Matter And Energy Vocabulary

Word	Definition
Alloy	A solution where two metals are dissolved into each other in the solid phase.
Amalgam	A solution where a metal is dissolved into mercury.
Aqueous	A solution where a solute is dissolved into water.
Atom	The smallest part of an element that still retains the properties of that element.
Calorimetry	The measurement of energy change between potential and kinetic energy by measuring the temperature change induced on a measured mass of water in a calorimeter.
Change	A transformation from one condition of matter to another.
Chemical Property	A property that can only be observed when a chemical change occurs.
Compound	Matter which results from the bonding of atoms of two or more elements to each other, decomposable into elements.
Element	Matter which exhibits definite physical and chemical properties unique to itself and different from all other forms of matter and cannot be decomposed into simpler forms of matter.
Endothermic	The conversion of kinetic energy into potential energy.
Exothermic	The conversion of potential energy into kinetic energy.
Heterogeneous	Matter that is unevenly distributed throughout a volume.
Homogeneous	Matter that is evenly distributed throughout a volume.
Ion	A charged particle formed when an atom gains or loses electrons.
Kinetic energy	Energy of motion.
Matter	That which exists with mass and volume.
Metal	An element that loses electrons when forming chemical bonds.
Metalloid	An element that exhibits properties of both metals and nonmetals.
Mixture	Matter of different types that are in physical proximity to each other, yet not chemically combined.
Nonmetal	An element that gains electrons from metals or shares electrons from other nonmetals when forming chemical bonds.
Periodic Table	A chart that lists the elements in order of increasing atomic number and arranges them in groups of similar chemical properties.
Physical Property	A change that can be observed without a chemical change occurring.
Potential energy	Stored energy, often stored in chemical bonds.
Property	A distinguishing characteristic of a sample of matter.
Solution	A homogeneous mixture consisting of a solute dissolved into a solvent.
Temperature	The average kinetic energy of a sample or system.
Tincture	A solution where a solute is dissolved into alcohol.

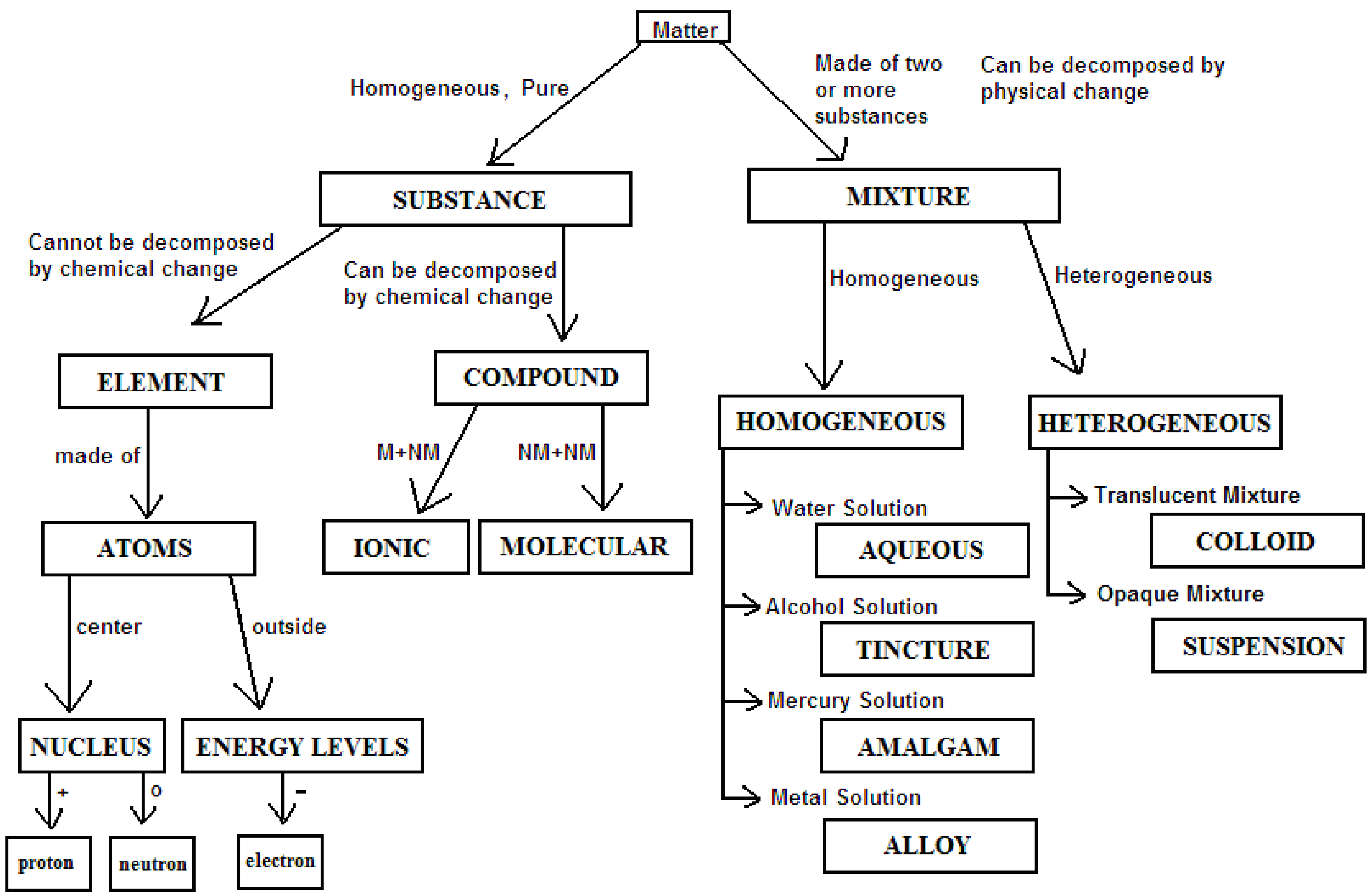
1) Properties and Changes of Matter (HW: p.11, 12)

Essential Question: What kinds of matter are there, and how can you turn one form of matter into another?

Chemistry - The study of MATTER the CHANGES matter undergoes, and the ENERGY associated with those changes.

Matter - Anything that exists that has definite MASS and occupies a definite VOLUME.

CLASSIFICATION OF MATTER



Substances (**elements** and **compounds**) are all HOMOGENEOUS (containing the same composition of material throughout the sample).

Elements are substances that cannot be decomposed by chemical change. They are made up of ATOMS. Element symbols are either one letter, which is capitalized, or two letters…the first one capital, the second lower-case. Examples of elements:

One letter: **O** (oxygen) Two letters: **Ni** (nickel) *Note: Cl is chlorine. C followed by a lower-case L.*

Compounds are substances that are made of elements chemically bonded to each other, and can be decomposed by chemical change back into separate elements. Examples of compounds:

NaCl (made of sodium and chlorine) **$Cu_3(PO_4)_2$** (made of copper, phosphorous and oxygen)

Mixtures are combinations of substances that are not chemically combined together, and they can be broken apart by physical change.

Homogeneous mixtures are called **SOLUTIONS**. Examples of these mixtures include:

1) Aqueous solutions: NaCl (aq) Aqueous means that the solute (NaCl) is dissolved into WATER. This is an example of a SOLUTION. It can not be separated by filtering. To separate the salt from the water, you must evaporate the water. Solutions are TRANSPARENT (you can see through them).

2) Tinctures: a solution where the solute is dissolved in alcohol (ethanol). Some things which cannot dissolve in water can dissolve in alcohol. This includes tincture of iodine, which is used to disinfect cuts. It consists of iodine dissolved into alcohol.

3) Amalgam: a solid solution where a metal is dissolved into mercury (Hg). Metals commonly used to make amalgams with mercury are silver (Ag) and gold (Au), which used to be used for dental fillings until porcelain and composite substances became more widely used for that purpose.

4) Alloys: metals can not chemically bond with each other, but they can be mixed together to enhance their properties. Iron (Fe) is a strong metal that is useful for making into structural shapes, but it does have drawbacks. It can rust and it is quite soft. Mixing in carbon (C) makes an alloy known as steel. This steel can be further enhanced by adding yet more metals, like chromium (Cr), molybdenum (Mo) or cadmium (Cd).

Gold is pretty to look at, but it is too soft on its own to fashion durable jewelry. 24 karat gold is pure gold, 14 karat gold is more than half pure gold, but silver (Ag) and copper (Cu) are added to make the gold item more durable. 18 karat white gold is an alloy of gold, palladium, nickel and zinc, or gold and platinum or palladium.

Heterogeneous (varying composition throughout the sample) **mixtures** include:

1) Muddy water. The composition towards the bottom is mostly mud, towards the top it's mostly water. When shaken, the particles will never be dispersed evenly enough to be considered homogeneous.

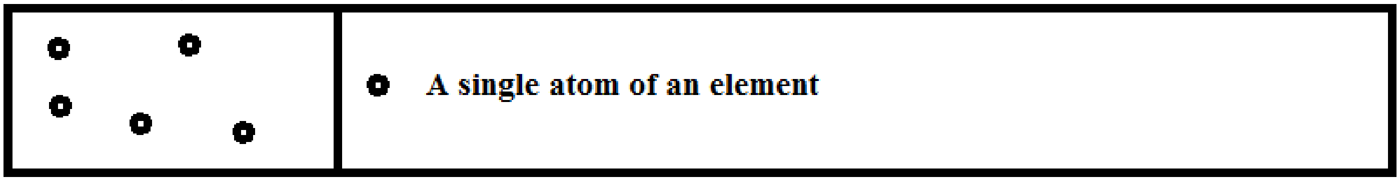
2) Italian salad dressing: The different ingredients separate by density with the oil on top and the vinegar and water at the bottom with various pieces of chopped garlic and pepper at different levels with varying concentration. As with muddy water, the particles are too large to form a homogenous mixture.

3) Soil: this contains microscopic rock fragments, organic debris and other items, depending on where you find it.

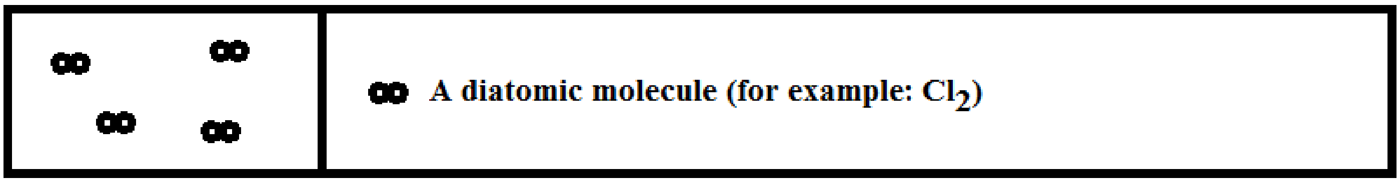
4) Cat vomit: this amazing material can contain a wide assortment of components, including partially digested dry or wet food, stomach juices, animal bones, fur and other items which vary widely from cat to cat and from vomit to vomit. These components are not mixed together regularly, upon examination of the vomit pile, one might see more fur on one side and more crunched-up dry food on the other.

Particle Diagrams: These show how the forms of matter look in a simple diagram form.

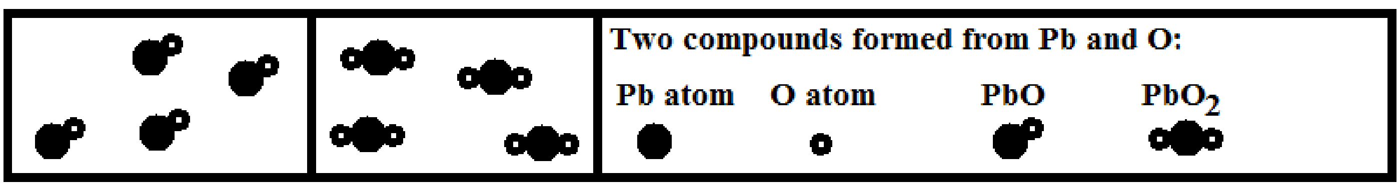
Elements: single atoms, not bonded to each other.



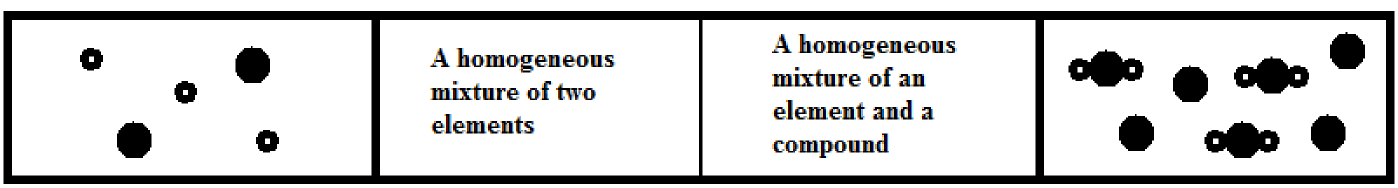
Diatomic Molecule: certain elements are so reactive that they are more stable as pairs, forming two-atom molecules that are called **diatomic**. The elements that do this are Br, I, N, Cl, H, O and F. Their formulas are written as Br_2, I_2, N_2, Cl_2, H_2, O_2 and F_2. Since they are made of only one element, they are not considered to be compounds.



Compounds: These are made of two or more different elements chemically bonded together in a definite, whole-number ratio.



Homogeneous mixtures: These are combinations of elements, compounds or both, in no fixed ratio, and not bonded together, but evenly dispersed throughout the volume of the mixture.



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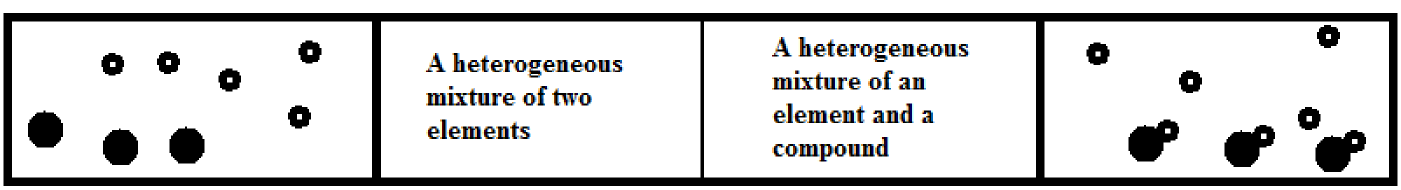


Physical Changes and Properties

Physical Changes: Changes that change only the appearance of a substance, not its chemical identity.
Physical Properties: Properties that can be observed through physical change

Physical Change	Physical Property
Melting	Melting point (the temperature at which a substance turns from a solid to a liquid)
Boiling	Boiling point (the temperature at which a substance turns from a liquid to a gas)
Dissolving	Solubility (the amount of solute that can be dissolved in a solvent)
Evaporating	Vapor pressure (the pressure exerted by a vapor at vapor-liquid equilibrium)
Crushing	Malleability (the ability to be hammered or rolled into thin sheets)
Stretching	Ductility (the ability to be stretched into a wire)
	Specific heat (the heat it takes to raise the temperature of 1 gram by 1 K)
	Heat of Fusion (the heat it takes to melt 1 gram of solid at the melting point)
	Heat of Vaporization (the heat it takes to boil 1 gram of liquid at the boiling point)
	Density (the mass of a substance per unit volume)
	Electrical & Heat Conductivity (the ability to pass heat or electricity through a substance

Chemical Properties and Changes

Chemical Changes: Changes that result in changing the chemical composition of a substance. Can be reversed only by another chemical change.
Chemical Properties: Properties that can only be observed through chemical change.

Chemical Change	Chemical Property
Corrosion of metals, flammability	Reactivity (the likelihood of one substance to undergo a chemical reaction with another substance)
Chemical decomposition e.g. hydrogen peroxide decomposes to form water and oxygen, but water does not decompose spontaneously	Stability (the likelihood that a substance will no decompose)
Combustion releases heat (exothermic) Rarely do chemical changes absorb heat (endothermic)	Heat of Reaction (the energy absorbed or released by a chemical reaction)

LAW OF CONSERVATION OF MASS

Matter cannot be created nor destroyed by physical or chemical change, only converted from one form to another.

If 40 grams of substance A are reacted with 20 grams of substance B to form substance C, what will the mass of substance C be?

Answer: 60 grams. Since the total combined mass of the reactants is 60 grams, then the total mass of the product must be equal.

35 grams of liquid water are evaporated off in a closed container. How many grams of water vapor will there be when this process is done?

Answer: 35 grams. The mass cannot change, regardless of the phase.

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

Answer: Equal. The Law of Conservation of Mass states that the mass of the products must be equal to the mass of the reactants that went into making them.

2) Energy (HW: p. 13, 14)

Essential Question: What are the forces at work in the universe that make things happen?

Energy: The ability to do WORK which is using FORCE to move an object a DISTANCE.

1) Kinetic Energy: Energy of MOTION, contained by anything that MOVES.

Atoms, molecules and other particles of that scale move faster when TEMPERATURE is increased.

Celsius: Devised by Anders Celsius (~1742): Based on setting the melting point of water as 0^oC and the boiling point of water as 100^oC.

Kelvin Scale: Devised by Lord William Thompson Kelvin: He used the Celsius-sized degree, but he reset the scale so that it starts at 0 Kelvins. At this temperature (which is also -273^oC), all particle motion stops.

To convert back and forth between Celsius and Kelvin temperatures:

Melting point of water, 0^oC is equal to 273 K (0 + 273 = 273)

Boiling point of water, $100.^oC$ is equal to 373 K. (100 + 273 = 373)

2) Potential Energy: STORED energy, energy that's not doing work right now, but it has the ability to if released.

Found in coiled springs, chemical bonds (batteries, explosives, chemical hot packs), objects at a height above gravity, magnetism (both attraction and repulsion)

Measurement: Since stored energy cannot be directly measured, it must be converted to KINETIC energy and measured using a CALORIMETER.

JOULE (J): The metric unit for potential energy. 1000. Joules is a kiloJoule (kJ), and is the unit most often used to measure potential energy changes in chemical and physical changes (such as burning, melting and so on).

3) Heat Flow

Heat flows from where it's HOT to where it's NOT.

Examples:

1) Open the front door of your nice warm house on a cold winter morning. The heat will flow from your house out into the cold air.

2) Place a hot pack on a sore muscle to soothe it. The heat will flow from the hot pack into the muscle.

3) Place a 45^oC piece of warm metal into a beaker of water at 10^oC. The heat will flow out of the metal into the water.

LAW OF CONSERVATION OF ENERGY

Energy cannot be created nor destroyed by physical or chemical change, only converted from one form of energy into another.

How can the energy stored in a substance be determined using Calorimetry?

1) **Exothermic** changes: PE stored in a substance is released and converted into kinetic energy, which is absorbed by a sample of WATER whose mass is known. The temperature of the water INCREASES. Water absorbs heat at the rate of 4.18 Joules/gram-degree C. This means that if you give 1 gram of water 4.18 Joules of heat, the temperature of that one gram of water will rise by 1 degree Celsius. This is called the SPECIFIC HEAT of water.

The change in heat (ΔH) is NEGATIVE. (PE --> KE, stored energy is released into the surrounding energy as KE.)

Example: burning a peanut releases heat, which is then absorbed by a measured mass of water in a calorimeter cup.

The temperature of the water INCREASES.

2) **Endothermic** changes: KE from the surroundings (a measured mass of water in a calorimeter) is absorbed by the change and converted into potential energy. The temperature of the water DECREASES.

The change in heat (ΔH) is POSITIVE. (KE --> PE, motion energy from the surroundings is captured and stored)

Example: placing an ice cube into a measured mass of water in a calorimeter cup. As the ice cube melts, it absorbs heat from the water. The temperature of the water decreases.

Example:

For the reaction: A + B → C:

If the reactants A and B have 80. KJ of energy total stored in their bonds and the product C contains 20. KJ of energy stored in its bonds:

1) 60. kJ of potential energy must have been absorbed or released in this reaction. If you start with 80. kilojoules and end up with 20. kilojoules, that means that 60 kilojoules of potential energy were released into the surroundings as kinetic energy.

2) Since this reaction LOST potential energy, this reaction is EXOTHERMIC.

3) If this reaction were placed in a calorimeter with water in it, the temperature of the water in the calorimeter would INCREASE as the newly formed kinetic energy made the water molecules move faster.

The heat content of food (measured in Calories here in the United States and in kilojoules in just abut every other country in the world) is found by burning the food (cellular respiration and combustion are essentially the same reaction) in a sealed container called a "bomb calorimeter". The heat released by the burning food is absorbed by the water in the calorimeter, and by knowing how many grams of water there are in the calorimeter and how much the temperature of the water rose, you can calculate the energy given off by the food that the body would be able to absorb. How is this done? Stay tuned for tomorrow's incredible lesson!

3) Calorimetry (HW: p. 15, 16)

Essential Question: How are the calories in your food determined experimentally?

All physical and chemical changes are accompanied by an associated change in energy. This can be referred to in many ways. **ΔH** is called the **heat of reaction** and is the change in potential energy associated with a change.

A positive change in potential energy (**+ΔH)** results when kinetic energy from the surroundings is absorbed into the change, resulting in greater stored energy and lower temperature in the surroundings. This is an **ENDOTHERMIC** change. If you reverse the change,

Table I
Heats of Reaction at 101.3 kPa and 298 K

Reaction	ΔH (kJ)*
$N_2(g) + 2O_2(g) \longrightarrow 2NO_2(g)$	+66.4

Reacting one mole of nitrogen gas and two moles of oxygen gas with each other produces two moles of nitrogen dioxide gas. This reaction requires the absorption of 66.4 kJ of PE from the surrounding environment. The PE is stored in the covalent bonds between the nitrogen and oxygen atoms. The surrounding temperature decreases as a result.

If the change were reversed, and the nitrogen dioxide were decomposed back into nitrogen and oxygen, the reaction would release the 66.4 kJ of heat that were absorbed when the compound was originally formed. The ΔH, which was + when the compound was formed, will now be a - ΔH.

A negative change in potential energy (**-ΔH)** results when potential energy stored in the substance undergoing the change is released into the surroundings as kinetic energy, resulting in lower amounts of stored energy and higher temperature in the surroundings. This is an **EXOTHERMIC** change.

Table I
Heats of Reaction at 101.3 kPa and 298 K

Reaction	ΔH (kJ)*
$LiBr(s) \xrightarrow{H_2O} Li^+(aq) + Br^-(aq)$	−48.83

Dissolving lithium bromide crystals into water results in the breakup of those crystals into lithium ions and bromide ions. This physical change results in the release of 48.33 moles of PE, which is converted into KE and released into the surroundings, causing the temperature to rise.

If the change were reversed, and the water was evaporated away so that the ions could come back together and reform the original crystal, the reaction would absorb the 48.83 kJ of heat that were released when the compound was originally dissolved. The ΔH, which was - when the compound was dissolved, will now be a + ΔH.

The Law of Conservation of Energy states that energy cannot be created or destroyed, only converted from one form to another. Therefore the following must be true:

P.E.lost by change = K.E. gained by measured mass of water in calorimeter cup (temp. of water INCREASES)

P.E. gained by change = K.E. lost by measured mass of water in calorimeter cup (temp. of water DECREASES)

If 1.00 gram of water is given 4.18 Joules of energy, its temperature will increase by 1.00°C.

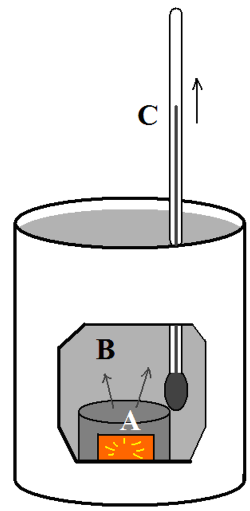
This is called the SPECIFIC HEAT (C) of water, **4.18 J/g-°C**. This value can be found on Reference Table B.

Putting it all together, here is the calorimetry equation (which can be found on Reference Table T):

Equation	q	=	m	C	ΔT
Units	**Joules (J)**	=	**Grams (g)**	**4.18 J/g-°C**	**°C**
What Each Variable Means	**q** is the quantity of heat that is absorbed or released by a physical or chemical change.	=	**m** is the mass of water in the calorimeter cup that absorbs heat from the change or releases heat to the change.	**C** is the specific heat of water, the rate at which water gains or loses heat if energy is absorbed or removed from it.	**ΔT** is the temperature change of the water in the calorimeter cup as a result of the physical or chemical change.

HOW A CALORIMETER WORKS

A sample that is undergoing a physical or chemical change is placed into the reaction chamber (A). In this example, the change is releasing heat that it once held as potential energy inside of its chemical bonds, intermolecular attractive forces, or both. That head changes into kinetic energy, which is released into the measured mass of water (B). The water molecules heat up, moving faster and striking the thermometer bulb with more force. Th energy is transferred to the thermometer (C) and the liquid in the bulb expands with the heat, sending the liquid in the thermometer higher, indicating an increase in kinetic energy. This is an example of an EXOTHERMIC reaction. In an ENDOTHERMIC reaction, the energy of the water in the calorimeter would be absorbed into the change and trapped into new chemical bonds and/or intermolecular attractive forces as potential energy, while the thermometer would register a decrease in temperature.



How to do Calorimetry Problems

There are four things you can calculate using the calorimetry equation. In each example, the number of sig figs in each measurement has been provided in italics underneath each number to help you understand how each answer was rounded.

1) Calculating the number of joules absorbed or released by a change

Use the equation **q = m C ΔT**!

Example: How many joules are absorbed by 100.0 grams of water if the temperature is increased from 35.0°C to 50.0°C?

Solution:

q = mCΔT   q = (100.0 g) (4.18 J/g-°C) (15.0°C) = 6270 rounded to 3 sig figs is **6270 J**.

4 sig figs 3 sig figs 3 sig figs

The temperature change from 35.0°C to 50.0°C is a 15.0°C temperature increase, so that was used for ΔT.

2) Calculating the mass of water that is undergoing the temperature change

Rearrange the equation to solve for m: q = m C ΔT (divide both sides by C ΔT)

So, **m = q / C ΔT**

Example: A sample of water is heated by 20.0 °C by the addition of 80.0 J of energy. What is the mass of the water?
Solution: m = q / C ΔT m = (80.0 J) / (4.18 J/g-°C X 20.0°C) = 0.9569377 rounded to 3 sig figs is **0.957 g** *3 sig figs 3 sig figs 3 sig figs*

3) Calculating the temperature change of water induced by the absorption or release of energy

Rearrange the equation to solve for ΔT: q = m C ΔT (divide both sides by m C)

So, **ΔT = q / m C**

Example: 300. J of energy is absorbed by a 50. g sample of water in a calorimeter. How much will the temperature change by?
Solution: ΔT = q / m C ΔT = (300. J) / (50. g X 4.18 J/g-°C) = 1.4354066 rounded to 2 sig figs is **1.4 °C** *3 sig figs 2 sig figs 3 sig figs*

4) Calculating the temperature change of water induced by the absorption or release of energy and using it to determine the initial or final temperature of the water.

Rearrange the equation to solve for ΔT: q = m C ΔT (divide both sides by m C)

So, **ΔT = q / m C**

Example: 200. J of energy is absorbed by an 80.0 g sample of water in a calorimeter at 25.000 °C. What will the final temperature be?
Solution: ΔT = q / m C ΔT = (200. J) / (80.0 g X 4.18 J/g-°C) = 0.5980861 rounded to 3 sig figs is **0.598 °C** **This isn't the end of the problem!** The question asked "what will the final temperature be?" The clue is in the wording: "**energy is absorbed** by an 80.0 g sample of water". This means that the temperature will rise by the number of degrees you just calculated. If the temperature started at 25.000 °C and increases by 0.598 °C, then the final temperature will be: **25.598 °C** **If the problem had stated that the water had RELEASED energy, then you would have subtracted the change in temperature to show that the water cooled off!**

Student Name:________________________________ Grades: _____, _____, _____
Matter Energy Calorim

1) Properties and Changes of Matter Homework

A) Multiple-Choice: Place your answer in the space to the left of the question.

_____**1) Which of the following CAN be decomposed by chemical change?**
a) SO_2 b) N_2 c) Ne d) Al

Explain your choice:

_____**2) Which of the following fictitious element symbols are legitimate?**
a) Cn b) HB c) zL d) r

Explain why each of the incorrect choices are incorrect:

Choice_____:____

Choice_____:____

Choice_____:____

B) Identify the following as either being physical or chemical in nature and explain why.

Description	Physical/Chemical	Why?
The paint has worn away, so the steel body of an old car begins to rust.		
Potassium thiocyanate crystals dissolve easily into water.		
A 10.0 g sample of lauric acid can be melted by adding heat.		
Paradichlorobenzene melts at a temperature of 52°C when heat is added to solid paradichlorobenzene.		
Sodium metal explosively reacts with water to form hydrogen gas and sodium hydroxide.		
110 g of sodium nitrate crystals can dissolve in 100 g of water at 45°C.		
Platinum metal conducts electricity because its atoms pass electrons easily from one atom to the next.		
Gold metal can be hammered or rolled into extremely thin sheets, called “gold leaf” because gold is very malleable.		

C) Draw a particle diagram of a compound of $CaCl_2$, using black solid circles to represent the Ca and empty circles to represent the Cl. Draw at least five molecules of $CaCl_2$ in the box below:

D) Short-answer, from the reading:

1) What are the two components in the mixture known as tincture of iodine (used as an anti-infection agent, the red stuff you put on your cuts)?

2) When you vacuum the floor, all of the dirt accumulates in a bag, or in a special compartment of the vacuum cleaner. Stricken with overpowering scientific curiosity, you decide to examine the contents of the bag. Based on what you know about the dirt around your home that a vacuum cleaner might pick up, would you expect the contents to be homogeneous or heterogeneous? Briefly explain why you chose the one you did.

3) Why can't Br be decomposed into simpler substances?

4) What elements can the compound $Ca(NO_3)_2$ be decomposed into?

5) Brass is not a pure substance, it is made of two metals, copper (Cu) and zinc (Zn). What is a mixture of this type referred to as?

2) Energy Homework

A) Multiple-choice: Answer the question in the blank space to the left of the question.

_____1) What unit is used to express the average kinetic energy of a system?
a) Joule b) Kelvin c) Gram d) Meter

_____2) 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

Explain your answer:

_____3) Which of the following samples has the highest average kinetic energy?
a) 10 g H_2O @ 20^oC b) 20 g H_2O @ 20 K c) 30 g H_2O @ 70^oC d) 40 g H_2O @ 200 K

Explain your answer:

_____4) Which statement is correct concerning the direction of heat flow between two substances?
a) Heat will flow from an ice cube at 260. K to water at 280. K.
b) Heat will flow from a piece of hot glass at 800. K to a hand that accidentally touches it at 300. K.
c) Heat will flow from dry ice at 100. K to air at 310. K.
d) Heat will flow from a frozen flagpole at 270. K to a tongue that is stuck on it at 310. K.

Explain your answer:

B) Perform the following conversions (show all work):

1) 20.0 kJ =	joules
2) 100. joules =	KJ
3) 100. K =	^oC
4) 200.^oC =	K

C) Describe the following as being either potential or kinetic energy.

Situation	**PE or KE**
Energy stored in a compressed spring	
Heat given off by burning coal	
An earthquake in progress	
A rock falling from a cliff	
Laser light	
A stick of dynamite (held in the hand)	

D) Is a temperature of -300^{o}C possible? Explain.

E) For the reaction: A + B → C:

If the reactants A and B have 40. KJ of energy total stored in their bonds and the product C contains 60. KJ of energy stored in its bonds:

_____1) How many KJ of potential energy must have been absorbed or released in this reaction?
a) absorbed 120. KJ b) released 120. KJ c) absorbed 20. KJ d) released 20. KJ

2) Was this reaction **exothermic** or **endothermic**?

3) If this reaction were placed in a calorimeter with water in it, would the temperature of the water **increase** or **decrease**?

4) What is the overall change in energy of this reaction, in kilojoules? Use a + sign before the number if the change is endothermic, a – sign for exothermic.

F) Why was water used as the standard on which the Celsius scale was based? It is also used as the standard for such things as specific heat (1.0 cal/g$\cdot$^{o}C), viscosity (water = 1.00 centipoise) and density (water = 1.00 g/cm^3). Why <u>water</u>? Use complete sentences.

3) Calorimetry Homework

A) Identify the following changes as indicating an endothermic or exothermic reaction.

1) Forming ammonia from its elements releases 46.2 kilojoules.____

2) Forming iodine chloride from its elements absorbs 18.1 kilojoules.____

B) Are the following reactions exothermic or endothermic? Base your answers on Reference Table I.

Reaction	Exo or Endo?	Reaction	Exo or Endo?
The formation of Al_2O_3		Dissolving NaCl into water	
The decomposition of Al_2O_3		Dissolving NaOH into water	
The formation of HI		Burning CH_4 in oxygen	
The decomposition of HI		Burning C_2H_5OH in oxygen	

C) Solve the following calorimetry problems (correct numerical setup must be shown):

1) How many joules are required to raise the temperature of 100. grams of water from 30.0^{o}C to 40.0^{o}C ?

2) How many joules are needed to raise the temperature of 200. grams of water by 20.0^{o}C?

3) If a 2.0 gram sample of water at 5.0^{o}C absorbs 5.0 joules of heat, the temperature of the sample will be raised by how much?

4) The temperature of 50. grams of water was raised to 50.0^{o}C by the addition of 1000. joules of heat energy. What was the initial temperature of the water?

5) A sample of water is heated from 10.0^{o}C to 15.0^{o}C by the addition of 30. joules of heat. What is the mass of the water?

6) A substance has a heat of reaction of 20.0 kJ/mole. How many moles of this substance must be reacted to increase the temperature of 150. grams of water from 40.0^{o}C to 65.0^{o}C?

7) What temperature change in Celsius degees is produced when 800. J is absorbed by 100. g of water?

8) How many grams of water can be heated from 20.0^{o}C to 75.0^{o}C using 3500. J?

9) When 8.0 grams of methane are burned, the heat released by the burning methane (55 600 Joules released for each gram burned) is absorbed by a 2000.0 gram sample of water. By how many Celsius degrees will the temperature of the water rise, assuming the water absorbed 100% of the energy lost by the burning methane?

10) How many grams of water can be heated 75.0^{o}C by the absorption of 4.50 KJ?

11) What is the final temperature after 80.0 J is absorbed by 10.0 g of water at 25.0^{o}C?

12) How many joules are released when 250.0 g of water cools from 60.0^{o}C to 20.0^{o}C?

13) What temperature change is produced when 600.0 grams of water gives off 9.60 KJ?

14) What is the final temperature when 640 J is given off by 40.0 grams of water at 45.0^{o}C?

D) The heat content of natural gas (methane) is 37.38 kJ/L. How many liters of natural gas are needed to heat 200 kilograms of water from 20.0^{O}C to 373.0^{O}K?

Review Questions

_____1) Which of the following substances can not be decomposed by chemical change?

a) Na b) HNO_3 c) $ZnCl_2$ d) $C_6H_{12}O_6$

Explain:

_____2) You have discovered a new element and name it. Which one of the following symbols may be used for your new element?

a) U b) DG c) nD d) Sd

Explain:

_____3) Which of the following substances can be decomposed by chemical change?

a) Na b) Cl c) NaCl d) K

Explain:

_____4) Which of the following represents a homogeneous mixture?

a) NaCl (s) b) NaCl (l) c) NaCl (aq) d) NaCl (g)

Explain:

_____5) Which of the following represents a heterogeneous mixture?

a) air b) soil c) salt water d) sugar

Explain:

_____6) What is 30.^{o}C, expressed in Kelvin?

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

Explain:

_____7) What is 200. K, expressed in degrees Celsius?

a) 200. ^{o}C b) 473 ^{o}C c) –73 ^{o}C d) 73 ^{o}C

Explain:

_____8) What device is used to measure the average kinetic energy of a system?

a) balance b) calorimeter c) thermometer d) graduated cylinder

Explain:

_____9) Which system contains the greatest amount of kinetic energy?

a) 30. g of water @ 200. K b) 40. g of water @ 200. ^{o}C c) 50. g of water @ 400. K

Explain:

_____10) What kind of energy is found stored within the bonds of a molecule of octane (gasoline)?

a) potential b) kinetic c) both d) neither

Explain: