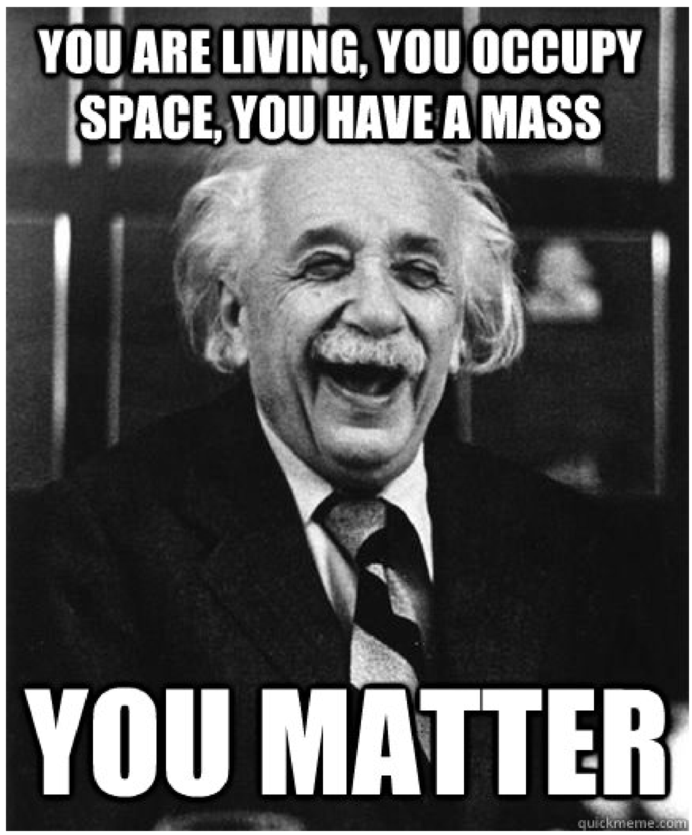
CHEMISTRY 11

UNIT 2: MATTER & INORGANIC NAMING



BOOK 1: THE NATURE OF MATTER , CLASSIFICATION MIXTURES & SEPARATION TECHNIQUES

Name:________________ **Block:_______**

Properties of Matter

Every material possesses a unique set of properties that can be used to identify it.

Classifying Material Properties

Chemistry is the science concerned with the properties, composition, and behaviour of matter. Matter is anything that has mass and occupies space. (volume)

Mass is the amount of matter contained in a thing. Usually the mass of common things is measured in grams(g) or kilograms(kg)

Properties are the qualities of a thing, especially those qualities common to a group of things. The relationship between matter and its properties is a very important aspect of chemistry.

A physical property of a substance is a property that can be found without creating a new substance. (no chemical reaction)

For example: colour, shape, (odour), hardness, texture, melting point/boiling point.

A chemical property is the ability of a substance to undergo *chemical change*/ reaction and change into a NEW substance.

For example: flammability, solubility, reactivity, oxidation state, toxicity, radioactive, etc.

* ***Physical properties*** are classified as being extensive or intensive.

Extensive **properties** are qualities that are or depend on the amount of the material.

Examples are:

- mass
- volume
- flexible
- electrical resistance

} the more of a substance you have, the greater the "Extent" of this property.

Figure 2.1.1 *Gold has a melting point of 1064°C and a density of 19.3 g/cm3.*

These are two physical properties that can be used to identify samples.

Intensive **properties** are qualities that DO NOT depend on the amount of the material. melting point (BP) and density are examples of intensive properties. The gold in Figure 2.1.1 has a melting point and density that are the same for all samples of gold. These properties can therefore be used to identify that material.

Other intensive properties such as temperature (MP/BP), concentration, and tension differ from sample to sample of the same material. (not often) } (a couple exceptions)

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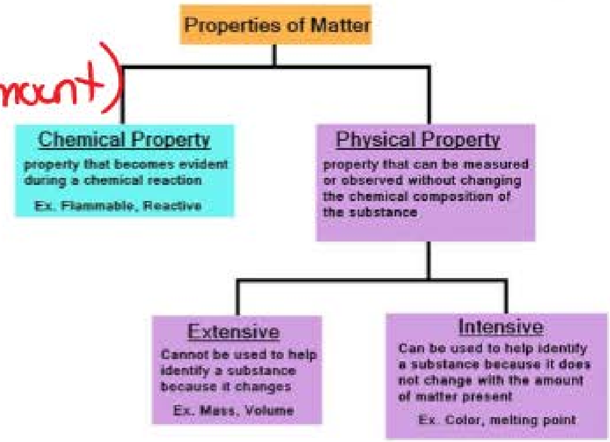
Assignment #1- Hebden pg 44-45 Questions #13-15
All assignments are to be completed on a separate page with the assignment number & heading. Be sure to show FULL WORKING OUT for all homework.

Intensive Properties

- hardness
- conductivity.
- smell
- colour

Extensive Properties (depend on amount)

- shape
- length
- time to dissolve



Physical Properties versus Chemical Properties

The properties of matter are also classified as being either physical properties or chemical properties. Recall, **Physical properties** describe physical changes which are changes of state or (shape) form. Physical properties also describe the physical characteristics of a material.

Chemical properties describe chemical changes. Chemical changes are those in which a new substance(s) or species is formed (Figure 2.1.2). Chemical properties also describe the tendency of a chemical to react (with other substance)

Chemical properties describe relationships or interactions between different forms of matter.

Figure 2.1.2 *The wood that is burning to heat the pot is undergoing chemical changes. The boiling soup in the pot is undergoing a physical change.*

They include a chemical's :

- reactivity
- toxicity
- flammability
- stability.

Signs of a Chemical Change: (Evidence)

- bubbles (gas formation)
- Energy change (temperature)
- colour change
- sound produced
- solid produced (precipitate)
- odor change / produced.

Most physical properties describe relationships or interactions between matter and energy.

- Hardness ability to resist scratching / abrasion (Moh's hardness scale)
- Malleability can be rolled / hammered into thin sheets
- Ductility can be stretched / rolled into fine wires
- Lustre "shininess" / a solid surface which reflects light (glassy, oily, or dull)
- Viscosity is the resistance of a fluid to flow (particles stick to itself)
- Diffusion the intermingling of fluids or gases as a result of motion in the fluid or gas ("spreading out")

For example,

A material can be classified as opaque, transparent or translucent by how it interacts with light. (eg. Lustre)

Other physical properties you may have learned about include temperature, density, viscosity, and surface tension.

Physical properties describe **physical changes**.

Chemical properties describe interactions between different forms of matter. — chemical reactions

} observing "matter"

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Assignment #2- Physical & Chemical Properties & Changes Worksheet Part A + Part B + Part C
This assignment is to be completed on THIS PAGE in the space provided below.

Name KEY ES

PHYSICAL AND CHEMICAL PROPERTIES AND CHANGES

Part A: Physical or Chemical?

Identify the following as a chemical (C) or physical property (P):

P 1. blue color
P 2. density
C 3. flammability (burns)
P 4. solubility (dissolves)
C 5. reacts with acid
C 6. supports combustion
P 7. sour taste
P 8. melting point
C 9. reacts with water
P 10. hardness
P 11. boiling point
P 12. ~~luster~~ shine
P 13. odor
C 14. reacts with air

Identify the following as chemical (C) or physical (P) changes.

P 1. NaCl (Table Salt) dissolves in water.
C 2. Ag (Silver) tarnishes.
P 3. An apple is cut.
P 4. Heat changes H_2O to steam.
C 5. Baking soda reacts to vineger.
C 6. Fe (Iron) rusts.
P 7. Alcohol evaporates .
P 8. Ice melts.
C 9. Milk sours.
P 10. Sugar dissolves in water.
C 11. Wood rots.
C 12. Pancakes cook.
C 13. Grass grows.
P 14. A tire is inflated.
C 15. Food is digested.
P 16. Paper towel absorbs water.
P 17. An ice cube is placed in the sun.
C 18. Two chemicals are mixed together and a gas is produced.
C 19. A bicycle changes colour as it rusts.
P 20. A solid is crushed into a powder.
C 21. Two substances are mixed and light is produced.
C 22. A piece of ice melts and reacts with sodium.
P 23. Mixing salt and pepper.
P 24. Chocolate syrup is dissolved in milk.
C 25. A marshmallow is toasted over a campfire.
P 26. A marshmallow is cut in half

Part B

Read each scenario. Decide whether a physical or chemical change has occurred and give evidence for your decision. The first one has been done for you to use as an example.

	Scenario	Physical or Chemical Change?	Evidence…
1.	Umm! A student removes a loaf of bread hot from the oven. The student cuts a slice off the loaf and spreads butter on it.	Physical	No change in substances. No unexpected color change, temperature change or gas given off.
2.	Your friend decides to toast a piece of bread, but leaves it in the toaster too long. The bread is black and the kitchen if full of smoke.	Chemical	New substance produced ↳colour change, smell
3.	You forgot to dry the bread knife when you washed it and reddish brown spots appeared on it.	Chemical	New substance produced (rust)
4.	You blow dry your wet hair.	Physical	No new substance produced
5.	In baking biscuits and other quick breads, the baking powder reacts to release carbon dioxide bubbles. The carbon dioxide bubbles cause the dough to rise.	Chemical	Reaction takes place
6.	You take out your best silver spoons and notice that they are very dull and have some black spots.	Chemical	New substance produced
7.	A straight piece of wire is coiled to form a spring.	Physical	Just changed the shape.
8.	Food color is dropped into water to give it color.	Physical	Chemical make-up of H_2O and food colouring not changed.
9.	Chewing food to break it down into smaller particles represents a ①______ change, but the changing of starch into sugars by enzymes in the digestive system represents a ②______ change.	① Physical ② Chemical	Just breaking food down; Chemical reaction
10.	In a fireworks show, the fireworks explode giving off heat and light.	Chemical	Reaction takes place

Part C: True (T) or False (F)?

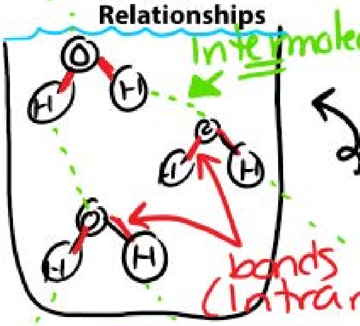
1.	F	Changing the size and shapes of pieces of wood would be a chemical change.
2.	F	In a physical change, the makeup of matter is changed.
3.	T	Evaporation occurs when liquid water changes into a gas.
4.	T	Evaporation is a physical change.
5.	F	Burning wood is a physical change.
6.	F	Combining hydrogen and oxygen to make water is a physical change.
7.	T	Breaking up concrete is a physical change.
8.	F	Sand being washed out to sea from the beach is a chemical change.
9.	F	When ice cream melts, a chemical change occurs.
10.	F	Acid rain damaging a marble statue is a physical change.

PRACTICE

1. What is matter?
2. What is a property?
3. What is an extensive property?
4. What is a chemical property?

1. The stuff that materials are composed of
2. A quality of a thing, especially a quality common to a group, type, class, etc.
3. A quality that is or depends upon the amount of the material
4. A property that describes a chemical change, i.e. one in which a new substance(s) or species

Particle Relationships



Matter is composed of basic units or particles that move independently. In some forms of matter, these particles are atoms while in others these particles are groups of atoms called molecules or polyatomic ions. chemical changes involve the rearrangement of a material's own particles. chemical changes involve the reorganization of two or more substances' atoms in relation to each other. Physical changes alter inter molecular relationships (those between the molecules) while chemical changes alter intra molecular relationships (those within molecules). Physical changes generally involve less energy than chemical changes.

breaking + forming new bonds "chemical reaction"

Kinetic Energy

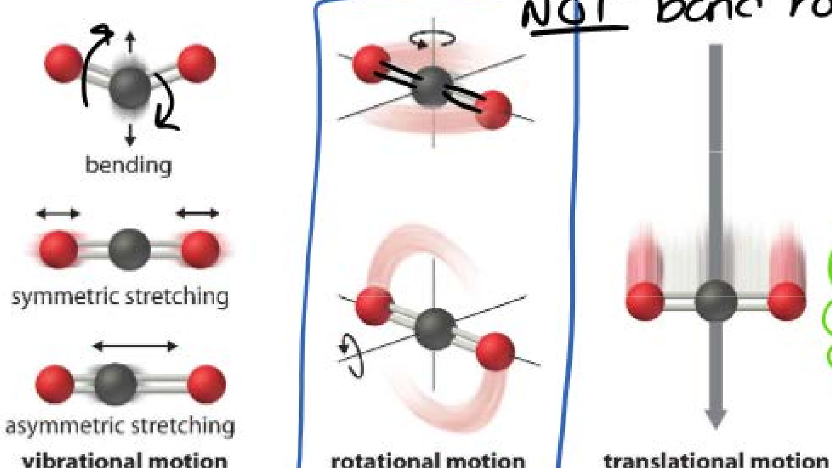
$(KE = \frac{1}{2}mv^2)$

Kinetic Energy is any form of energy that cannot be stored. The greater an object's speed and mass, the greater/more its kinetic energy. The particles of matter possess a type of kinetic energy called mechanical energy because of their continuous motion.

Independent atoms and molecules have three forms of mechanical energy or types of motion:

- Translational (movement from place to place) - Point A → Point B
- Rotational (movement about an axis) -
- Vibrational (a repetitive "back and forth" motion). ⟷

NOT bond rotation



Thermal **energy** is the total mechanical energy of an object's or a material's particles. It is an Extensive property as it depends on the size of the object or the amount of the material.

Temperature is the average mechanical energy of the particles that compose a material and is therefore an intensive property.

An increase in a material's temperature, increases the kinetic energy and indicates that the average speed of its particles has increased.

The differences between solids, liquids and gases can be explained by looking at the particles.

All substances are made up of particles. The particles are attracted to each other. Some particles are attracted strongly to each other, and others weakly.

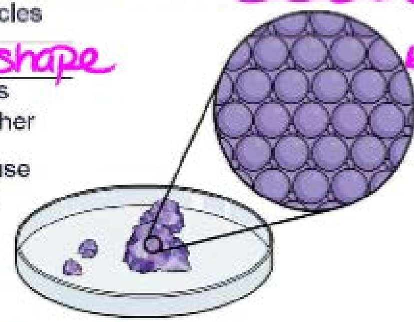
The particles move around. They are described as having Kinetic Energy

The kinetic energy of the particles increase with temperature. (proportionally related)

What are the properties of solids?

Solids:

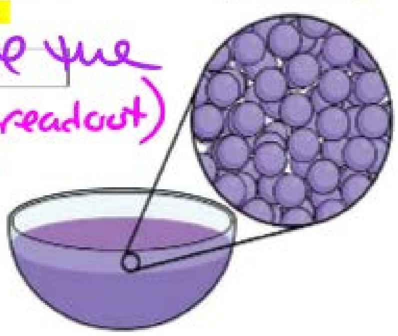
- have a high density as the particles are packed very closely together
- can NOT be compressed because there is very little empty space between particles
- have a fixed shape because the particles are held tightly together
- cannot diffuse because the particles are not able to move.



What are the properties of liquids?

Liquids:

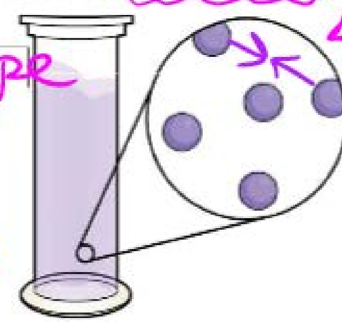
- have a fairly high density because the particles are close together
- Can be compressed (very little) because there is very little empty space between particles
- take up the shape of the container because the particles can move (spread out)
- CAN diffuse because the particles are able to change places.



What are the properties of gases?

Gases:

- have a low density because the particles are spaced very far apart
- can be compressed because there is space between particles
- have no fixed shape because the particles move about rapidly in all directions
- can diffuse because the particles are able to move in all directions.



Physical Properites VOCAB:

Vapour: the gaseous material (properties like a gas) formed by evaporation of a substance which boils above room temp. (25°C)

Vapour Pressure the pressure created by the vapor evaporating from the liquid.

Boiling Temperature *(boiling point)*: a temperature where a liquid changes into a gas. @ the boiling point liquid + gas coexist.

Melting Temperature *(melting point)*: the temperature where a solid changes to the liquid phase. @ the melting point, solid + liquid coexist.

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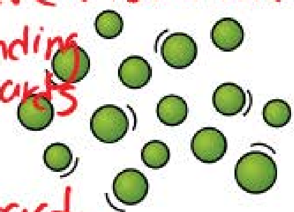
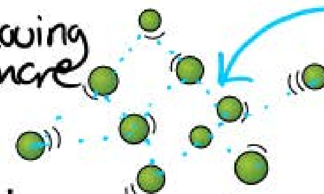
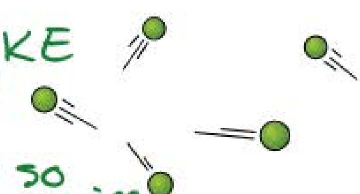
Assignment #3- Hebden pg 48 Questions #22-24
All assignments are to be completed on a separate page with the assignment number & heading. Be sure to show FULL WORKING OUT for all homework.

The States of Matter

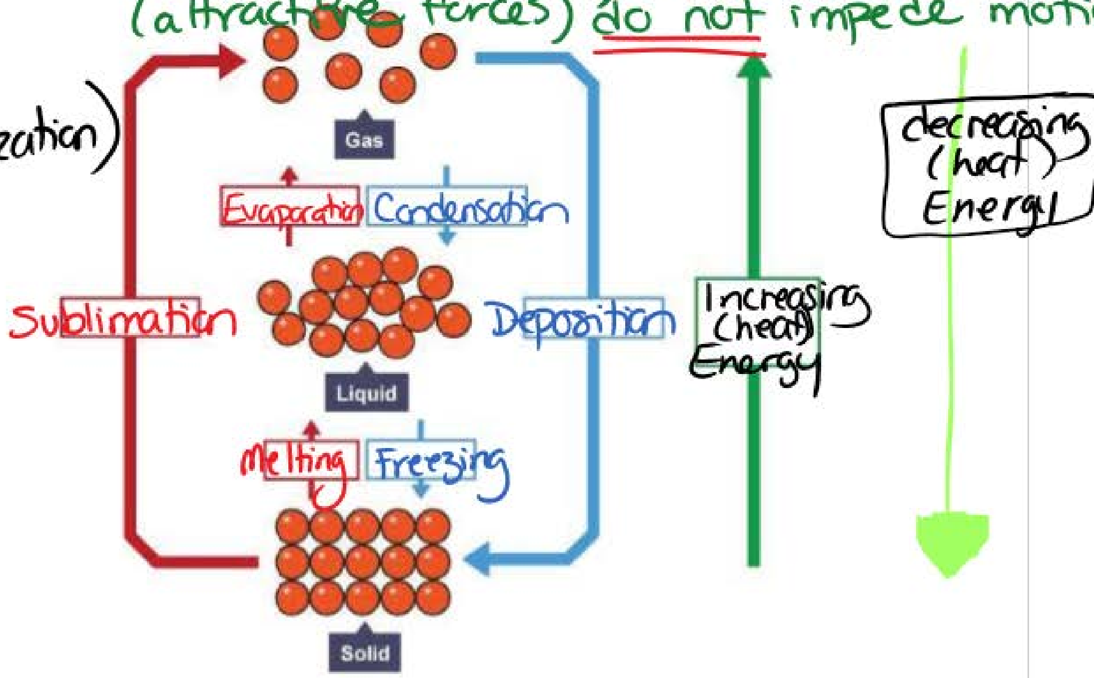
Under normal conditions, matter exists in three states: solid, liquids and gases

Table 2.1.1 *The States of Matter*

State	Operational Definition		Conceptual Definition (explanation)
	Shape	Volume	
solid	fixed (defined)	fixed (defined)	• particles have vibrational energy. • push surrounding particles outwards • strong bonds • structure intact. 
			
liquid	adapt to container	fixed	• more K.E. • particles are moving faster (and in more ways) • collide with greater force. • particles are spread (further) apart.  Intermolecular "forces" (hold particles together)
			
gas	spread to fill container (or space)	"undefined"	• much larger KE • higher force of collision • particles are so far apart + moving with great speed, intermolecular forces (attractive forces) do not impede motion. 
			

*The 6 **Physical Changes** of State:*

1. Evaporation (vaporization)
2. Condensation
3. Melting
4. Freezing
5. Sublimation
6. Deposition



The Kinetic Molecular Theory

The **kinetic molecular theory** explains what happens to matter when the kinetic energy of particles changes. The key points of the kinetic molecular theory are:

1. All matter is made up of tiny particles
2. There is empty space between the particles
3. Particles are always moving. Their freedom to move depends on whether they are in a solid, liquid, or gas. ← K.E.
4. The particles move because of ENERGY. The amount of energy the particles have determine how fast the particles move and how much or far they move.

PRACTICE

1. Explain the difference betwe
2. Describe the differences in k
3. How does heat contribute to

1. The average mechanical energy of the particles that compose a material
2. The total mechanical energy of an object's or a material's particles
3. The energy transferred from one body to another because of a difference in temperature

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Assignment #4 Review Questions #1-2, 6-7

This assignment may be completed in the space provided below.

Review Questions

1. In each pair of items below, which is a form of matter and which is a property?
   (a) vapour, vapour pressure
   (b) freezing point, solid

Answers

1. a. Vapour is a form of matter, vapour pressure is a property, and vaporizing is a phenomenon.
   b. Solid is a form of matter, freezing point is a property, and freezing is a phenomenon.

2. What are two properties shared by all matter?

2. All matter exerts a force of gravity on other matter and occupies space.

6. Whether a property is intensive or extensive often depends on how it is expressed. State whether each of the following physical properties is intensive or extensive.
   (a) temperature
   (b) thermal energy
   (c) thermal expansion (the change in volume in response to a change in temperature)
   (d) coefficient of thermal expansion (the fractional change in volume per degree Celsius change in
   (e) specific heat capacity (the joules of heat required to raise 1 g of the material by 1°C)
   (f) heat capacity (the joules of heat required to raise the temperature of the object 1°C)

6. a. intensive
   b. extensive
   c. extensive
   d. intensive
   e. intensive
   f. extensive

7. State whether each phrase refers to a physical or a chemical property.
   (a) changes of state or form
   (b) relationships or interactions between matter and energy
   (c) only evident through a chemical reaction or a lack thereof
   (d) dependent solely on the relationships between the material's own particles
   (e) relationships or interactions between different forms of matter

7. a. physical
   b. physical
   c. chemical
   d. physical
   e. physical
   f. chemical

Some Physical Properties of Pure Substances

Figure 2.1.5 *At the melting point, a substance can exist in both the solid and liquid states.*

Melting Point

(s) → (l)

A material's melting point is the temperature of its solid as it changes to a liquid. Melting occurs because the independent particles have spread far enough apart so that they can just slip through the gaps between the atoms surrounding them. The melting point of a substance depends on the strength of the attractive forces (intermolecular forces) (also bond strength) between the particles as well as the mass and symmetry of the particles.
The freezing point and melting point of most substances are the same.

Boiling Point

Boiling is a "special case" of evaporation. Any particle in the liquid state may evaporate. The puddles on your street evaporate but you've never seen a puddle boil. The gas formed by a substance that boils **above room temperature** is called vapour.

Boiling is the vigorous bubbling that occurs within the body of a liquid as it vaporizes internally. A bubble is a quantity of gas or vapour surrounded by liquid.

Figure 2.1.6 *Vigorously boiling water. The bubbles are rising to the surface without collapsing.*

Boiling Point is also defined as a substance's highest possible temperature in the liquid state at any given atmospheric pressure. It therefore represents the highest Kinetic Energy the substance's particles can possess in the liquid state. As the temperature of the water approaches 100°C, more and more of the molecules have their max. kinetic energy in the liquid state until at 100°C all the molecules are moving at the same maximum speed in the liquid state.

Boiling point, vapour pressure, and volatility are three closely related properties that are all relevant to boiling. Volatile substances are substances that readily evaporate or evaporate at high rates. They have high vapour pressures and low boiling points.

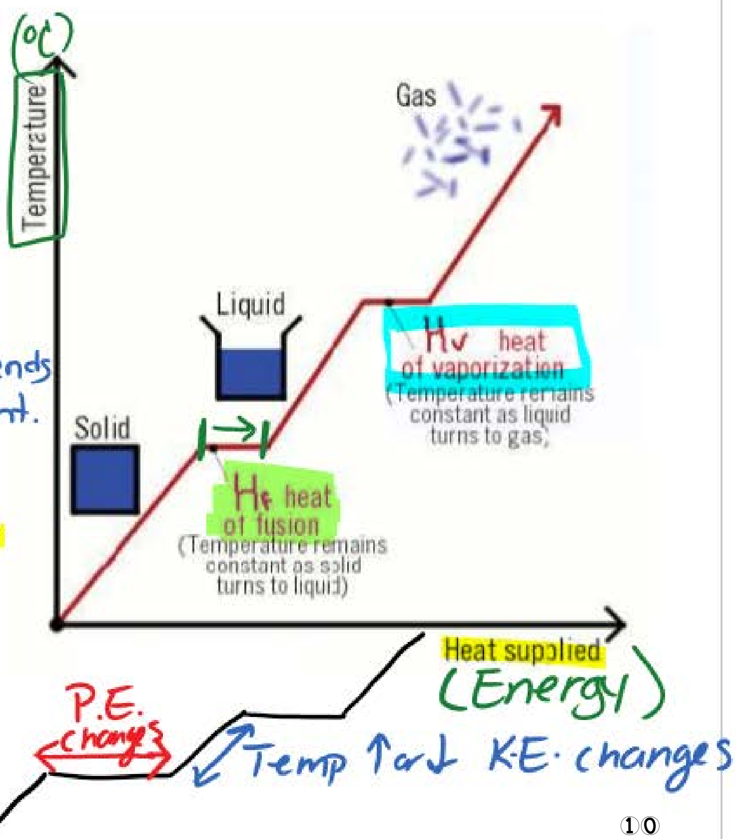
Heat of Fusion (H_f)

The **heat of fusion** is the amount of heat required to melt a specified amount of a substance at its melting point. It represents the difference of potential energy between the solid and liquid states since only the substance's state, not its temperature, is changing. **Potential energy** is stored energy in the bonds. The heat of fusion is released when the specified quantity of the substance freezes. Heat of fusion is measured in Joules/g (Energy).

Heat of Vaporization (H_v) *(measured in joules/gram)*

depends on amount.

The **heat of vaporization** is the amount of heat required to evaporate a specified amount of a substance at its boiling point. It represents the difference of potential energy between the Liquid and gas states since only the substance's state, not its temperature, is changing. The heat of vaporization is released when the specified quantity of the substance condenses. The heat of vaporization indicates the strength of the force holding the liquid particles together in the liquid state.



PRACTICE

1. What is melting? ________________
2. What is boiling? ________________
3. What is the heat of fusion? ________

1. The process of changing from a solid to a liquid
2. The vigorous bubbling that occurs within the body of a liquid as it vaporizes internally
3. The amount of heat energy required to melt a specified amount of a substance at its melting point

Reading a Heating Curve

B → C

As energy is added to a solid, the temperature changes. These changes in temperature can be illustrated in a graph called a Heating curve. Figure 2.1.7 illustrates an ideal heating curve for water.

Note the first plateau in the graph. As a solid melts slowly in its own liquid, the temperature of the liquid will NOT rise if the melting converts kinetic energy into potential energy as fast as the heat is being added. As the amount of solid decreases, it becomes less able to remove the heat as fast as it is being added. This usually causes the melting segment on the graph to curve upward on the right, rather than remaining horizontal as shown on the ideal heating curve (Figure 2.1.7). The amount of heat needed to melt the ice is the Heat of fusion. Once all the ice has melted the water's temperature will begin to increase.

Figure 2.1.7 *Ideal heating curve of a* **pure substance**

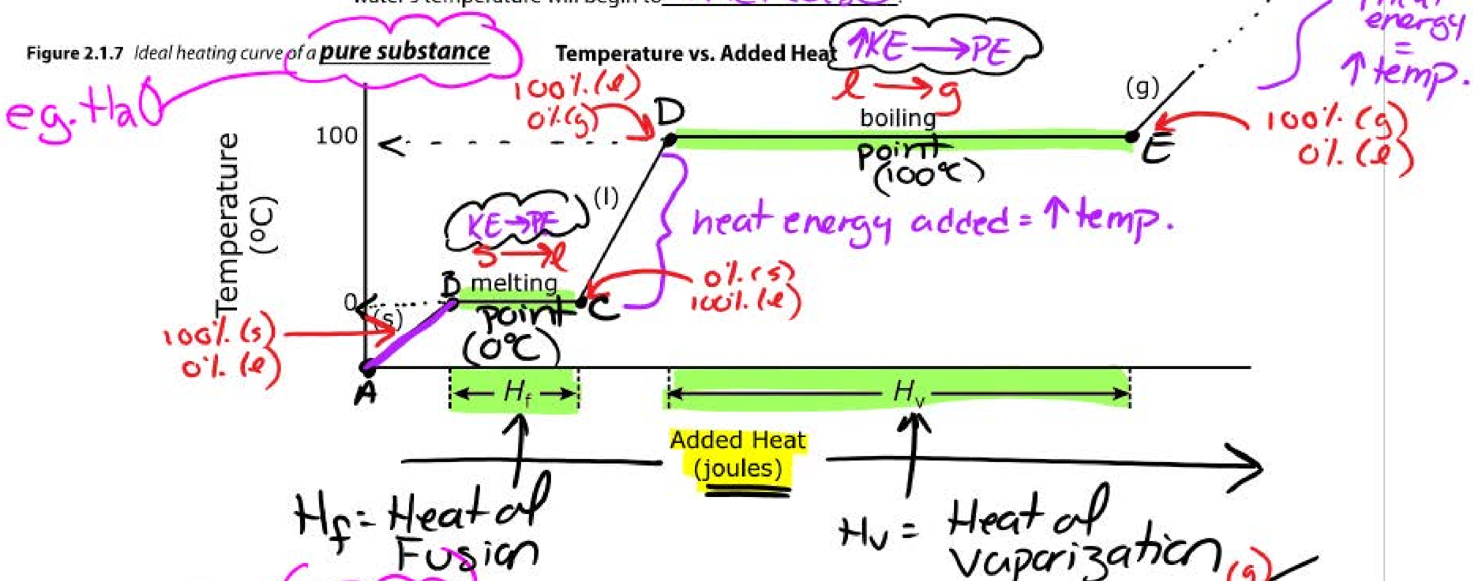
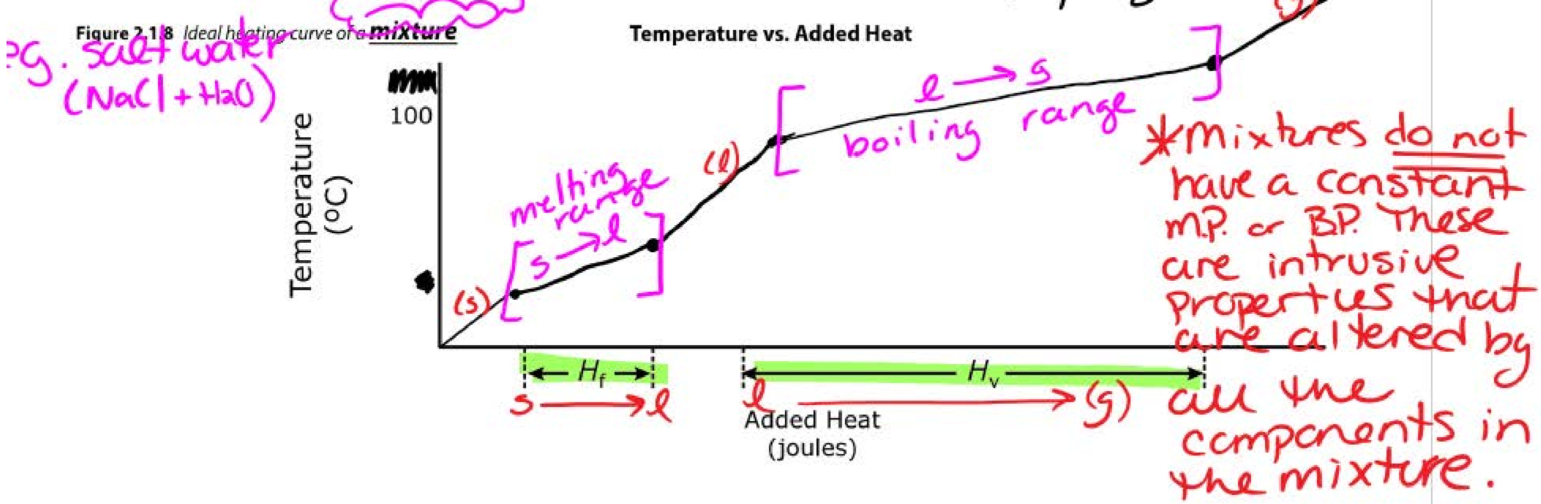


Figure 2.1.8 *Ideal heating curve of a* **mixture**



Assignment #5 Review Questions #8-23 + Phase Change Worksheet

This assignment may be completed in the space provided below.

8. State whether each of the following properties is physical or chemical.

llowing properties is

(a) heat c

(b) heat c

(c) corros

(d) electr

(e) flamm ignite

(f) speec

9. Composit two or mo each othe materials you think materials i

10. What two temperatu

11. Density is amount of material. W density of

12. Briefly explain what causes materials to expand at the particle level when heated.

12. Briefly explain what causes ma the particle level when heated.

KEY

8. a. physical d. physical
   b. chemical e. chemical
   c. chemical f. physical

9. To get a combination of properties not possible in a single material

10. mass, speed

11. The particles move faster and thereby strike each other harder causing them to bounce further apart.

12. Solids: fixed shape and volume
    Liquids: fixed volume, adopt the shape of their container
    Gases: adopt the shape and volume of their container

13. No. An individual atom or molecule cannot melt. Melting describes a change in the relationship between atoms or molecules.

14. The particles have spread apart to an extent where they can slip by one another.

15. As a solid melts slowly in its own liquid, the temperature of the liquid does not rise because any added kinetic energy is absorbed by the solid and converted into potential energy through melting.

16. At the liquid's boiling point

when a material melts.

each phase

ave a melting

cular level

water bath (a absorbs heat

17. Under what co… have the same…

…ition do all the particles of a liquid …netic energy?

KEY

18. Provide an ope… conceptual (ar… point.

19. (a) Which is g… its heat of…

(b) Explain in… be expect…

20. (a) Which is g… vaporizati…

(b) Explain in …ms of r… be expect…

…ter, a… or its heat of combustion?

…es of a …rties of …erties of our …ial properties …erties or are

21. Sensorial propertie… material. Rather tha… something, they are… interaction with tha…

…hange and a …e lit candle.

…d times …y schools. How … reaction?

17. Operational: the temperature at which vigorous bubbling occurs
Conceptual: the temperature at which the substance's vapour pressure equals the pressure of the gas above the liquid

18. Lower the atmospheric pressure above the liquid, for example by putting it in a vacuum chamber or by going to a higher altitude

19. a. heat of vaporization
b. Particles in the liquid state are not that much farther apart than they are in the solid state whereas particles in the gas state are much farther apart (on average) than they are in the liquid state, i.e. there is a much greater increase in P.E. going from a liquid to a gas than going from a solid to a liquid.

20. a. heat of combustion
b. Changing the positions of molecules relative to one another involves less energy than changing the positions of atoms within molecules, i.e. chemical changes generally involve much more energy than physical changes

21. Chemical properties

22.

23. Each student forms new associations with different students

Phase Changes Worksheet

Name ______________

Kinetic Theory of Matter:

- Molecules are always *moving*. This is known as the *kinetic* theory of matter.
- We measure this kinetic energy with a thermometer as *temperature*.
- The greater the material's internal energy, the higher the temperature of that material.
- *Heat* is the energy flow between objects of different temperature.
- Heat and temperature are NOT the same.
- *Brownian motion* describes how visible particles are seen moving due to invisible molecules bumping into them.

Phases of Matter:

Solid

- matter that has definite volume and shape.
- The molecules are packed together tightly and move slowly.

Liquid

- matter that has definite volume but not shape.
- Since the molecules of a liquid are loosely packed and move with greater speed,
- a liquid can flow and spread.

Gas

- matter that has indefinite volume or shape.
- Molecules of a gas are so loosely arranged and move so rapidly that they will fill their container.

Phase Change Descriptions:

Melting

the change from SOLID to LIQUID.

Freezing

the change from LIQUID to SOLID.

Evaporation

the change from LIQUID to GAS.

Condensation

the change from GAS to LIQUID.

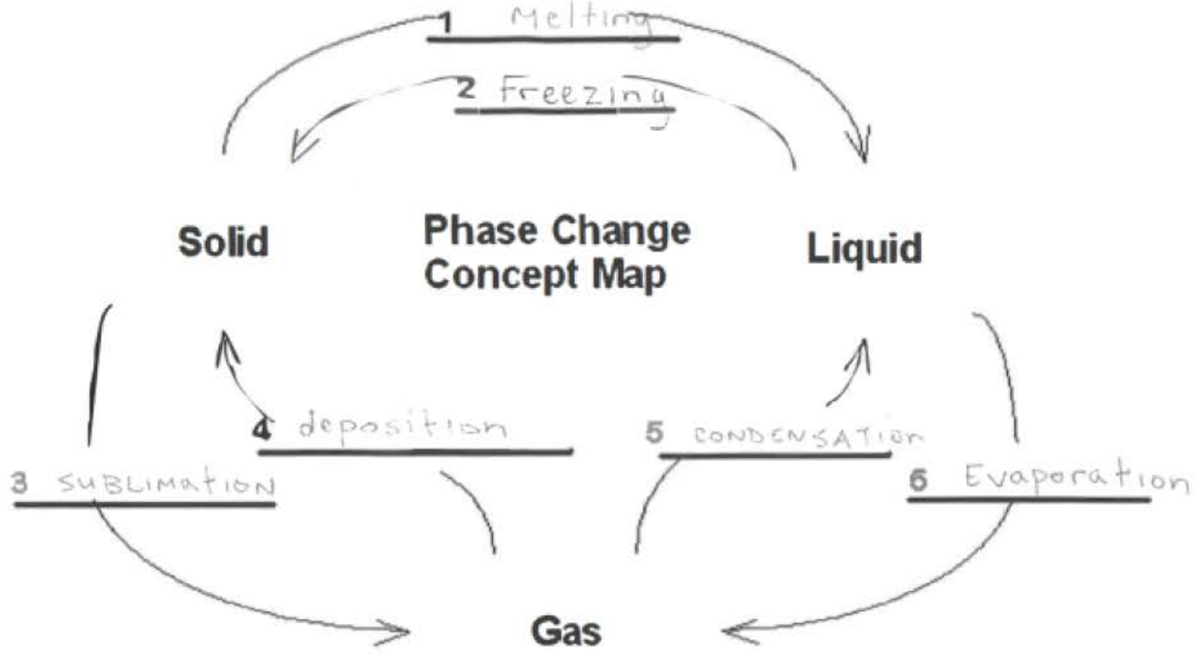
Sublimation

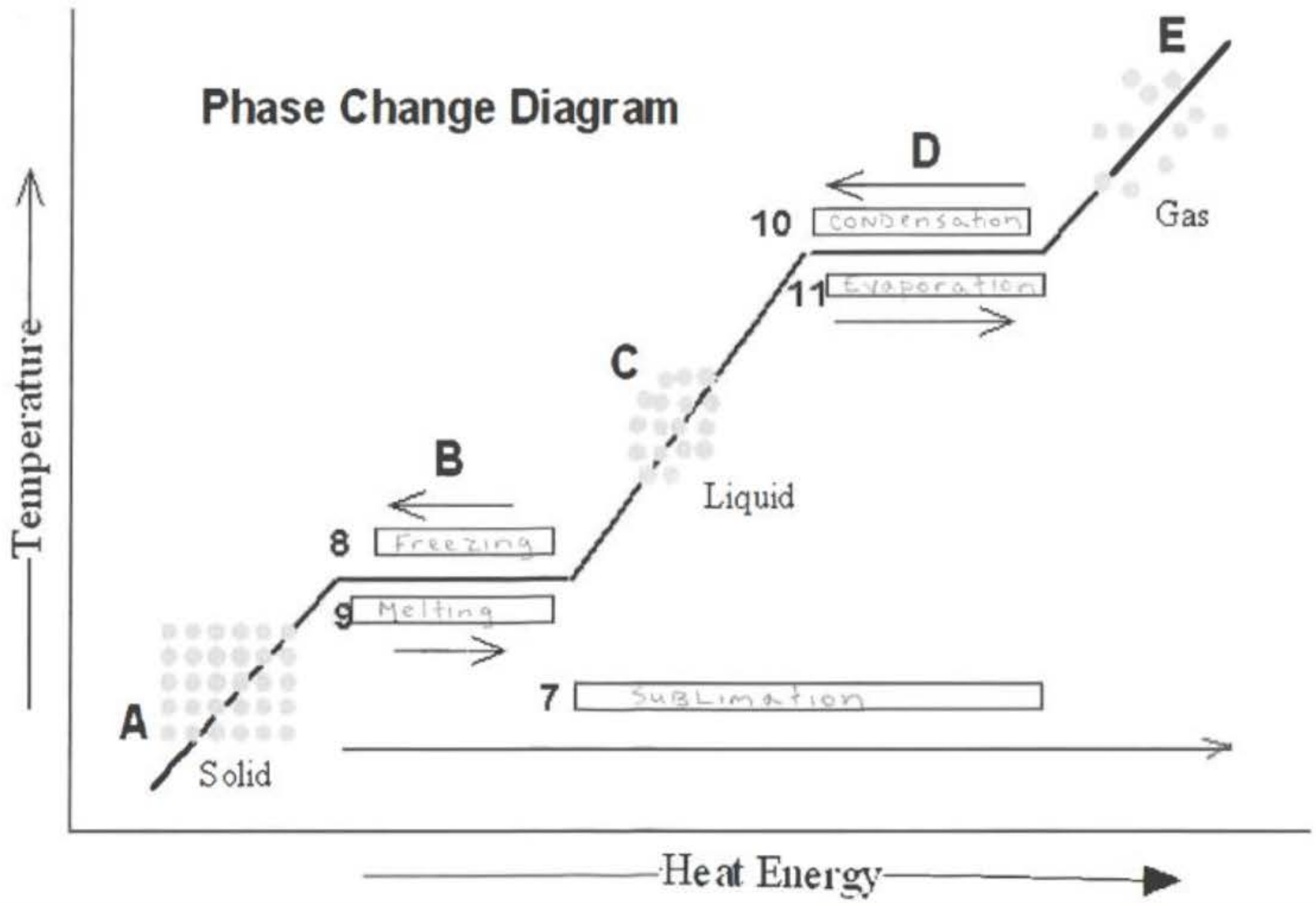
the change from SOLID to GAS.

Deposition

the change from GAS to SOLID.

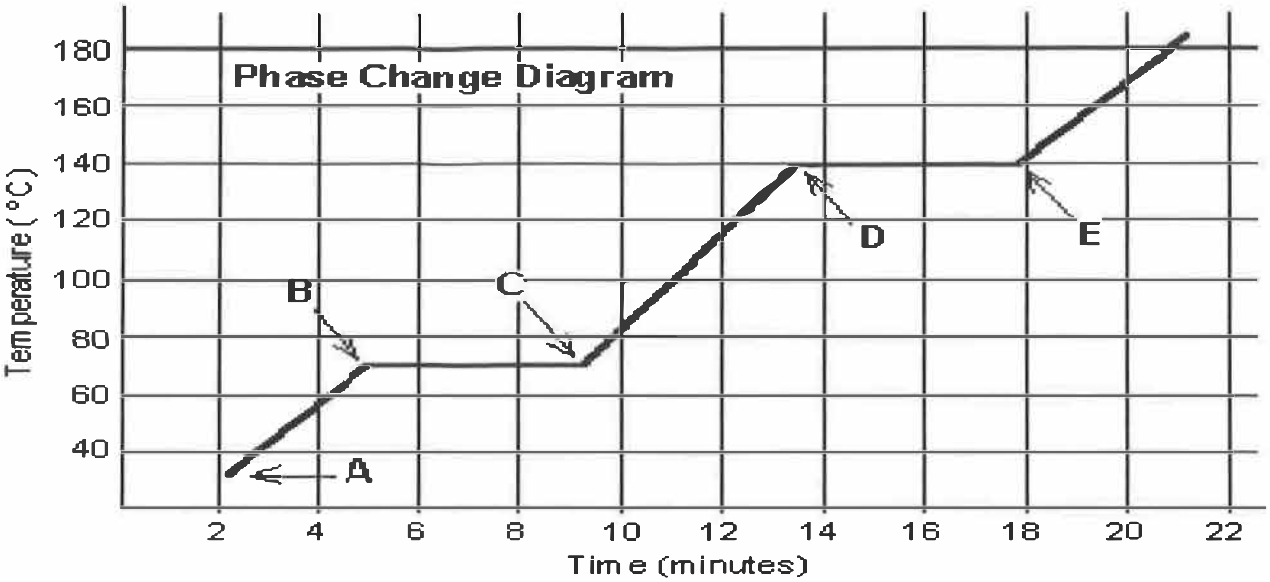
Fill in the phase changes in the blank provided.





Phase Change Worksheet

The graph was drawn from data collected as a substance was heated at a constant rate. Use the graph to answer the following questions.



At **point A**, the beginning of observations, the substance exists in a solid state. Material in this phase has definite volume and definite shape. With each passing minute, energy is added to the substance. This causes the molecules of the substance to vibrate more rapidly which we detect by a steady rise in the substance. At **point B**, the temperature of the substance is 70 °C. The solid begins to Melt. At point C, the substance is completely melted or in a liquid state. Material in this phase has definite volume and Indefinite shape. The energy put to the substance between minutes 5 and 9 was used to convert the substance from a Solid to a liquid. This heat energy is called the **latent heat of fusion**. (An interesting fact.)

Between 9 and 13 minutes, the added energy increases the temperature of the substance. During the time from **point D to point E**, the liquid is boiling. By **point E**, the substance is completely in the gas or vapor phase. Material in this phase has indefinite volume and indefinite shape. The energy put to the substance between minutes 13 and 18 converted the substance from a Liquid to a gas state. This heat energy is called the **latent heat of vaporization**. (An interesting fact.) Beyond **point E**, the substance is still in the gas phase, but the molecules are moving rapidly as indicated by the increasing temperature.

Which of these three substances was likely used in this phase change experiment?

Foosium

Substance	Melting point	Boiling point
Bolognium	20 °C	100 °C
Unobtainium	40 °C	140 °C
Foosium	70 °C	140 °C

BONUS: For water, the value for the latent heat of vaporization is 6.8 times greater than the latent heat of fusion. Imagine we were adding heat at a constant rate to a block of ice in a beaker on a hot plate, and it took 4 minutes for the ice to melt completely. How long would it take, after the water started boiling, for the beaker to be completely empty (the liquid water totally converted to water vapor)?

The Classification of Matter

Warm Up

Most sentences or paragraphs in your textbooks could be classified as a definition, a description, an explanation, a comparison, a sequence, an example, or a classification.

1. Give an example of a sport. ______________________________

2. Name a class of sports. ______________________________

3. What is the difference between an example of something and a class of something?

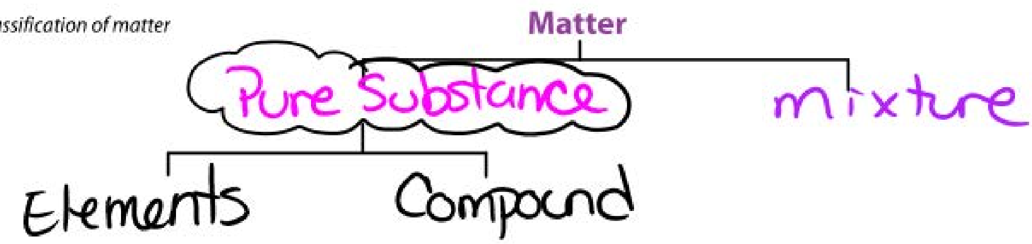
____

Classifying Matter

We currently classify everything in the physical world as either a form of __________________or a form of ______________.

Any solid, liquid, or gas is a form of matter. Matter can be further classified as shown:

Figure 2.2.1 *Classification of matter*



Material	Definition	Examples
pure substance	•all samples have the same properties and components •material with only 1 set of properties	•sugar ($C_6H_{12}O_6$) ← compound •oxygen gas (O_2) ← molecule •copper (Cu) ← atom (element)
mixture	a system/sample made up of 2+ substances; amounts can vary	•salt water (NaCl and H_2O) •air (O_2, N_2, CO_2, H_2) •trail mix
atom	smallest unit of an element, which retains the properties of the larger sample.	•Cu atom of copper •oxygen atom = O
Molecule	a cluster of atoms. chemically bonded. 2+ atoms.	oxygen gas – O_2 ← *generally covalent. "diatomic molec." water – H_2O ethanol – CH_3CH_2OH
Ion	•atoms or polyatomic (molecule) •have an electric charge ⊕⊖	Na^+ ← ⊕ "cations" → NH_4^+ Cl^- ← ⊖ "anions" → NO_3^-
element	a pure substance which cannot be simplified into smaller (or diff.) substances	H, He, Ag, Cu... (all atoms of the same type)
Compound	a pure substance, made up of 2+ different types of atoms.	salt – NaCl water – H_2O } ionic or covalent
Particle	a general term used to describe a "piece of something", or a "part of matter"	} atom, compound, or molecule

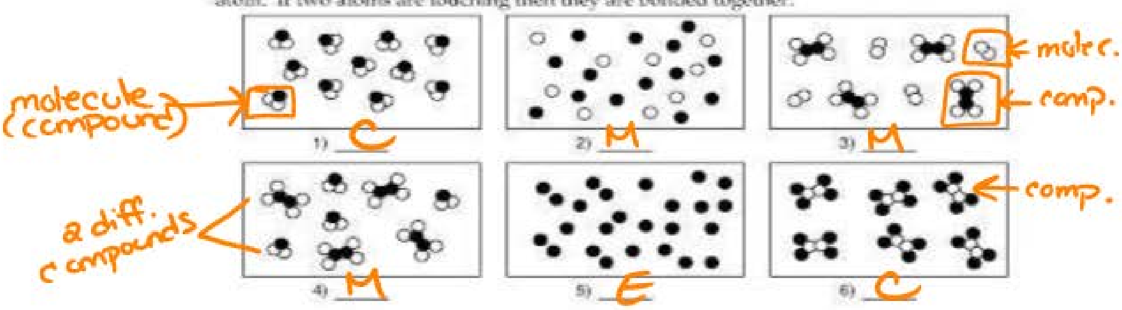
The particles that make up materials are also forms of matter. Chemists refer to all the particles of matter collectively as chemical species. Just as materials are classified, so are chemical species. Chemical species can be classified as neutral atoms molecules, or ions or compounds. Atoms are composed of particles that can be classified as well.

Pure Substance

Classify each of the pictures below by placing the correct label in the blanks below:

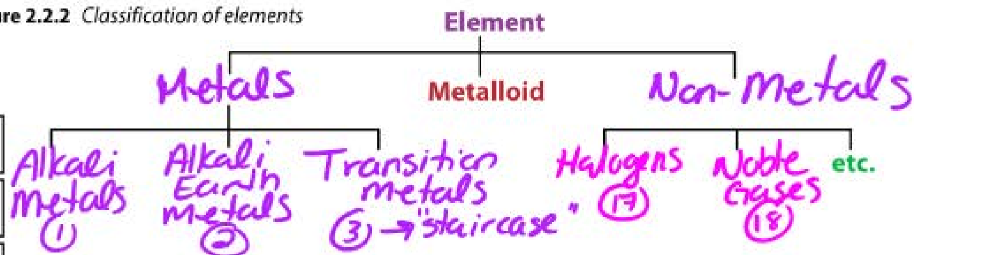
E=Element C=Compound M=Mixture

Each circle represents an atom and each different color represents a different kind of atom. If two atoms are touching then they are bonded together.



Elements

Figure 2.2.2 *Classification of elements*



Non-metals →

					1 H	2 He
	5 B	6 C	7 N	8 O	9 F	10 Ne
	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn

← Metals

Figure 2.2.3 *The location of metals, non-metals, and metalloids in the periodic table of the elements*

The elements are further classified as metals, non-metals, and metalloids. About 80% of the elements are metals.

Hydrogen has properties that are in-between those of the metals and the non-metals. Although it has some chemical properties of metals (H⁺ ion), it has more in common with non-metals and is classified as a non-metal for most purposes.

Hydrogen is such a unique element that it is usually considered to be in a group of its own.

Metals are good conductors of both heat and electricity. They are also malleable (*can be pounded into thin sheets*), ductile (can be drawn into wires), and lustrous. Alloys mixtures containing metals, which are hard. Metal oxides (eg. Na_2O) react with water to form bases (hydroxides). For example: $Na_2O + H_2O \rightarrow 2\,NaOH$ (hydroxide)

Non-metals are poor conductors of both heat and electricity. Many are gases at room temperature but in the solid phase their crystals are brittle and shatter easily. Non-metal oxides react with water to form acids.

For example: $CO_2(g) + H_2O(l) \rightarrow H_2CO_3(aq)$ (carbonic acid)

Moving up and to the right in the periodic table, there is a general trend toward decreasing "metallic character" ("metal-like" properties) from one element to the next. As a consequence, there is no sharp demarcation between the metals and non-metals. Instead, there is a group of elements called metalloids that exhibit some metallic properties (although weakly) and some non-metallic properties. For example, Si (silicon) is a semiconductor meaning that it conducts electricity but poorly.

• soft
• shiny

Compounds

A compound of matter is a pure substance composed of **more than one** type of atom.

A compound can be decompounded (we say decomposed).

Decomposition is a type of chemical reaction in which a single compound reacts to produce 2+ new substances substances.

They reassemble into two or more new groupings or patterns of the atoms.

$2NaCl \rightarrow 2Na + Cl_2$
$K_2CO_3 \rightarrow K_2O + CO_2$
$2H_2O \rightarrow 2H_2 + O_2$

Compounds are classified in several ways. An organic compound is any compound that has carbon and hydrogen atoms. It may have other types of atoms as well. All other compounds are inorganic meaning not organic. A binary compound is composed of only 2 elements. Hydrocarbons (compounds consisting of only carbon and hydrogen atoms) are thus binary compounds whereas carbohydrates are non-binary compounds because they contain carbon, hydrogen, and oxygen atoms.

An ion is a charged atom or group of atoms. Because ions are more stable than their corresponding neutral atoms, the atoms of many elements exist almost exclusively in nature as ions. Ionic compounds consist of positively and negatively charged ions held together by their opposite electrical charges into long range, symmetrical packing arrangements called ionic crystal lattices (Figure 2.2.4). The bond or attraction between oppositely charged ions is appropriately called an ionic bond.

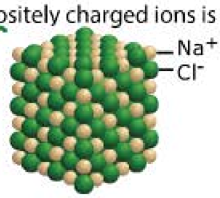


Figure 2.2.4 *An ionic crystal lattice*

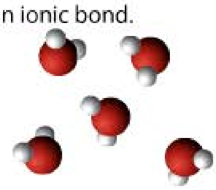


Figure 2.2.5 *A molecular compound*

Non-metal atoms can also become more stable by sharing valence (outer) electrons with each other, called a covalent **bond**. A neutral group of covalently bonded atoms is called a molecule and compounds consisting of molecules are called **molecular compounds.**

Any compound containing a metal is an ionic compound

Any compound containing only non-metals is a molecular compound except compounds containing the ammonium ion (NH_4^+) which are ionic.

Sample Problem — Classifying a Compound as Ionic or Molecular

State whether each of the following is an ionic compound or a molecular compound:

(a) NaCl (b) $Cu(NO_3)_2$ (c) P_2O_5

What to Think about	How to Do It
If the compound contains a metal or the ammonium ion then it is ionic, otherwise it is molecular. (a) Na is a metal (b) Cu is a metal (c) P and O are both non-metals	a) ionic compound b) ionic compound c) covalent/molecular compound.

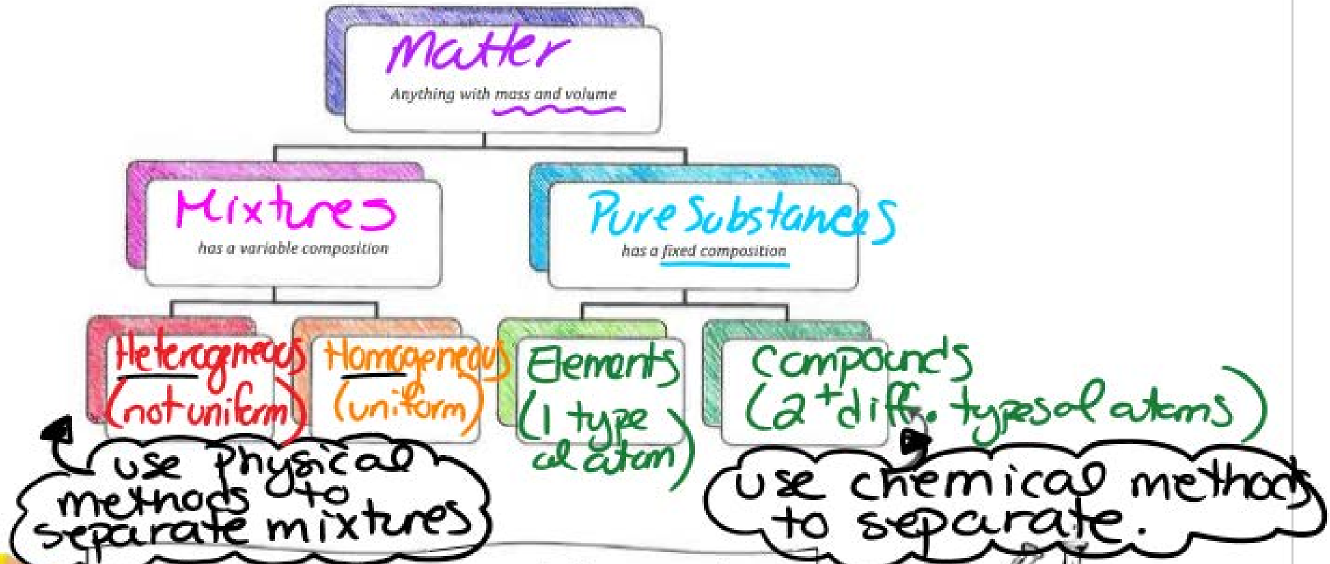
PRACTICE — **Classifying a Compound as Ionic or Molecular**

1

Practice Problems — Classifying a Compound as Ionic or Molecular

1. State whether each of the following is an ionic compound or a molecular compound:

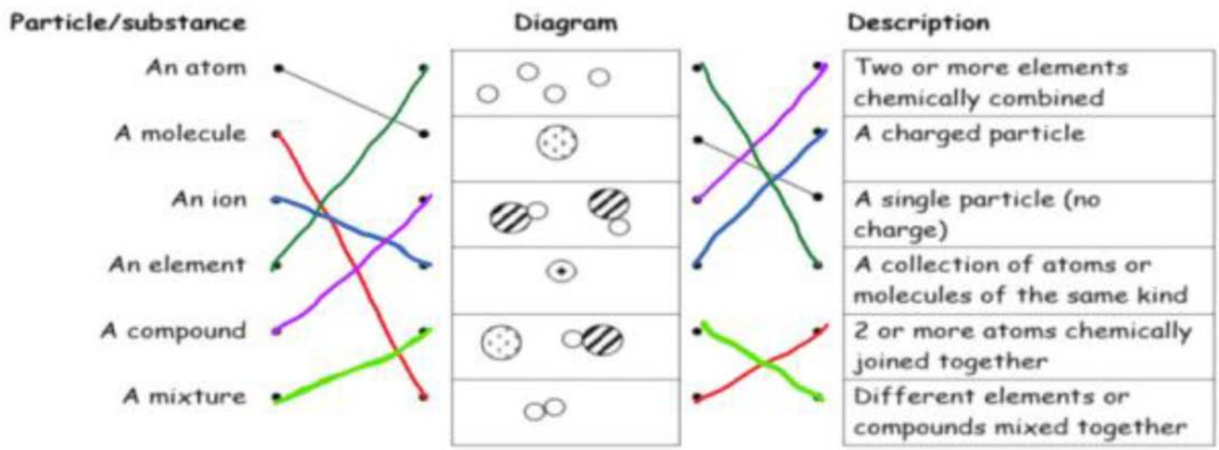
(a) CO_2 molecular
(b) CaF_2 ionic
(c) C_3H_8 molec.
(d) $Mg_3(PO_4)_2$ ionic
(e) $Li_2Cr_2O_7$ ionic
(f) NH_4Cl ionic



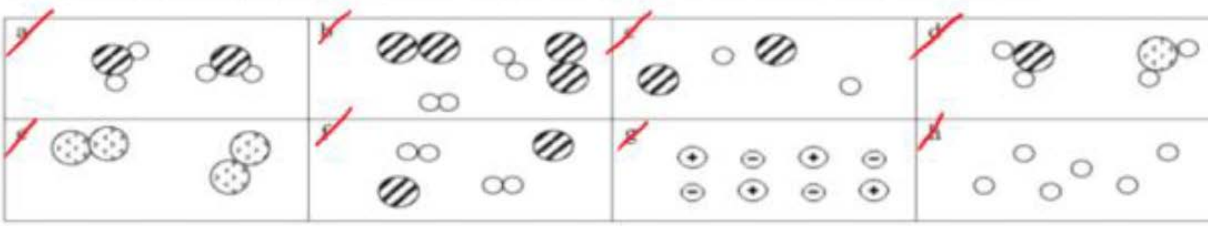
PRACTICE

Elements, Mixtures and Compounds

A. Link each particle or substance with the correct diagram and description. The first has been completed for you.



B. Study the diagrams, and decide which one each statement below is describing.



1. Atoms of a single element h
2. Molecules of a single element e
3. A mixture of 2 elements, both of which are made of atoms c
4. A mixture of 2 elements, both of which are made of molecules b
5. A mixture of 2 elements, one of which is made of atoms, the other molecules f
6. A pure compound made of molecules a
7. A pure compound made of ions g
8. A mixture of 2 compounds d

chemistry homework

Assignment #6 - Hebden pg 52-53 Questions #33-39
+ Classifying Matter Worksheet
All assignments are to be completed on a separate page with the assignment number & heading.

Name: KEY

Classifying Matter Worksheet

Classify each of the materials below. In the center column, state whether the material is a **pure substance** or a **mixture**. If the material is a pure substance, further classify it as either an **element** or **compound** in the right column. Similarly, if the material is a mixture, further classify it as **homogeneous** or **heterogeneous** in the right column.

Material	***Pure Substance or Mixture*** →	***Element, Compound, Homogeneous, Heterogeneous***
concrete	Mixture	Heterogeneous
sugar + pure water ($C_{12}H_{22}O_{11}$ + H_2O)	Mixture	Homogeneous
iron filings (Fe)	Pure Substance	Element
limestone ($CaCO_3$)	Pure Substance	Compound
orange juice (w/pulp)	Mixture	Heterogeneous
Pacific Ocean	Mixture	Homogeneous
air inside a balloon	Mixture	Homogeneous
aluminum (Al)	Pure Substance	Element
magnesium (Mg)	Pure Substance	Element
acetylene (C_2H_2)	Pure Substance	Compound
tap water in a glass	Mixture	Homogeneous
soil	Mixture	Heterogeneous
pure water (H_2O)	Pure Substance	Compound
chromium (Cr)	Pure Substance	Element
Chex mix	Mixture	Heterogeneous
salt + pure water (NaCl + H_2O)	Mixture	Homogeneous
benzene (C_6H_6)	Pure Substance	Compound
muddy water	Mixture	Heterogeneous
brass (Cu mixed with Zn)	Mixture	Homogeneous
baking soda ($NaHCO_3$)	Pure Substance	Compound

PART 2: MIXTURES & SEPARATION TECHNIQUES

Classification of Mixtures

- Mixture
  - Homogeneous
    - Solutions
    - Colloids
  - Heterogeneous
    - mechanical mixture
    - suspension.

Figure 2.2.6 *Classification of mixtures*

Table 2.2.2 *Distinguishing Between Homogeneous and Heterogeneous Mixtures*

Material	Definition	Example
Homogeneous mixture	appears the same throughout (uniform)	• particles smaller than 1 µm • $CuSO_4$, acids/bases, milk
Heterogeneous mixture	do NOT appear the same throughout (non-uniform) • see different components.	• particles larger than 1 µm • $CaCO_3$ in H_2O, trail mix, salad dressing.

1) HOMOGENEOUS MIXTURES

Solutions

A __solution__ is a type of homogeneous mixture in which the constituent chemical species do not aggregate to form any particles greater than 1 nm (nanometre).

A __solute__ is a minor component of the mixture, generally what has been dissolved. (smaller amount)

The __solvent__ is the major component of the mixture, generally what the solute was dissolved in. (usually H_2O)

Many chemicals are in __aqueous__ solution (dissolved in water). (aq)

Our lakes and rivers, our oceans, our drinks, our bodily fluids, and the bottles on the shelves of your laboratory are all aqueous solutions. Chemists denote that a chemical is in aqueous solution with "__aq__" in brackets after the formula (e.g., NaCl(*aq*)). ← "dissolved in H_2O"

Solutions can be produced from materials in __different phases__ (e.g., a solid can dissolve in a liquid). Regardless of the constituents' phases when undissolved, a solution is a __single__ phase, usually that of the solvent. If the solvent is a ______, it is melted to allow for mixing and then cooled to solidify the mixture.

e.g. if H_2O is solvent => "aq" (looks like liquid phase)

Table 2.2.3 *Examples of Solutions*

	Solute		
Solvent	**Solid**	**Liquid**	**Gas**
Solid	Alloys: steel, bronze	mercury in gold	hydrogen in palladium
Liquid	salt water	gasoline	oxygen in water eg. carbonated drinks (CO_2 in H_2O)
Gas	–	–	air

Colloids

A colloidal system consists of __particles__ between 1 nm and 1 µm dispersed throughout a __continuously__ medium (Table 2.2.5). The particles of the __dispersed__ phase are large molecules (__macromolecules__) or aggregates of molecules that are **invisible** to the naked eye.

Unlike a solution, the colloid particles can be in a __DIFFERENT__ phase than the dispersion medium in which they are suspended. Any mixture of __solid__ particles in a __liquid__ regardless of how small the solid particles are, is a colloid or a __mechanical__ mixture. → larger particle

If a liquid is translucent (cloudy) then it is a colloid or a __heterogeneous__ mixture.

→ grey area ... hard to tell unless you know the components or try separation techniques.

Heterogeneous Mixtures

If one or more of the components of a mixture is visible then it is a heterogeneous mixture. The term, "mechanical mixture" is often misused as an intended synonym for "heterogeneous mixture."

Table 2.2.4 *Names and Examples of Colloids*

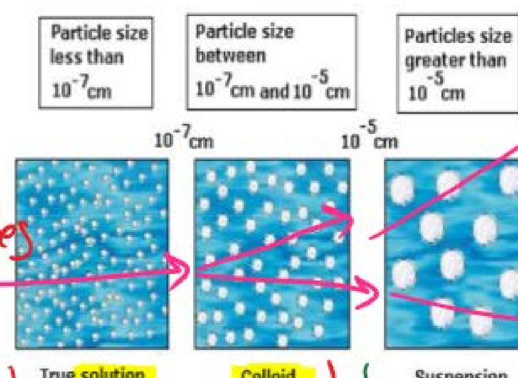
Medium	Dispersed Phase		
	Solid (grains)	**Liquid** (droplets)	**Gas** (bubbles)
Solid	solid sol (some stained glass)	gels (jelly, butter)	solid foam (styrofoam)
Liquid	blood	emulsions (milk, mayo)	foam (whipped cream)
Gas	solid aerosol (smoke)	liquid aerosol (fog)	X

A mechanical mixture is a mixture of components that can be separated by mechanical means, i.e. by picking, sifting, shaking, spinning, pouring, skimming, etc.

This definition includes at least some mixtures of every class. For example, the components of colloids can be separated by mechanical means such as centrifugation (spinning) and ultra-filtration.

If the heterogeneous mixture has a dispersed phase and a continuous medium then, it is a coarse suspension or just a suspension.

Colloids remain suspended indefinitely but the larger mass of the suspended particles in suspensions causes them to settle out or sediment upon standing. The dispersed phase in a suspension is usually a solid.
Examples of suspensions: silt in water, dust in air, and paint (pigments in a solvent).
The component particles are all visible solid particles in some heterogeneous mixtures such as gravel.



EXTENSION: The Tyndall effect, also known as Willis–Tyndall scattering, is *light scattering by particles in a colloid* or else particles in a very fine suspension

Type of Mixture	Operational Definition*			Conceptual Definition**
	Tyndall Effect	Sediments if left undisturbed	Separates by Centrifugation	
Solution	no	no	no	All particles are < 1 nm.
Colloid	yes	no	yes	Dispersed particles are between 1 nm and 1 um. Particles comprising the medium are < 1 nm.
Suspension	yes	yes	yes	Dispersed particles are > 1 µm.

* The operational definitions only provide methods of differentiating mixtures that have a liquid continuous medium.

** The sizes cited for the particles are only rough guidelines, not steadfast rules.

Review Questions

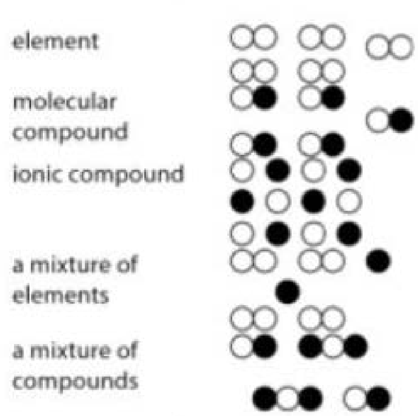
1. Name an element, a compound, and a mixture found in your home.

2. Is it easier to prove that an unknown substance is an element or a compound? Explain.

ANSWERS

1. e.g. copper (in wires), water, milk
2. A compound. It's easy to demonstrate that you can decompose a substance but difficult to prove that you can't.
3. a. properties
   b. composition
   c. properties (the particle sizes are only rough guidelines)

4.



5. a. compound
   b. mixture
   c. compound
   d. mixture
6. a. semi-metal
   b. metal
   c. non-metal
   d. non-metal
7. conduct heat and electricity, malleable, ductile, lustrous

h. mixture
g. element
e. element
f. mixture

(e) carbon
(f) seawater

7. Give four examples of physical properties of metals.

8. Complete the following table by classifying each of the compounds.

classifying each of the compounds.

ANSWERS

8.

Compound	Organic or Inorganic	Binary or Non-Binary	Molecular or Ionic	Acid, Base, Salt or None of these
$CaCl_2$	Inorganic	Binary	Ionic	Salt
CH_3CH_2OH	Organic	Non-binary	Molecular	None of these
NH_4ClO_3	Inorganic	Non-binary	Ionic	Salt
KOH	Inorganic	Non-binary	Ionic	Base
C_3H_8	Organic	Binary	Molecular	None of these
H_3PO_4	Inorganic	Non-binary	Molecular	Acid
$Ba(NO_3)_2$	Inorganic	Non-binary	Ionic	Salt
CO_2	Inorganic	Binary	Molecular	None of these
$Al(OH)_3$	Inorganic	Non-binary	Ionic	Base

c. ion f. ion

9. A mixture of metals (alloy). The same components could be mixed in different proportions. Any material having atoms that are not chemically combined in a fixed ratio is a chemical mixture and would be so even if those atoms were organized in a uniform pattern.

10. Atoms are not homogeneous (the same throughout) and therefore nothing composed of atoms is truly homogeneous.

11. Yes. The different allotropes of an element are different substances. Even though they are composed of the same type of atom, the atoms are grouped or arranged differently resulting in the allotropes having different physical and chemical properties.

12. a. molecule d. neutral atom
b. neutral atom e. molecule

9. Su
or
10. W
11. Is
12. Id
(a)
T *
ic
metal + a
n a H+ (as
in a OH-
n

13. Comple

All pa
Gravel
Does the ty
Forms
Has a
Milk
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May b

14. To diag ... ats the
patient ... a suspension
and a c

15. Is dust a

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imag

16. Correct

(a) Sa

(b) Th

acing
wate
er.

13.

	Solution	Colloid	Hetero-geneous Mixture
all particles are less than 1 nm in size	✓		
gravel			✓
does not appear the same throughout			✓
forms a sediment if left undisturbed			✓
has a solute and a solvent	✓		
milk	✓	✓	
exhibits the Tyndall effect		✓	✓
homogeneous mixture	✓	✓	
coarse suspension			✓
orange juice with pulp	✓		✓
may be separated by centrifugation		✓	✓

14. A suspension will settle out if left undisturbed whereas a colloid will not settle out because it's dispersed particles are smaller.

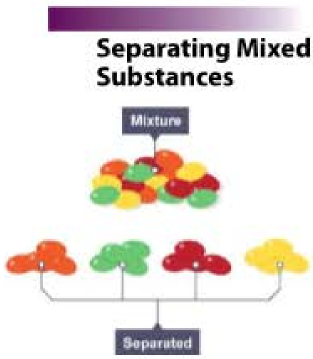
15. Both. Some dust particles settle and some don't.

16. a. Salt water is a denser solution than fresh water.
(Fresh water is not pure water. It also has substances dissolved in it.)

b. The colloid particles were dispersed in water.

Separating the Substances of a Mixture

Separating Mixed Substances



Most naturally occurring objects and materials are mixtures. Our atmosphere, our natural water systems, and the ores and petroleum products (such as crude oil and natural gas) that we extract from the ground are mixtures. Just as a compound can be decompounded (decomposed.), a mixture can be UNmixed. Since the ingredients of a mixture are NOT chemically combined, they retain their individual identities. The trick to separating the substances in a mixture is to pick a property that clearly differentiates the substances.

Laboratory technicians perform a tremendous number of separations daily in medical, forensic, and analytical chemistry laboratories to allow the substances in the mixtures to be identified. Large industrial-scale separations are performed around the world in commercial refineries (for sugar, oil, metal, etc.) to obtain the target substances for their useful properties, their intrinsic values, or more commonly to use the substances to produce useful mixtures of our own design.

Mechanical Means of Separation

In Chemistry 12, you'll examine a chemical separation technique called selective precipitation. In this course we restrict our studies to physical **separations**: those NOT involving chemical reactions to separate.

Physical separation techniques include centrifugation, chromatography, re-crystallization, decantation, density separation, distillation, electrophoresis, evaporation, extraction, flotation, filtration, freezing, magnetic separation, reverse osmosis, and sedimentation.

Physical separations may be classified as mechanical or non-mechanical

Non-mechanical means of separation include techniques that use heat, electricity, magnetism, dissolving, or sticking to separate a mixture's components. **Mechanical means of separation** use gravity, contact forces, or motion to sort the components of a mixture. Terms such as picking, sifting, filtering, shaking, spinning, ← centrifuge pouring, and skimming, describe the type of actions involved in mechanical separations.

Density Separation

To sediment (verb) means to fall or sink to the bottom of a liquid.

Sediment (noun) is matter that has fallen or sunk to the bottom of a liquid.

A medium exerts an upward force called **b**ouyancy on all objects immersed in it. As an object enters a fluid, it lifts the fluid it displaces. If the object is less dense than the fluid, then the object will float because it will displace a weight of fluid greater than its own weight. Density separation can be used to separate solid with different densities. The solids must be insoluble ("don't dissolve into it") in the liquid media used to separate them. This technique is used to separate plastics of different densities. Although density separation separates the solid particles from each other, they are now mixed with the liquid used to separate them. The particles that float can be skimmed off the top of the liquid and dried. The particles that sediment can be separated from the liquid by **decanting** off the liquid or by **filtering** out the sediment.

Decanting is carefully pouring off the liquid and leaving the sediment in the bottom of the original container.

sediment

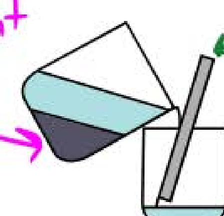
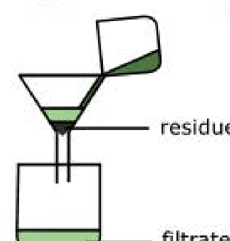


Figure 2.3.2 *Decanting (top) and filtering (bottom)*

"careful pouring" - usually multiple times



e.g. Filtration

Centrifugation

Another mechanical means of separation is centrifugation or spinning. Centrifugation enhances density separation. Particles that would normally sink or rise still do so, just more rapidly.

When you are in a car that turns a sharp corner you may be "thrown" sideways. It might seem as though a force pushed you against the door. This property is called inertia. The suspended particles in a mixture behave similarly in a centrifuge. As the tube changes its direction, the suspended particles initially maintain their linear motion. This process occurs continuously as the tube spins, directing the suspended particles to the bottom of the tube. (more dense)

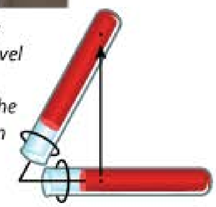


Figure 2.3.3 *The particle in the centrifuge tube continues to travel in a straight line while the tube turns. The spinning forces it to the bottom of the tube, as shown on the right.*

Non-Mechanical Means of Separation

Chromatography

Chromatography is one of the most widely used techniques in scientific research today. Researchers have been able to devise a chromatographic method for separating all but a few mixtures.

Chromatography separates the substances in a solution by having a flowing liquid or gas carry them at different rates through a stationary phase. The flowing liquid or gas is called the mobile phase. Each substance travels through the stationary phase at its own characteristic rate. according to its relative affinities for the two phases. A substance that adheres strongly to the stationary phase (paper) but isn't very soluble in the mobile phase travels slowly through the chromatogram. Conversely, a substance that adheres weakly to the stationary phase but is very soluble in the mobile phase (in the solvent) travels QUICKLY through the chromatogram.

There are many forms of chromatography: gas chromatography, column chromatography, thin layer chromatography, and paper chromatography.

In Paper chromatography, the stationary phase is a strip or sheet of paper. The mobile phase in both forms of chromatography could be water, an organic solvent such as alcohol, or a mixture of solvents.

* A drop of the solution to be separated is placed near the bottom of the sheet or plate and allowed to dry. Another drop of the solution is then placed on top of the first and also allowed to dry.

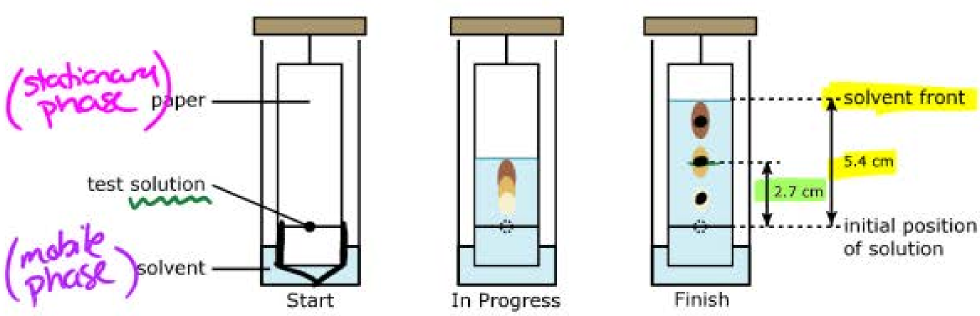


Figure 2.3.4 *Thin layer or paper chromatography*

This process is repeated many times until there is a sufficient amount of each solute to produce a clear chromatogram. The bottom of the chromatogram is lowered into a pool of the solvent. (mobile phase)

Capillary Action is the tendency of a liquid to rise in narrow tubes or to be drawn into small openings. Capillary action results from the adhesive forces between the solvent molecules and those of the wicking material in combination with the cohesive forces between the solvent molecules themselves. Capillary action causes the solvent to rise up the stationary medium, between the paper fibres, past the deposit of solutes, and up the remainder of the paper or glass plate.

* it allows the components of the solution to separate. (homogeneous)

A substance's Rf (retention factor) for any particular system is defined as its flow speed relative to that of the mobile phase.

$$R_f = \frac{\text{distance the substance flows}}{\text{distance the solvent front flows}} < 1 \quad \text{(in a given time period)}$$

A substance's R_f may help identify it or at least support its identification by more definitive means.

* support that an "unknown substance" is a homogeneous mixture. (solution)

Distillation

Distillation is any process that separates a mixture of substances by using their different vapor pressures or boiling points. Distillations require a heating device, a flask containing the original mixture, a condenser to cool and condense the vapours, and something to collect the condensed substances as they leave the condenser one after the other. Distilled water is produced by boiling tap water, cooling its vapours, and then collecting the condensate or distillate. The impurities that were dissolved in the water remain as residue in the original flask.

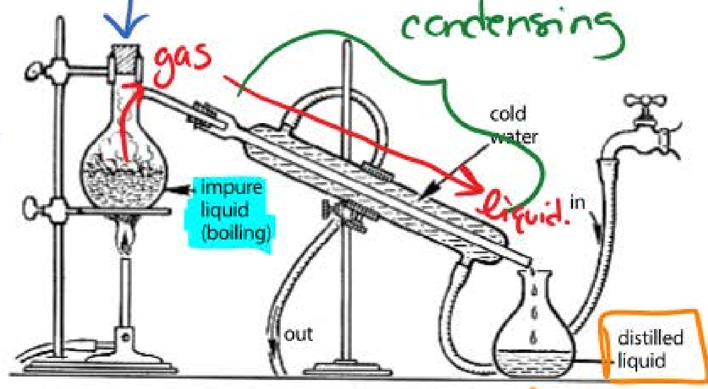


Figure 2.3.5 *Laboratory distillation apparatus*

Scientists have devised a method called fractional **distillation** in which the simple distillation (vaporizing and condensing) is repeated many times within the one device. After evaporating, the vapour enters a fractionating column. This may be a tube packed with glass fibres, a tube containing overlapping glass lips or plates, or simply coiled tubing as popularized by backwoods stills.

Figure 2.3.6 *Industrial distillation*

FYI...ADDITIONAL INFORMATION for the "KEEN BEANS":

The idea is to provide surfaces on which the vapours can condense. As the hot vapours from below reheat the distillate, some compounds revapourize and travel farther up the column. At the same time, others with higher boiling points drip back in the opposite direction. This process is called reflux. The plates become progressively cooler as you move up the column. Each time the process is repeated, the distillate becomes richer in the liquid with the lower boiling point. The component liquids thus proceed at different rates up the fractionating column so as you move higher up, the mixture becomes increasing richer in the liquid with the lower boiling point. If the column is long enough, the liquid components may separate completely and enter the condenser one after the other. There are of course several variations on this same technique.

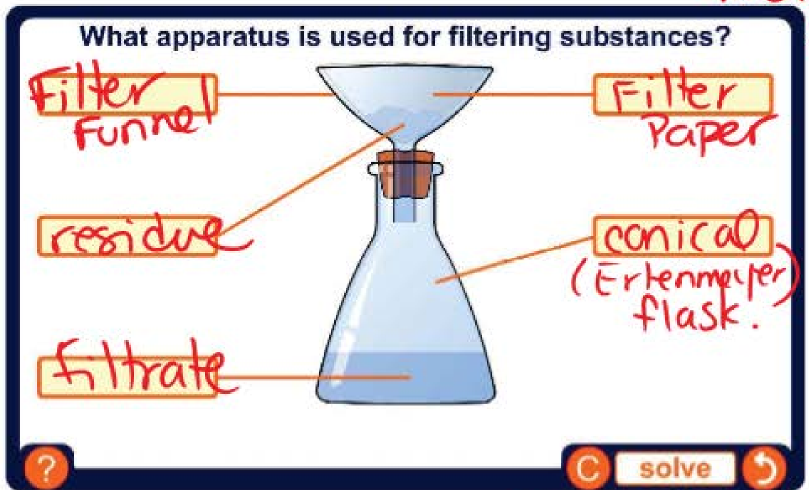
Distillation is an important laboratory and industrial process (Figure 2.3.6). Oil refineries employ distillation to separate the hundreds of different hydrocarbons in crude oil into smaller groups of hydrocarbons with similar boiling points. ***Chevron has an oil refinery in Burnaby and Husky has an oil refinery in Prince George.*** *When distilling a single batch, as described and illustrated above, the temperatures within the column continuously change as the chemicals travel through the column much like solutes travelling up a piece of chromatography paper. By contrast, oil refineries continuously feed the vaporized crude oil mixture into large steel fractionating towers that electronically monitor and maintain a steady range of temperatures from 400°C at the bottom to 40°C at the top. Each compound rises until it reaches a section of the column that is cool enough for it to condense and be withdrawn from the column. For example, the gasoline fraction (meaning the fraction containing gasoline, itself a mixture) exits near the top of the tower at the 40°C to 110°C level.*

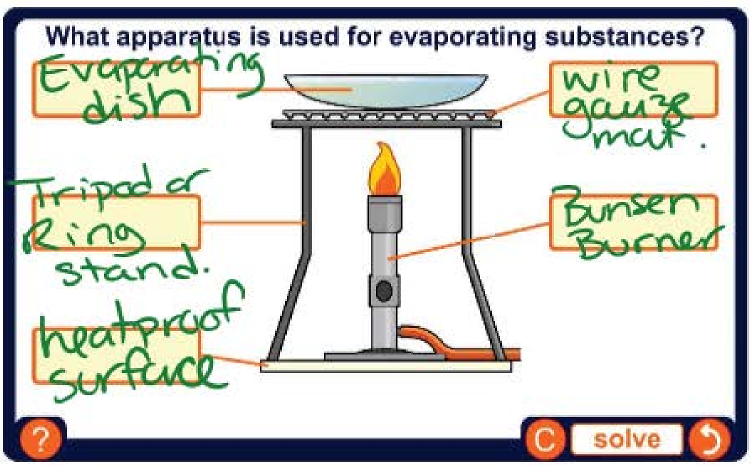
doesn't dissolve (solid-liquid mixture) → Heterogeneous mixture. eg. suspensions

Separating an insoluble solid

How could you separate an insoluble solid like sand from a mixture of sand and water? mechanical mix.

It is easy to separate an insoluble solid by filtering the mixture. The insoluble solid cannot pass through the filter paper but the water can. The sand that is trapped by the filter paper is called the residue. The water that passes through the filter paper is called the filtrate.





Separating a soluble solid

→ has dissolved.

How could you separate a soluble solid, like salt, from a seawater solution?

To separate a soluble solid from a solution, evaporation can be used. The solution is heated so that the water evaporates and leaves the dissolved solid behind.

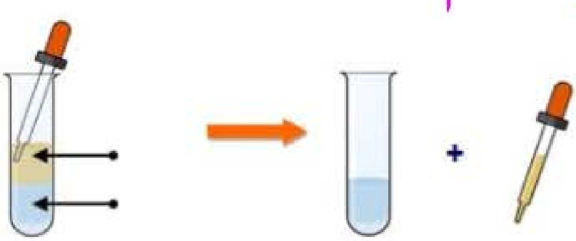
(Recrystallization)

Separating immiscible liquids

Liquids that DO NOT MIX together are described as immiscible. *solvent extraction*

Can you think of any examples of immiscible liquids? oil + water

On a small scale, immiscible liquids can be separated by simply removing the top layer using a pipette. In laboratories, chemists use a sepratory funnel to separate immiscible layers.



Separating miscible liquids

Liquids that DO MIX together are described as miscible.

An example of this is water and alcohol – these two liquids mix together easily. eg. Listerine

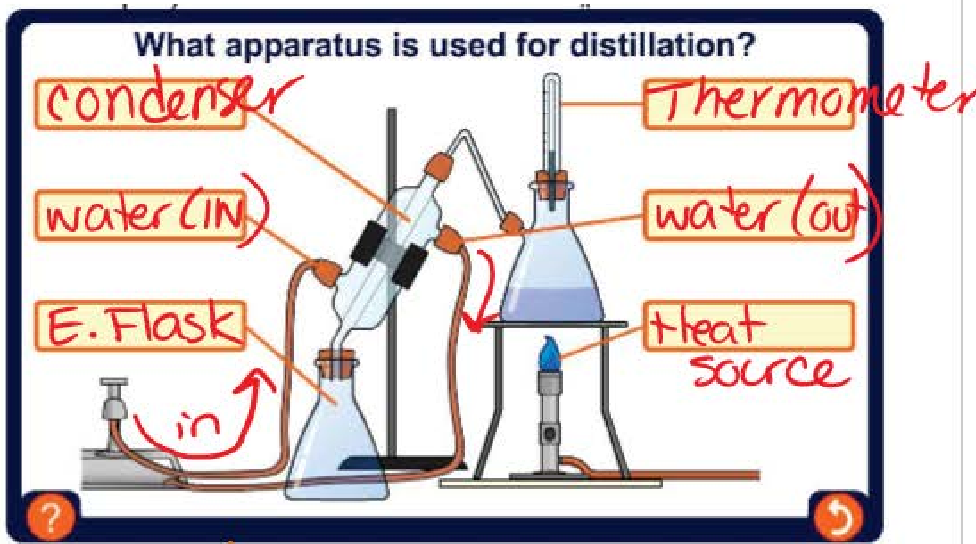
Can you think of any more examples of miscible liquids?

How could you separate a mixture of miscible liquids?

Distillation.

Distillation

The technique used to separate a liquid from a mixture is called distillation.

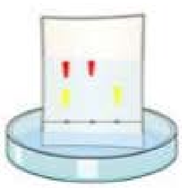


Distillation has three steps:

1. Evaporation
2. condensation
3. collection (of the distillate)

The solution is heated so that the liquid __evaporates__ and is turned into a gas. Everything else is left behind. The gas cools in the __condenser__ and turns back into a liquid, which can then be collected.

Could distillation be used to make seawater safe to drink? yes.

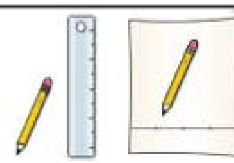
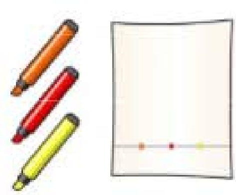
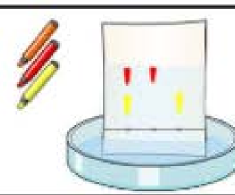
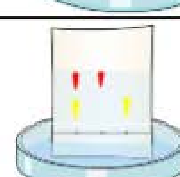


In method A, __________ ____________________.

In method B, ______________ ________________________.

Chromatography

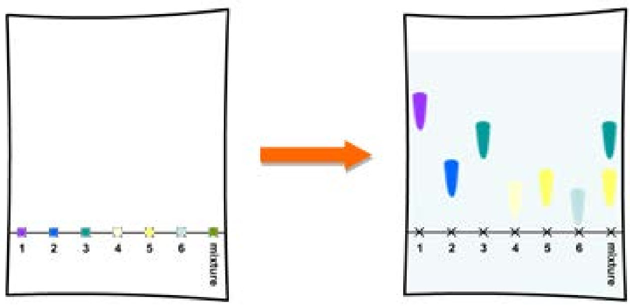
Chromatography is used to ___________________________ of coloured or non-coloured substances that are ________________________________ in the same solvent. A spot of the mixture is placed on some filter paper.

How is a Chromatogram Produced?		
Stage 1		
Stage 2		
Stage 3		
Stage 4		

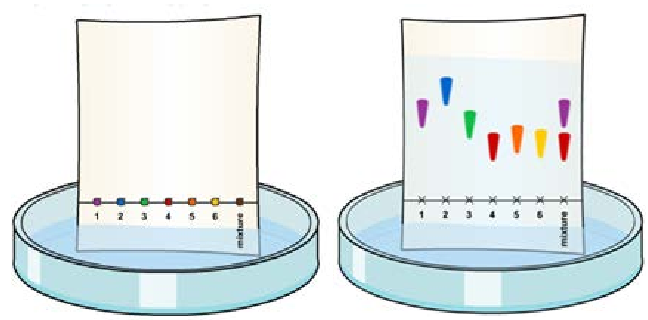
Identifying dyes in a mixture

Dots of single dyes are placed alongside a dot of ________________________mixture.
The solvent washes up the paper, and then the pattern of the dyes in the mixture can be compared with the single dyes.
Which dyes do the the following mixtures contain?

Example 1:



Example 2:



Match each technique to the substances it is used to separate

sieving	separating an insoluble solid from a liquid
filtering	separating solids of different sizes
distillation	separating a soluble solid from a liquid
evaporation	separating a mixture of two liquids
chromatography	separating a mixture of dyes

? solve

Which method could be used to separate each mixture?

Mixture	Substance to collect	Method
glass and water	glass	
sea water	salt	
sea water	water	
cooking oil and water	cooking oil	
alcohol and water	alcohol	

? C solve

chemistry homework

Assignment #8- Hebden pg 58-59 Questions #45-58 (odd)
All assignments are to be completed on a separate page with the assignment number & heading. Be sure to show FULL WORKING OUT for all homework.