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 a 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.

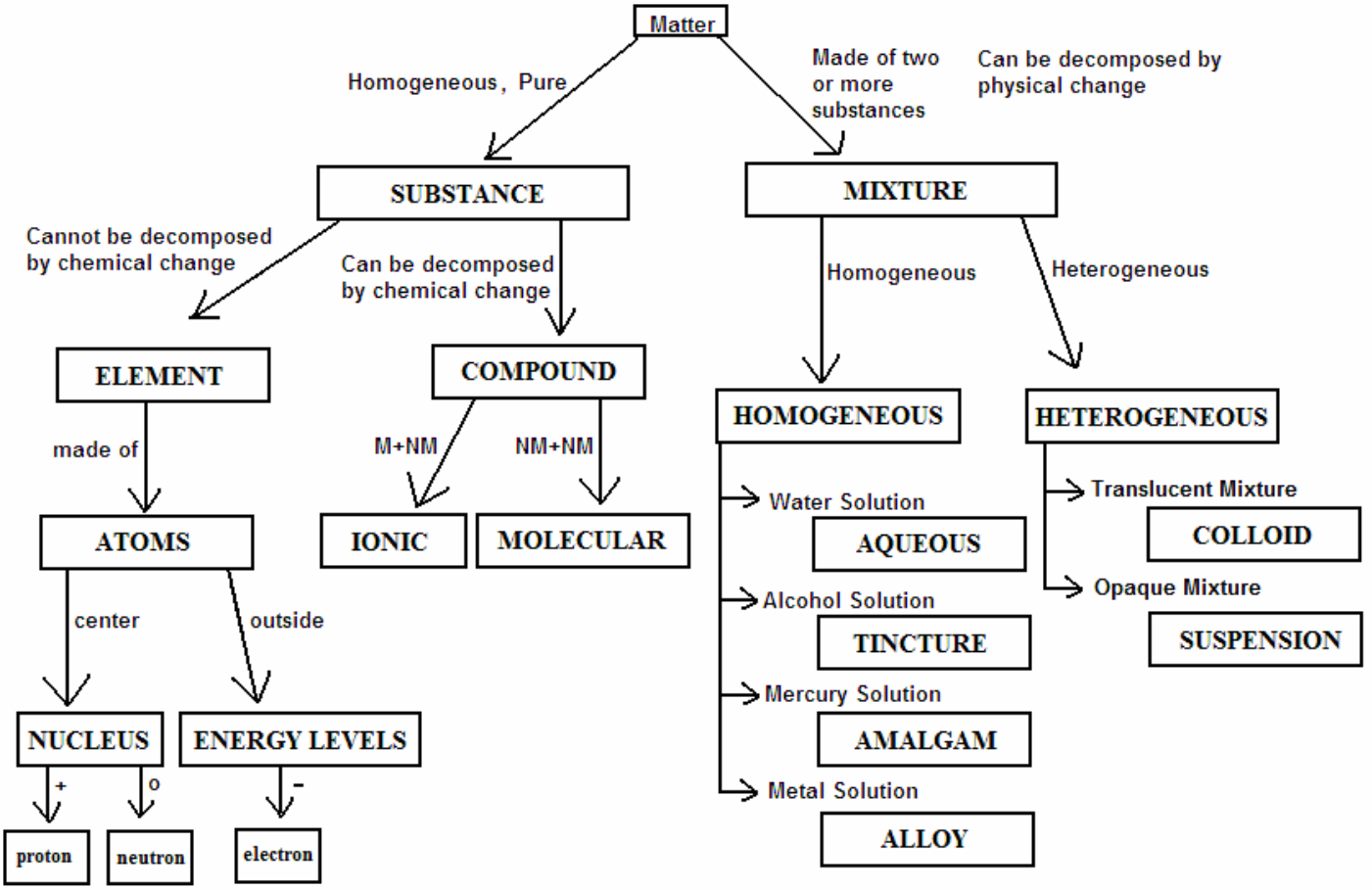
Topic 1) Classification of Matter

Objective: You will identify the different types of matter by their properties and formulas and make basic calculations regarding the particles that atoms are made of.

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.

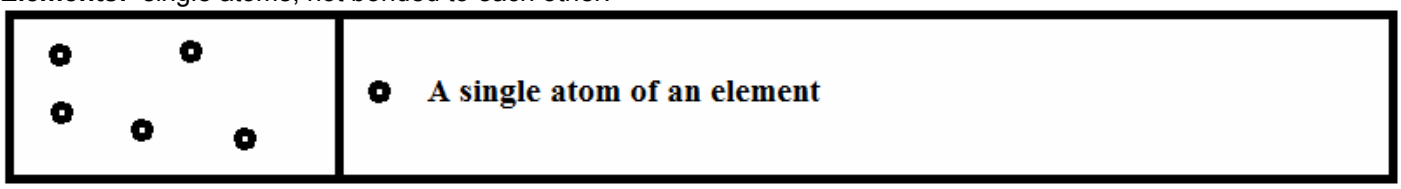
2) Italian salad dressing: The different ingredients separate by density with the oil on top and the vinegar and water at the bottom with various pieces of chopped garlic and pepper at different levels with varying concentration. As with muddy water, the particles are too large to form a homogenous mixture.

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

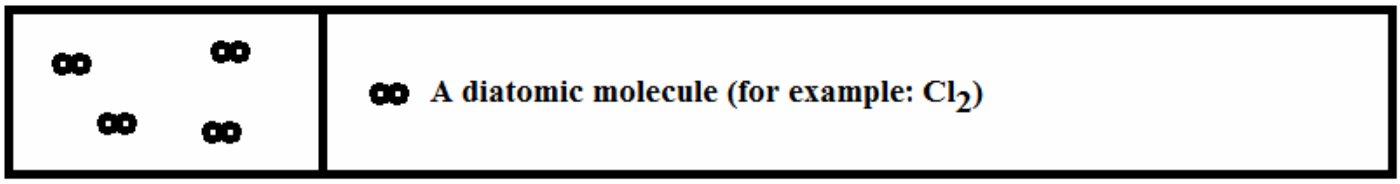
4) Cat vomit: this amazing material can contain a wide assortment of components, including partially digested dry or wet food, stomach juices, animal bones, fur and other items which vary widely from cat to cat and from vomit to vomit. These components are not mixed together regularly, upon examination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

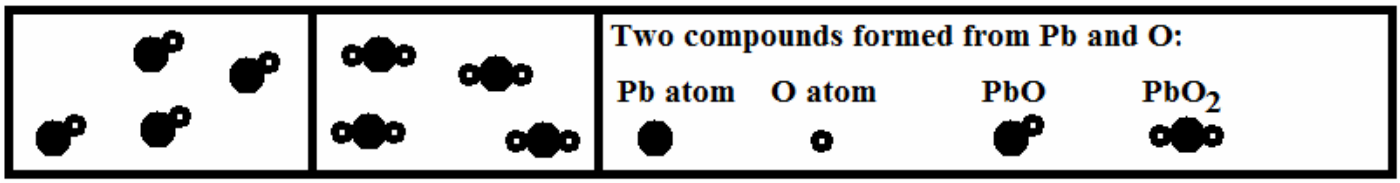
Elements: single atoms, not bonded to each other.



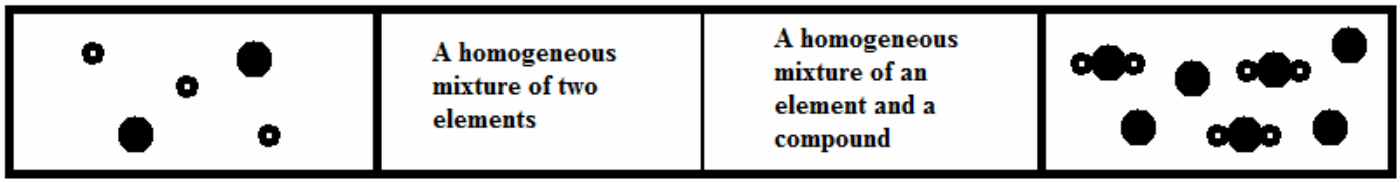
Diatomic Molecule: certain elements are so reactive that they are more stable as pairs, forming two-atom molecules that are called **diatomic**. The elements that do this are Br, I, N, Cl, H, O and F. Their formulas are written as Br_2, I_2, N_2, Cl_2, H_2, O_2 and F_2. Since they are made of only one 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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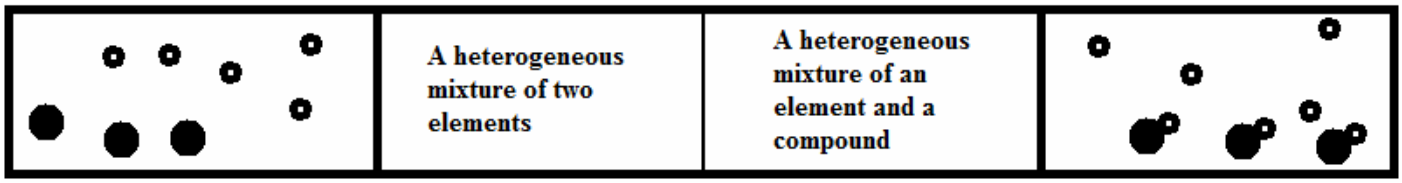


Topic 2) Introduction To The Periodic Table

Objective: You will identify the different types of elements that are found on the Periodic Table by their position and properties, identify properties of substances as being physical or chemical, name common elements (with the ultimate goal of memorizing their names and symbols) and write simple formulas of ionic compounds given the charges of the elements that go into making them.

The Periodic Table is a chart that organizes the known elements

A) Element Types

Elements on the Periodic Table are divided into four subgroups called metals (like aluminum, iron and gold), nonmetals (like oxygen, chlorine and sulfur), metalloids (semimetals like silicon in microchips) and noble gases (like the helium in your balloon or the argon in your double-paned windows), based on the properties of the elements. Here is the breakdown:

Groups

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	H																	He
2	Li	Be											B	C	N	O	F	Ne
3	Na	Mg											Al	Si	P	S	Cl	Ar
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
6	Cs	Ba	La-Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
7	Fr	Ra	Ac-Lr	Rf	Db	Sg	Bh	Hs	Mt									

Key:

Metal | Metalloid | Nonmetal | Noble gas

B) Properties Types

1) Physical Properties: properties that can be observed without changing the chemical composition of the substance. Physical changes can be reversed by other physical changes. These include:

Melting point (the temperature at which a substance melts)	Ability to conduct heat or electricity (conductivity)
Boiling point (the temperature at which a substance boils)	Ductility (ability to be rolled or drawn into a wire)
Malleability (ability to be rolled or flattened into thin sheets)	Solubility (ability to dissolve in a solvent)
Heat of phase change (energy needed to melt or boil)	Density (mass / volume of substance)
Brittleness (susceptibility to shattering under crushing force)	Luster (shininess)

2) Chemical Properties: properties that can be observed only by changing the chemical composition of the substance. Chemical changes can only be reversed by other chemical changes. These include:

Reactivity (how likely a substance is to react with another)	Ability to be corroded, rust, tarnish, be eaten away by acid, to be turned into soap by base, form an insoluble (not dissolvable) precipitate (solid) when reacted, explode, combust (burn) or anything else that changes the chemical composition of a substance.
Heat of reaction (energy absorbed or released in a reaction)	
Electronegativity (an atom's attraction to electrons in a bond)	
Ionization energy (energy required to remove one electron)	

C) Properties of Element Types

Element Type	Physical Properties	Chemical Properties
Metal	- Malleable (aluminum foil) - Ductile (copper wire) - Luster (aluminized glass = a mirror!) - Excellent conductors of heat and electricity (wires + toasters) - Large atomic radius (big atoms)	- Low electronegativity - Lose electrons when forming bonds - Form + charged ions (called CATIONS) - Low ionization energy - Tend to tarnish or rust or form a patina (oxide coating) in the presence of oxygen - Group 1 and 2 metals react violently with water
Nonmetal	- Brittle (sulfur can be crushed to a powder) - Dull (don't reflect light well) - Poor conductors of heat and electricity (except for certain forms of carbon) - Small atomic radius (small atoms)	- High electronegativity - Gain electrons when forming bonds with metals to form ionic bonds - Form – charged ions (called ANIONS) - Share electrons with other nonmetals to form covalent bonds - Form molecules when bonded to other nonmetals - Group 17 nonmetals (halogens) are extremely corrosive - High ionization energy
Metalloid	- Sometimes conduct electricity (semiconductors) - Used to make computer microchips - Luster (like metals) - Brittle (like nonmetals) - Photovoltaic (produce electricity from light) - Used to make solar energy panels	- Gain electrons from metals - Lose electrons to nonmetals
Noble Gas	- Low boiling points - All gases at room temperature - Poor conductors of heat and electricity	- Completely chemically nonreactive - No electronegativity (no bonds form) - Extremely high ionization energy

D) Common Element Names and Symbols (based on Reference Table S)

You will memorize the names and symbols in this list of elements, as you will be quizzed frequently on them:

Symbol	Name	Significance/Use	Symbol	Name	Significance/Use
H	Hydrogen	Lightest element, flammable	Co	Cobalt	Magnetic alloys
He	Helium	Balloons, radioactivity	Ni	Nickel	Coins, alloys
Li	Lithium	Battery technology	Cu	Copper	Wires, pipes, alloys
C	Carbon	Life, plastics, energy	Zn	Zinc	Galvanized steel, batteries
N	Nitrogen	Life, atmosphere	Br	Bromine	Cleaning properties
O	Oxygen	Life, atmosphere, oxides	Kr	Krypton	Headlamps
F	Fluorine	Most nonmetallic element	Ag	Silver	Jewelry, alloys
Ne	Neon	Advertising signs	Sn	Tin	Alloys, toxic heavy metal
Na	Sodium	Explosive metal, makes salt	I	Iodine	Disinfectant
Mg	Magnesium	Lightweight metal, flares	Xe	Xenon	Flashbulbs
Al	Aluminum	Structural lightweight metal	Ba	Barium	Radiocontrast for X-rays
Si	Silicon	Microchip technology	W	Tungsten	Light bulb filaments
P	Phosphorous	Life, incendiary devices	Au	Gold	Jewelry, conductor, alloys
S	Sulfur	Matches, gunpowder	Hg	Mercury	Amalgams, thermostats
Cl	Chlorine	Cleaning properties	Pb	Lead	X-ray blankets, toxic
Ar	Argon	Gas in windows	Fr	Francium	Most metallic element
K	Potassium	Nutrition, explosive metal	Rn	Radon	Carcinogenic gas
Ca	Calcium	Bones, minerals (limestone)	U	Uranium	Nuclear reactor fuel
Fe	Iron	Structural metal, rusts	Am	Americium	Used in smoke detectors

E) Metallic and Nonmetallic Character

1) Metallic Character: metals lose electrons due to low ionization energy. The element with the least ionization energy (Fr) is the most metallic, because it will lose electrons more easily than any other metal. When comparing metals, the lower the ionization energy, the more metallic character the element has. You can find ionization energy values on Reference Table S.

Example: Ca has an ionization energy of 590 kJ/mol, and K has an ionization energy of 419 kJ/mol. If you heat both metals up, K will lose its electron first, as it requires less energy. K has more metallic character than Ca.

Note: The total quantity of Francium on this planet (Earth) has been estimated to be just enough to fit inside a small pen cap. Being so rare, we will not be using Fr during this course for any other reason than as the most metallic element.

2) Nonmetallic Character: nonmetals tend to gain electrons due to high electronegativity. The element with the highest electronegativity (F) is the most metallic, because it will gain electrons more easily than any other nonmetal. When comparing nonmetals, the higher the electronegativity, the more nonmetallic character the element has. You can find electronegativity values on Reference Table S.

Example: O has an electronegativity of 3.5 and Cl has an electronegativity of 3.2. Since O has a greater attraction to electrons than Cl does, it is more likely to gain electrons from a metal than Cl is. O has greater nonmetallic character than Cl.

F) Simple Formula Writing

Metal atoms form + charged ions and nonmetals form – charged ions. These ions combine in such a way that their charges cancel out (add up to zero), and form compounds that we can write formulas for. Later in the course you will learn how to find the charge of any ion and how to write complex chemical formulas. For now, you will be given the charges of the ions and you will write simple formulas. X represents a metal ion, Y represents a nonmetal ion.

+ ion charge	- ion charge	Formula	Example
X^{+1}	Y^{-1}	XY	Na^{+1} and Cl^{-1} form NaCl (table salt)
X^{+2}	Y^{-2}	XY	Zn^{+2} and O^{-2} form ZnO (the source of zinc in cereal)
X^{+3}	Y^{-3}	XY	Al^{+3} and P^{-3} form AlP (used in making LED's)
X^{+2}	Y^{-1}	XY_2	Ca^{+2} and Cl^{-1} form $CaCl_2$ (ice remover pellets for roads)
X^{+3}	Y^{-1}	XY_3	Fe^{+3} and Cl^{-1} form $FeCl_3$ (used to etch copper for circuits)
X^{+1}	Y^{-2}	X_2Y	Cu^{+1} and O^{-2} form Cu_2O (used to be used to make diodes)
X^{+1}	Y^{-3}	X_3Y	Li^{+1} and N^{-3} form Li_3N (solid electrolyte for batteries)
X^{+3}	Y^{-2}	X_2Y_3	Al^{+3} and O^{-2} form Al_2O_3 (corundum, ruby, sapphire)
X^{+2}	Y^{-3}	X_3Y_2	Mg^{+2} and N^{-3} form Mg_3N_2 (a chemical catalyst)

Later in the course you will learn WHY ions have the charges they do, about ions made of more than one element and how to put formulas together to make chemical reactions, with which you can make just about anything you might want!

Topic 3) Energy

Objective: You will differentiate between kinetic and potential energy, convert between ^{o}C and K, convert between J and kJ, and state the law of conservation of energy.

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

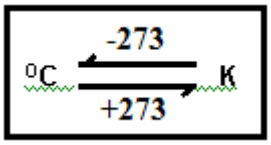
1) Kinetic Energy: Energy of MOTION, contained by anything that MOVES.

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^{o}C and the boiling point of water as 100^{o}C.

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^{o}C), all particle motion stops.

To convert back and forth between Celsius and Kelvin temperatures:



Melting point of water, 0^{o}C is equal to 273 K (0 + 273 = 273)

Boiling point of water, 100.^{o}C 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^{o}C piece of warm metal into a beaker of water at 10^{o}C. 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 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. 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!

Topic 4) Calorimetry

Objective: You will identify changes as being endothermic or exothermic, describe these changes in terms of potential and kinetic energy and perform calorimetry calculations. These include calculating the joules absorbed or released during a change, the mass of water that undergoes a temperature change or the temperature change of water that has had heat added or removed from it.

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.

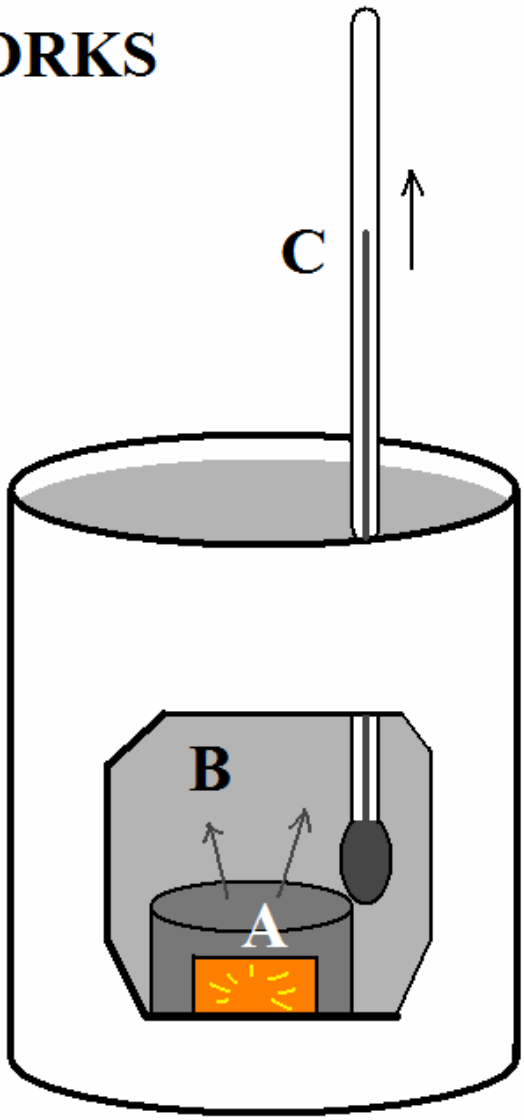
Cue equals…

Em Cee Delta Tee!
Em Cee Delta Tee!
Em Cee Delta Tee!
That's CALORIMETRY!

HOW A CALORIMETER WORKS

A sample that is undergoing an 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. That heat 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. The 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 heat.

If this had been an endothermic change, the change in (A) would have absorbed heat from the water (B), causing the temperature in the thermometer (C) to decrease.



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: $q = \underline{m}\ C\ \Delta T$ (divide both sides by $C\ \Delta T$)

So, **$m = q / C\ \Delta T$**

Example: A sample of water is heated by 20.0 ^{o}C by the addition of 80.0 J of energy. What is the mass of the water?
Solution: $m = q / C\ \Delta T$ $m = (80.0\ J) / (4.18\ J/g\text{-}^{o}C \times 20.0^{o}C) = 0.9569377$ 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: $q = m\ C\ \underline{\Delta T}$ (divide both sides by m C)

So, **$\underline{\Delta T} = q / m\ C$**

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: $\Delta T = q / m\ C$ $\Delta T = (300.\ J) / (50.\ g \times 4.18\ J/g\text{-}^{o}C) = 1.4354066$ rounded to 2 sig figs is **1.4 ^{o}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: $q = m\ C\ \underline{\Delta T}$ (divide both sides by m C)

So, **$\underline{\Delta T} = q / m\ C$**

Example: 200. J of energy is absorbed by an 80.0 g sample of water in a calorimeter at 25.000 ^{o}C. What will the final temperature be?
Solution: $\Delta T = q / m\ C$ $\Delta T = (200.\ J) / (80.0\ g \times 4.18\ J/g\text{-}^{o}C) = 0.5980861$ rounded to 3 sig figs is **0.598 ^{o}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 ^{o}C and increases by 0.598 ^{o}C, then the final temperature will be: **25.598 ^{o}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: _____, _____, _____, _____

1) Classification 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

_____2) Which of the following fictitious element symbols are legitimate?
a) Cn b) HB c) zL d) r

_____3) Which of the following substances can not be decomposed by chemical change?
a) Na b) HNO_3 c) $ZnCl_2$ d) $C_6H_{12}O_6$

_____4) 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

_____5) Which of the following substances can be decomposed by chemical change?
a) Na b) Cl c) NaCl d) K

_____6) Which of the following represents a homogeneous mixture?
a) NaCl (s) b) NaCl (l) c) NaCl (aq) d) NaCl (g)

_____7) Which of the following represents a heterogeneous mixture?
a) air b) soil c) salt water d) sugar

B) 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:

C) 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) Introduction To The Periodic Table Homework

A) Multiple choice: Place your answer in the space to the left of the question number.

_____1) Which of the following changes is a physical change?
a) rusting b) dissolving c) burning d) corroding

_____2) Which of the following changes can be reversed by a chemical change?
a) melting b) crushing c) rusting d) evaporating

_____3) Which element is a metalloid?
a) O b) Ge c) Li d) Ne

_____4) Which element has the most metallic character?
a) H b) He c) Cs d) O

_____5) Which element has the most nonmetallic character?
a) H b) He c) Cs d) O

_____6) When Ca and F bond together, which one forms the + charged ion? Which one forms the - charged ion?
a) F^+, Ca^- b) Ca^+, F^-

_____7) What another name for a + ion?
a) anion b) cation c) bob d) fred

_____8) What is another name for a - ion?
a) anion b) cation c) clarisse d) monique

_____9) Which element will have the greatest attraction for electrons in a chemical bond?
a) Fr b) Ca c) Fe d) F

_____10) Which element is most likely to lose electrons when bonding with Br?
a) N b) O c) Li d) Zn

_____11) Which element requires the most energy to remove an electron?
a) Mg b) Zn c) O d) He

_____12) Four atoms are given energy at the same rate. Which one will lose an electron first?
a) Na b) Cu c) S d) Ar

_____13) How do metal atoms form ions?
a) gain electrons *b) lose electrons* *c) gain protons* *d) lose protons*

_____14) How do nonmetal atoms form ions?
a) gain electrons *b) lose electrons* *c) gain protons* *d) lose protons*

B) Write the formulas for the following compounds, given the ions and their charges:

Symbols/Charge	Formula of Compound
Na^{+1} and S^{-2}	
Ca^{+2} and Cl^{-1}	
K^{+1} and Br^{-1}	
Mn^{+3} and O^{-2}	
Pb^{+2} and S^{-2}	
Fe^{+2} and N^{-3}	
Cr^{+3} and F^{-1}	
Li^{+1} and O^{-2}	
Al^{+3} and S^{-2}	

C) Fill In, using the SYMBOL of the elements in your answer:

1) List two elements that are MALLEABLE: _____ and _____

2) List two elements that are COMPLETELY NONREACTIVE: _____ and _____

3) List two elements that GAIN ELECTRONS when forming a bond: _____ and _____

4) List two elements that are GOOD CONDUCTORS of heat and electricity: _____ and _____

5) List two elements that share properties of both metals and nonmetals: _____ and _____

D) Identify the following as either being physical or chemical in nature.

Description	Physical or Chemical?
Iron rusting on an old car	
Dissolving potassium thiocyanate into water	
Melting a 10.0 g sample of lauric acid	
Paradichlorobenzene melts at a temperature of 52^{o}C	
Sodium metal explosively reacts with water to form hydrogen gas and sodium hydroxide	
110 g of sodium nitrate can dissolve in 100 g of water at 45^{o}C	
Platinum metal is an outstanding conductor of electricity	
Gold metal can be hammered or rolled into extremely thin sheets, called “gold leaf”.	

3) 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) What is 30.^{o}C, expressed in Kelvin?
a) 30. K b) 243 K c) 303 K d) 273 K

_____3) What is 200. K, expressed in degrees Celsius?
a) 200. ^{o}C b) 473 ^{o}C c) –73 ^{o}C d) 73 ^{o}C

_____4) Overnight, the temperature drops by 30.^{o}C. What is the drop in the Kelvin temperature?
a) 30. K b) 243 K c) 303 K d) 273 K

_____5) What device is used to measure the average kinetic energy of a system?
a) balance b) calorimeter c) thermometer d) graduated cylinder

_____6) 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

_____7) What kind of energy is found stored within the bonds of a molecule of octane (gasoline)?
a) potential b) kinetic c) both d) neither

_____8) Which of the following samples has the highest average kinetic energy?
a) 10 g H_2O @ 20^{o}C b) 20 g H_2O @ 20 K c) 30 g H_2O @ 70^{o}C d) 40 g H_2O @ 200 K

_____9) 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.

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

1) 20.0 kJ =	joules
2) 100. joules =	KJ
3) 100. K =	^{o}C
4) 200.^{o}C =	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? Circle the answer:
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) 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) Solve the following calorimetry problems (show all of your work, including a correct numerical setup, and the answer, rounded properly and with appropriate units):

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

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

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