Properties of Matter	2. Physical & Chemical Changes	3. Energy
LESSON ESSENTIAL QUESTIONS:		
How can we describe and classify different types of matter?	How do I differentiate between physical and chemical changes?	How do I solve problems with energy, temperature, mass, and specific heat capacity?
LESSON ESSENTIAL VOCABULARY:		
Matter Intensive Property Extensive Property Solid Liquid Gas Plasma Physical Property Chemical Property Pure Substance Element Compound Homogeneous Mixture Heterogeneous Mixture	Condensation Freezing Melting Boiling Evaporation Sublimation Deposition Precipitate Endothermic Exothermic Distillation Filtration Decant	Energy Heat Calorie Joule Specific Heat Capacity Celsius Fahrenheit Kelvin

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PROPERTIES OF MATTER

***EQ*: How can we describe and classify different types of matter?**

***EQ*: How will I define, identify and differentiate between a physical and a chemical changes?**

***EQ*: How do I solve problems with energy, temperature, mass, and specific heat capacity?**

Date:

Definition of Matter:

A. <u>Properties of Matter:</u>

1.

2.

B. <u>Phases of Matter:</u>

1.

- **a.**
- **b.**

2.

- **a.**
- **b.**

3.

- **a.**
- **b.**

4.

Physical Properties Of Matter:

Chemical Properties Of Matter:

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The properties of a substance can be divided up into two basic kinds:

Intensive Properties:

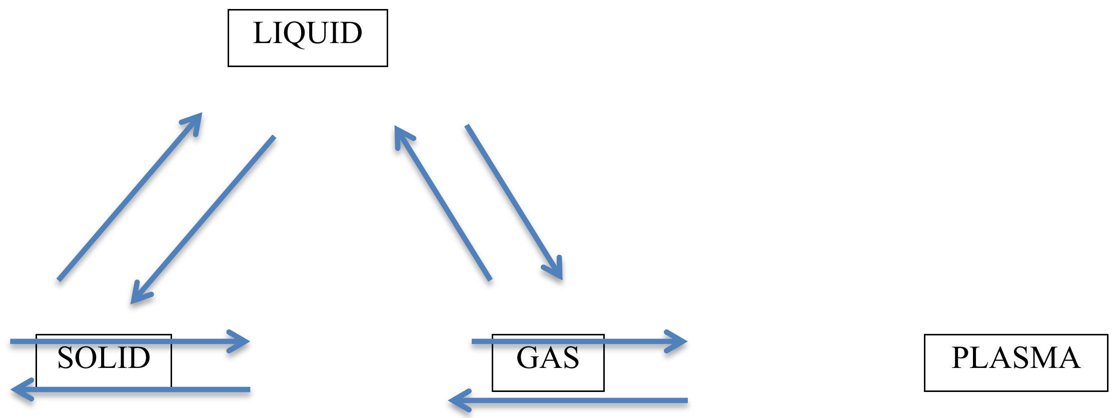
Extensive Properties:

C. **<u>Changes in Matter:</u>**

1.

2.

Date:



Physical Changes in states of matter

1. solid → liquid = ___________________

   example: ____

2. liquid → solid = ___________________

   example: ____

3. liquid → gas = ___________________ or ___________________

   example: ____

4. gas → liquid = ___________________

   example: ____

5. solid → gas = ___________________

   example: ____

6. gas → solid = ___________________

   example: ____

7. gas → plasma = ___________________

8. plasma → gas = ___________________

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Chemical Changes in states of matter:

Also called ___________________________

Demos:

Example 1: Paper

Example 2: $NaCl + AgNO_3 \rightarrow NaNO_3 + AgCl$

Example 3: $Na + H_2O \rightarrow NaOH + H_2$

II. Physical & Chemical Changes: Identify your own examples below.

	Physical	Chemical
1. Environment		
2. Kitchen		
3. Hair Salon		

HW: Problems: 1-12, 18 (pages 69-70)

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D. <u>Types Of Matter:</u>

Matter (any substance)

(1) Pure Substance

(a) Element

Definition and examples:

(b) Compound

Definition and examples:

(2) Mixture

(c) Homogeneous

Definition and examples:

(d) Heterogeneous

Definition and examples:

Compounds and Mixtures

	Compounds	Mixtures
1. Combination		
2. Properties		
3. Composition		

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Pure Substances and Mixtures Mini-Lab

Use the word bank below to identify the items in the test tubes.
Identify each substance as a pure substance or mixture, and then identify each as an element, compound, homogeneous mixture, or heterogeneous mixture.

Identity of Substance	Pure Substance (PS) or Mixture? (MIX)	Element (E), Compound (C), Homogeneous Mixture (HOM), or Heterogeneous Mixture (HET)?
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
18.		
19.		
20.		

Word bank:

Air
Aluminum
Baking Soda
Beads
Brass
Carbon (graphite)
Chocolate
Copper
Copper Sulfate
Lead
Muddy Water
Oil & Water
Orange Drink
Pistachios
Salt
Seasoning Mix
Soda
Sugar
Sulfur
Water

Date:

2. Physical & Chemical Changes (cont.)

D. Separation Techniques

← Matter →

____________________ ____________________

________________ ________________ ________________ ________________

How would you separate a mixture of salt and sand? Answer the questions below.

a. What substance did you separate first? How did you do it?

b. What substance did you separate next? How did you do it?

c. How did you separate the final two substances?

Notes:

Filtration **Distillation**

Date:

3. Energy

A. Temperature

In the laboratory, temperatures are usually measured in ________________.

Conversions:

Fahrenheit

Kelvin

1. Convert 89°F to °C.

$$°C = \tfrac{5}{9}(\_°F - 32)$$
$$= \tfrac{5}{9}(89°F - 32) = 32°C$$

2. Convert 25°C to °F.

$$°F = \tfrac{9}{5}\_°C + 32$$
$$= \tfrac{9}{5}(25°C) + 32 = 77°F$$

1. Convert 303 K to °C.

$$°C = \_K - 273$$
$$= 303\ K - 273 = 30.°C$$

2. Convert 25°C to K.

$$K = \_°C + 273$$
$$= 25°C + 273 = 298\ K$$

Use temperature conversions to complete the blanks in the following table.

Example:	**Celsius**	**Fahrenheit**	**Kelvin**
1. Room Temp	22°C		
2. $°F \rightarrow °C \rightarrow K$		75°F	
3. Body Temperature			310 K
4. $°F \rightarrow °C \rightarrow K$		24.5°F	
5. Below Freezing			233 K
6. Boiling Point	100°C		

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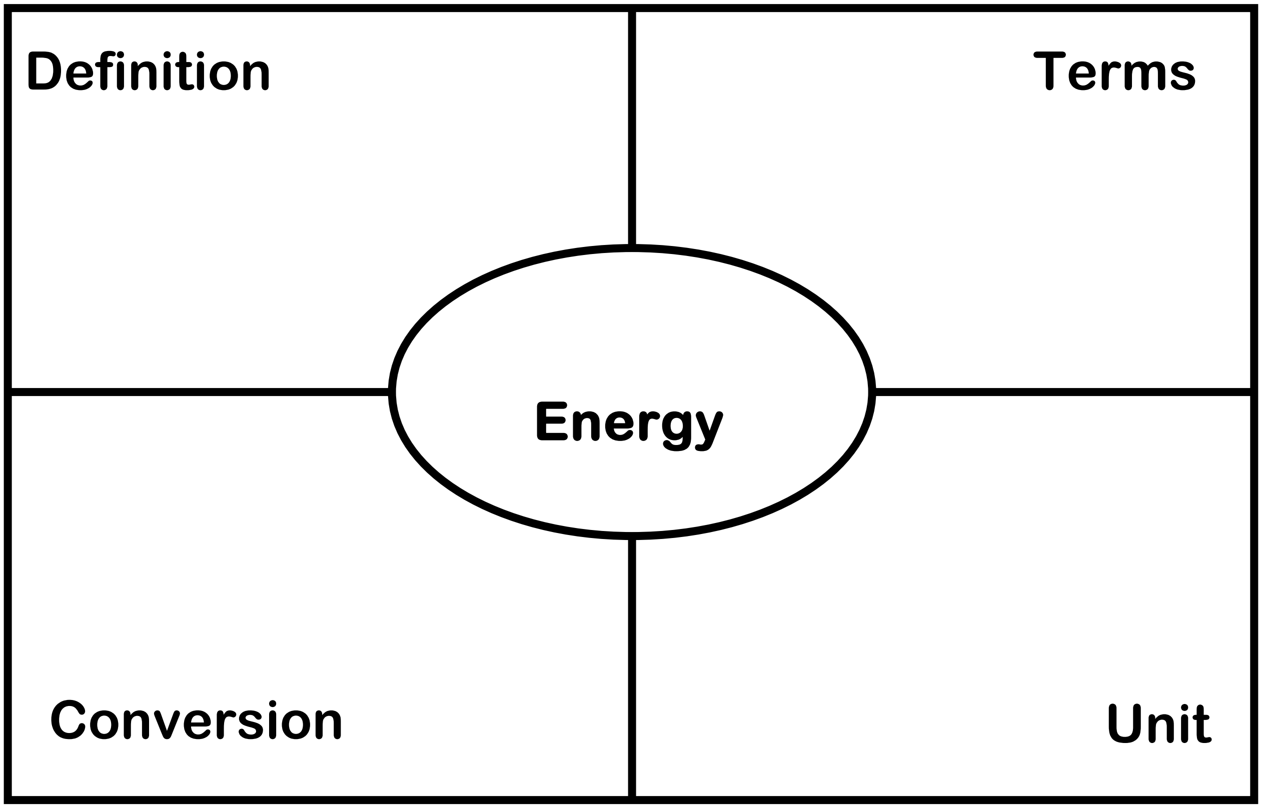
3. Energy (cont.)

B. Energy



*** Energy Conversions:**

calorie –

1. Convert 500. joules to calories.

$$500.\ \text{J} \times \frac{1\ \text{cal}}{4.184\ \text{J}} = 120.\ \text{cal}$$

2. Convert 1600 calories to kilojoules.

$$1600\ \text{calories} \times \frac{4.184\ \text{J}}{1\ \text{cal}} \times \frac{1\ \text{kJ}}{1000\ \text{J}} = 6.7\ \text{kJ}$$

3. For breakfast, you eat a bowl of Lucky Charms (Cal = 110) with half a cup of 1% milk (Cal = 55). How many joules is this?

110 Cal
+55 Cal
165 Cal

$$165\ \text{Cal} \times \frac{1000\ \text{cal}}{1\ \text{Cal}} \times \frac{4.184\ \text{J}}{1\ \text{cal}} = 69\bar{0}000\ \text{J}$$

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3. Energy (cont.)

* Specific Heat Capacity:

Which has a higher specific heat capacity: iron or water? Why?

Def. (Specific Heat Capacity):

s_{H2O} = s_{Fe} = s_{Al} =

* Energy Problems:

Show your work and use significant figures!

1. Calculate the energy required (in joules) to raise the temperature of 4.3 grams of liquid mercury by 5.6°C. (Specific heat capacity of Hg is 0.14 J/g°C.)

$$Q = s\ m\ \Delta T$$

$$Q = \left(0.14\ \frac{J}{g°C}\right)(4.3\ g)\ (5.6\ °C)$$

$$Q = 3.4\ J$$

2. How much energy (in joules) is required to heat 24 grams of carbon (see pg. 13) from 23.6°C to 54.2°C?

$$Q = s\ m\ (T_f - T_i)$$

$$Q = \left(0.71\ \frac{J}{g°C}\right)(24\ g)\ (54.2\ °C - 23.6\ °C)$$

$$Q = 520\ J$$

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3. Energy (cont.)

Specific Heat Capacities (J/g°C)

Aluminum = 0.89 **Carbon = 0.71** **Silver = 0.24** **Water = __________**

3. A sample of water requires 2.4 kilojoules to heat it from 23.4°C to 46.9°C. What is the mass of the water?

$$2.4\text{ kJ x } \frac{1000\text{ J}}{1\text{ kJ}} = \underbrace{24\bar{0}0}_{\rightarrow 2\text{ sig figs}}\text{ J}$$

$$m = \frac{Q}{s\,(T_f - T_i)} = \frac{(24\bar{0}0\text{ J})}{\left(4.184\ \frac{\text{J}}{\text{g°C}}\right)\underbrace{(46.9\text{ °C} - 23.4\text{ °C})}_{\rightarrow 3\text{ sig figs rounded to tenths place}}}$$

$$m = 24\text{ g}$$

4. If 45.8 joules is applied to 0.25 pounds of silver at 25°C, what will be the new temperature?

$$0.25\text{ pounds x } \frac{454\text{ g}}{1\text{ lb}} = \underbrace{113}_{\rightarrow 2\text{ sig figs}}\text{ g}$$

$$T_f = \frac{Q}{s\,m} + T_i = \frac{(26.69\text{ J})}{\left(0.24\ \frac{\text{J}}{\text{g°C}}\right)(113\text{ g})} + 25\text{ °C}$$

$$T_f = 27\text{°C}$$

5. Calculate the specific heat capacity of a substance if it takes 6.38 calories to raise the temperature of 0.253 kilograms from 34.0°C to 39.8°C.

$$6.38\text{ calories x } \frac{4.184\text{ J}}{1\text{ cal}} = \underbrace{26.69}_{\rightarrow 3\text{ sig figs}}\text{ J};\ 0.253\text{ kg x } \frac{1000\text{ g}}{1\text{ kg}} = \underbrace{253.0}_{\rightarrow 3\text{ sig figs}}\text{ g}$$

$$s = \frac{Q}{m\,(T_f - T_i)} = \frac{(26.69\text{ J})}{(253.0\text{ g})\underbrace{(39.8\text{ °C} - 34.0\text{ °C})}_{\rightarrow 2\text{ sig figs rounded to tenths place}}}$$

$$s = 0.018\ \frac{\text{J}}{\text{g°C}}$$

6. You place an aluminum pan in the oven (mass = 0.30 kg), and its temperature increases from 72°F to 250°F. How many joules of energy have you added?

$$\text{°C} = \tfrac{5}{9}(\_\text{°F} - 32) = \tfrac{5}{9}(250\text{°F} - 32) = 121.1\text{°C}$$

$$\text{°C} = \tfrac{5}{9}(\_\text{°F} - 32) = \tfrac{5}{9}(72\text{°F} - 32) = 22.2\text{°C}$$

$$0.30\text{ kg x } \frac{1000\text{ g}}{1\text{ kg}} = \underbrace{300.}_{\rightarrow 2\text{ sig figs}}\text{ g}$$

$$Q = s\,m(T_f - T_i) = \left(0.89\ \frac{\text{J}}{\text{g°C}}\right)(300.\text{ g})\underbrace{(121.1\text{ °C} - 22.2\text{ °C})}_{\rightarrow 3\text{ sig figs rounded to tenths place}}$$

$$m = 26000\text{ J}$$

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Class Review Questions:

1. How would you separate the mixture of sand and salt?

   - Add water to dissolve the salt
   - Pour the mixture through filter paper to collect the sand
   - Let the water evaporate (leaving the salt by itself).

2. How many joules does a meal at Five Guys contain?
   Bacon Cheeseburger: 920 calories
   Regular Fries: 953 calories
   24 oz Coca-Cola: 252 calories

$$\begin{array}{r} 920.\ \text{cal} \\ 953\ \text{cal} \\ +252\ \text{cal} \\ \hline 2125\ \text{cal} \end{array} \qquad 2125 \text{ calories x } \frac{4.184 \text{ J}}{1 \text{ cal}} = 8891 \text{ J}$$

3. If Aldrich Killian adds 3 000 000. joules of energy are applied to *Iron Man*'s 200. lb suit, what would be the new temperature? The suit initial temperature is Tony's body temperature.

$$200. \text{ pounds x } \frac{454 \text{ g}}{1 \text{ lb}} = \underbrace{90\bar{8}00}_{\rightarrow 3 \text{ sig figs}} \text{ g}$$

$$T_f = \frac{Q}{s\,m} + T_i = \frac{(3\,000\,000.\ \text{J})}{\left(0.45\ \frac{\text{J}}{\text{g}^\circ\text{C}}\right)(90\bar{8}00\ \text{g})} + 37\ ^\circ\text{C}$$

$$T_f = 110^\circ\text{C}$$

Review Notes (Optional):