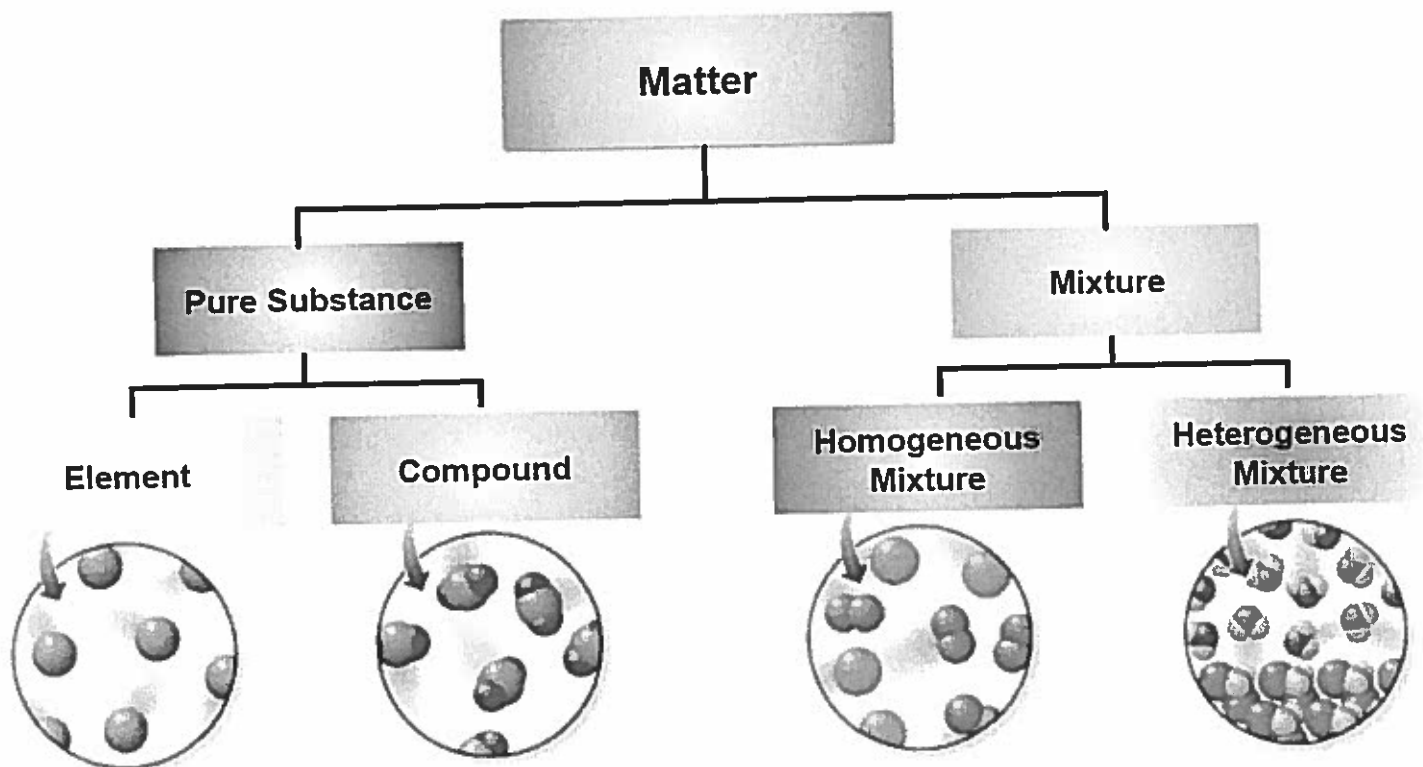


Unit 2a: Matter

Worksheet Packet



Name: _____

Date: _____

Unit 2A: Matter Vocabulary

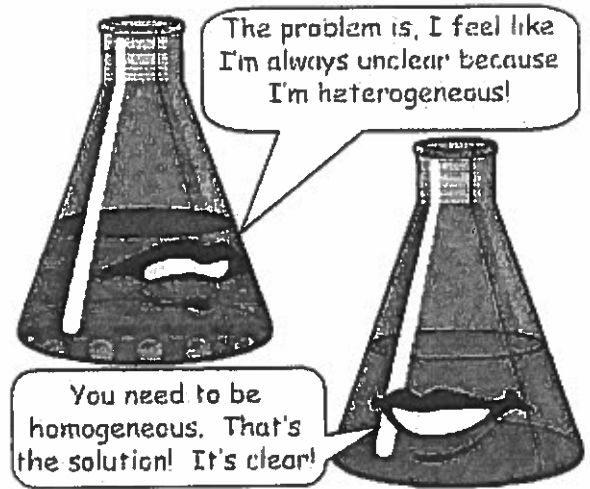
1. Matter:	
2. State (phases) of matter:	
2. Solid:	
3. Liquid:	
4. Gas:	
3. Intensive physical property:	
4. Extensive physical property:	
5. Physical change:	
6. Chemical change:	
7. Chemical property:	
8. Pure substance:	
9. Atom:	
10. Element:	
11. Compound:	
12. Mixture:	
13. Heterogeneous mixture:	
14. Homogeneous mixture:	
15. Entropy:	

My Type of Mixture

Not all mixtures are created equal. In fact, the components of a mixture will often vary and the substances are physically combined in a variable ratio. For example, the Atlantic Ocean is composed of salt water and contains far less salt than the salt water of the Dead Sea. This is why people swimming in the Dead Sea are very buoyant compared to those swimming in the Atlantic. Additionally, some mixtures, such as mechanical mixtures are heterogeneous while others, such as solutions are homogeneous. You can test the difference for yourself:

Perform the following procedure and answer questions based on your observations:

- Fill two test tubes half way with water. Place the test tubes in a test tube rack.
- In one test tube, place a small, microspatula amount of table salt (sodium chloride) and stir with a glass stirring rod until fully dissolved.
- In the other test tube, place a small amount of starch. Stir briefly. The starch will not fully dissolve.

**Questions:**

- How many substances are in the test tube with the water and table salt? How many substances appear to be present?
- How many substances are in the test tube with the starch and water? How many substances appear to be present?
- Homogeneous mixtures appear clear. Heterogeneous mixtures often appear cloudy. Identify which test tube is the homogeneous mixture and which is the heterogeneous mixture.
- If the particles of a heterogeneous mixture are small enough, it may not appear cloudy, but heterogeneous mixtures scatter a beam of light much like headlights in the fog. Ask the teacher to shine a laser light through each test tube. Describe what you observe.

Name: _____

Chemistry Worksheet: Matter #1

1. A mixture (is/is not) a chemical combining of substances.
2. In a compound the (atoms/molecules) are (chemically/physically) combined so that the elements that make up the compound (retain/lose) their identities and (do/do not) take on a new set of properties.
3. The smallest identifiable unit of a compound is a(n) _____, which is made up of _____ which are chemically bonded.
4. True or False: A mixture is always made up of a combination of elements.
5. In a mixture, the substances (lose/retain) their identities.
6. In a mixture the substances involved (can/cannot) be separated by a simple physical process.
In a compound the elements involved (can/cannot) be separated by a simple physical process because the elements are (physically combined/chemically bonded).
7. True or False: An element can be broken down into a simpler substance.
8. The smallest identifiable unit of an element is a(n) _____.
9. From the following list of substances, circle the ones that are elements: *(Use Table S for assistance)*

silver	carbon dioxide	wood alcohol	chromium
water	hydrogen	carbon	nitrogen
oxygen	gold	sugar	salt
air	sulfur	magnesium	nickel
10. Explain how to separate the sugar and water in a solution of sugar and water.

11. How would you separate a mixture of alcohol and water?

12. How would you separate sand and water?

13. Classify the following as pure substances or as mixtures:

air	gasoline	grain alcohol
water	sugar	gold
mercury	oxygen	salt water

14. Classify the following as heterogeneous or as homogeneous:

sand & salt mixture	hydrogen	iron
salt water	unfiltered air	iron with rust
pure water	an apple	nitric acid
tossed salad	granite	wood

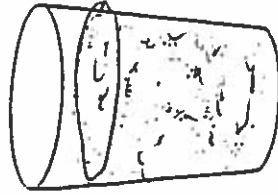
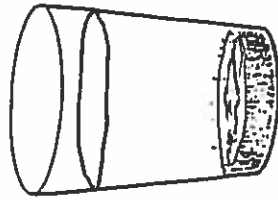
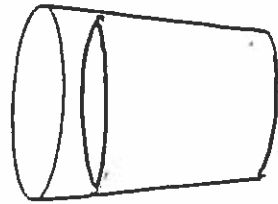
15. Classify the following as an element, a compound, a solution, or a heterogeneous mixture:

aluminum	raisin bread
carbon dioxide	water
sugar and water	sulfur
sulfuric acid	mercury
an orange	water & instant coffee
a pencil	carbon particles & sugar
nitrogen	air
gasoline	grain alcohol

Substances vs. Mixtures

A substance is matter for which a chemical formula can be written. Elements and compounds are substances. Mixtures can be in any proportion, and the parts are not chemically bonded. Classify the following as to whether it is a substance or a mixture by writing S or M in the space provided.

1. sodium _____
2. water _____
3. soil _____
4. coffee _____
5. oxygen _____
6. alcohol _____
7. carbon dioxide _____
8. cake batter _____
9. air _____
10. soup _____
11. iron _____
12. salt water _____
13. ice cream _____
14. nitrogen _____
15. eggs _____
16. blood _____
17. table salt _____
18. nail polish _____
19. milk _____
20. cola _____



Homogeneous vs. Heterogeneous Matter

Classify the following substances and mixtures as either homogeneous or heterogeneous. Place a \checkmark in the correct column.

	HOMOGENEOUS	HETEROGENEOUS
1. flat soda pop		
2. cherry vanilla ice cream		
3. salad dressing		
4. sugar		
5. soil		
6. aluminum foil		
7. black coffee		
8. sugar water		
9. city air		
10. paint		
11. alcohol		
12. iron		
13. beach sand		
14. pure air		
15. spaghetti sauce		

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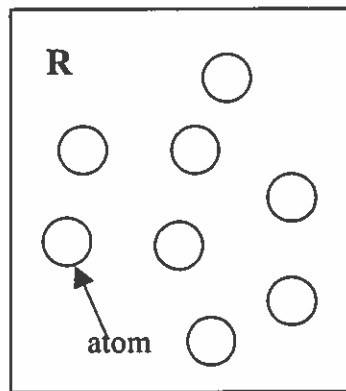
Classification of Matter

How do atoms combine to make different types of matter?

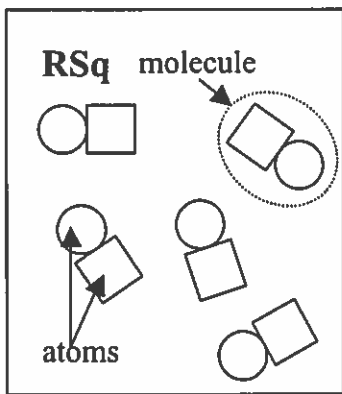
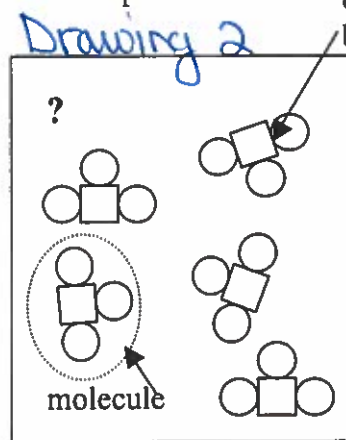
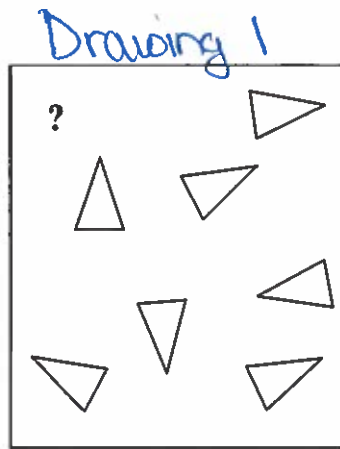
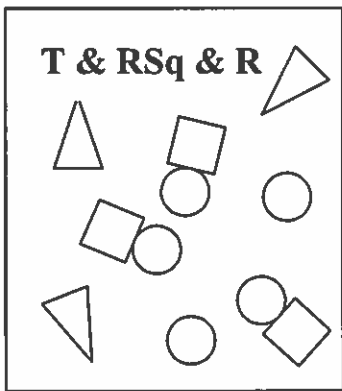
Why?

Look at the things in this room. They are all matter. That matter may be pure or it may be a mixture. Can you tell by looking at it? What if you looked at it under a microscope? Then could you tell? Something that looks pure may not really be pure. It depends on what type of particles that thing is made of. In this activity we will explore how the smallest chemical units of matter determine whether something is classified as an element, a compound, or a mixture.

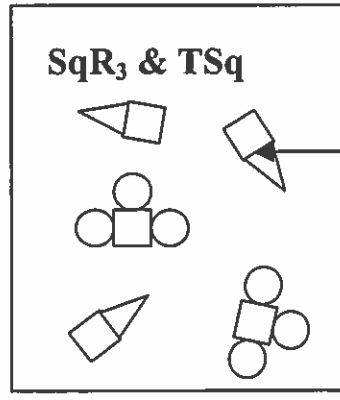
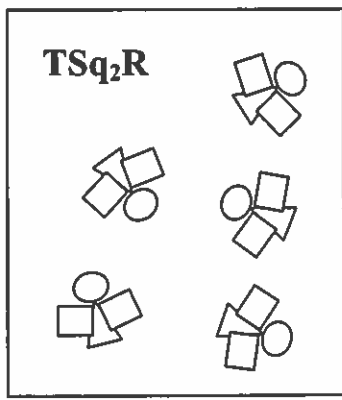
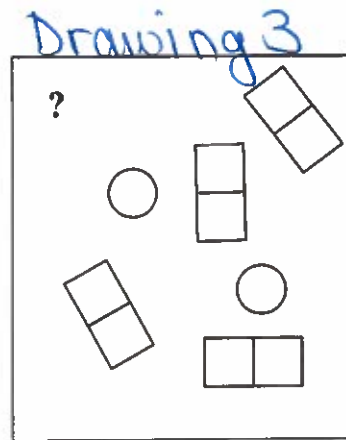
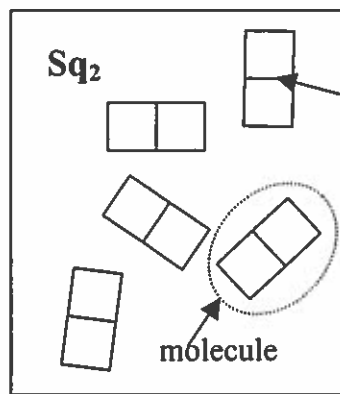
Model 1




8 particles



5 particles



5 particles


1. Circle a molecule of RSq in Model 1. How many atoms are in a molecule of RSq ?
2. Circle a molecule of TSq_2R in Model 1.
 - a) How many different types of atoms are found in a molecule of TSq_2R ?
 - b) How many Sq atoms are in a molecule of TSq_2R ?
3.
 - a) How many different types of atoms are found in a sample of SqR_3 & TSq ?
 - b) How many different types of molecules are found in a sample of SqR_3 & TSq ?
4. When two atoms are touching in the drawings of Model 1, what is holding the atoms together?
5.
 - a) Can a *particle* be a single atom?
 - b) Can a *particle* be a molecule?
 - c) How many particles are in the drawing representing T & RSq & R in Model 1?
 - d) As a group, agree on a definition of the word "particle", as it is used in chemistry.
6.  Compare the codes listed at the top of each drawing in Model 1 with the shapes in that box.
 - a) What do the letters R , Sq and T in the codes represent?
 - b) What do the small numbers (subscripts) in the codes represent?
 - c) When atoms are touching, how is that communicated in the code?
 - d) When atoms or molecules are not touching, how is that communicated in the code?
 - e) In Model 1 there are three drawings that are labeled "?". Write codes to properly label these drawings.



7. The manager should appoint one group member to cut apart Model 1 to separate the nine drawings. As a team, sort the pictures into those where all the particles in the drawing are identical, and those that have more than one type of particle in the drawing.

Read This!

Matter is classified as a **pure substance** when all of the particles are the identical. Matter is classified as a **mixture** if there are different types of particles present.

 8. Identify which set of drawings from #7 are pure substances and which set are mixtures. List the codes for each set here.


Pure Substances	Mixtures
_____	_____
_____	_____
_____	_____

9. How are the codes (chemical formulas) for pure substances different from those for mixtures?

10. As a team, take the set of pure substances drawings from #8 and sort them into those containing only one type of atom and those with two or more types of atoms.

Read This!

Elements are defined as pure substances made from only one type of atom. **Compounds** are defined as pure substances made from two or more types of atoms.

 11. Identify which set of drawings from #10 are elements and which set are compounds. List the codes for each set here.

Elements	Compounds
_____	_____
_____	_____
_____	_____

12. How are the codes (chemical formulas) for elements different from those for compounds?

13. Use what you have just learned about chemical formulas to identify the following as element, compound or mixture.

a. Br_2

b. NaHCO_3

c. $\text{C}_6\text{H}_{12}\text{O}_6$ & H_2O

d. Cu & Zn

e. CO_2

f. Al

STOP

Extension Questions

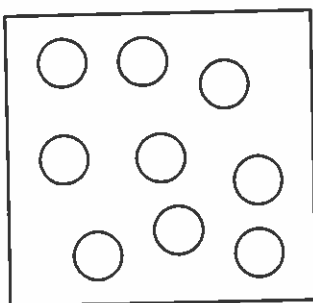
14. Often times it is useful to separate matter. (Examples: straining cooked pasta to get the liquid out, using a fuel cell to separate water into hydrogen and oxygen)

- a) Physical methods of separation (filtering, distillation) do not require a chemical change. In other words, no chemical bonds are broken or formed during the separation. Which type(s) of matter (mixtures/compounds/elements) could be separated by physical methods?
- b) Chemical methods of separation (decomposition, electrolysis) require a chemical change. In other words, chemical bonds are broken and/or formed during the separation. Which type(s) of matter (mixtures/compounds/elements) would need to be separated by chemical methods?

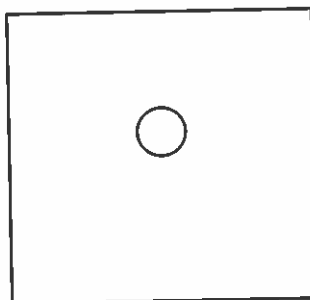
15. Students in a chemistry course were asked the following question on a unit exam:

“Draw a diagram representing an element using circles as atoms.”

- a) The following diagrams represent the two types of answers given by students. Which drawing is the best representation of an element? Explain.



Drawing A



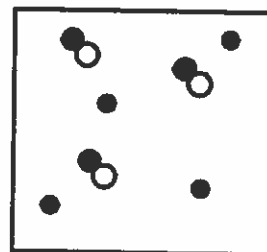
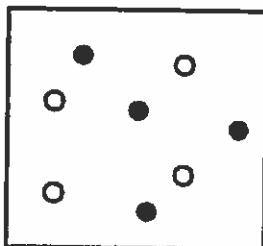
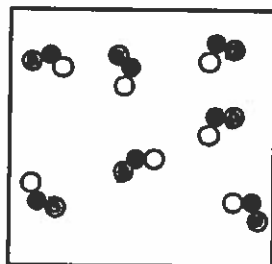
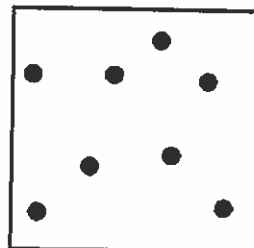
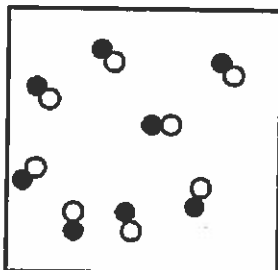
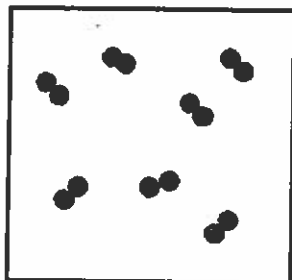
Drawing B

- b) Imagine that the atom in Drawing B had been removed by physical separation from one of the substances in Model 1. What substances could have been the source of the atom in Drawing B? Is Drawing B a good representation of any of those substances?

Name: _____

Particle Diagrams and Forms of Matter

- Please label each of the following as a substance or a mixture of substances.
- Please classify each substance in the box as either an *element*; *diatomic* or *monatomic*, or a *compound*; *binary* or *ternary*.



PARTICLE DIAGRAM EXAMPLES FOR DIFFERENT FORMS OF MATTER

SUBSTANCES		MIXTURES
<u>DIATOMIC ELEMENT</u>	<u>MONATOMIC ELEMENT</u>	<u>MIXTURE OF ELEMENTS</u>
<u>BINARY COMPOUND</u>	<u>TERNARY COMPOUND</u>	<u>MIXTURE OF COMPOUNDS AND ELEMENTS</u>
		<u>MIXTURE OF COMPOUNDS</u>

Elements, Compounds, and Mixtures

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

A= Element

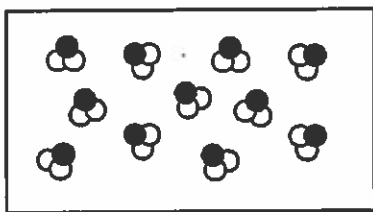
B= Compound

C= Mixture of elements

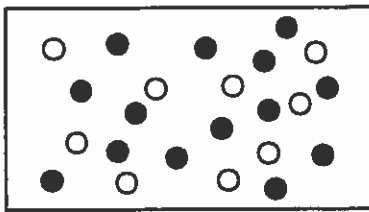
D= Mixture of compounds

E= Mixture of elements and compounds

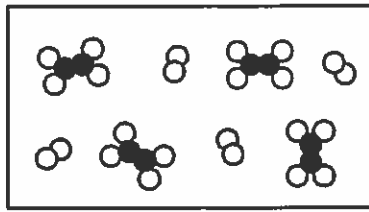
Each circle represents an atom and each different color represents a different kind of atom. If two atoms are touching then they are bonded together.



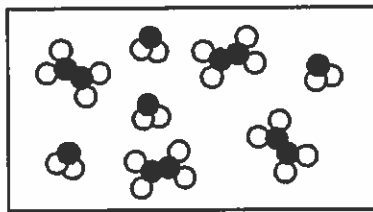
1) _____



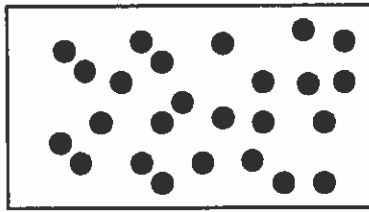
2) _____



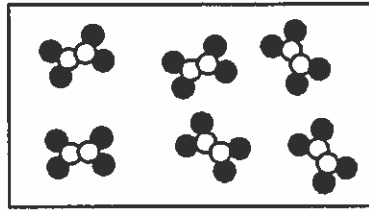
3) _____



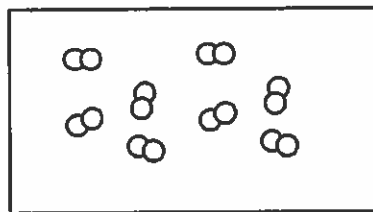
4) _____



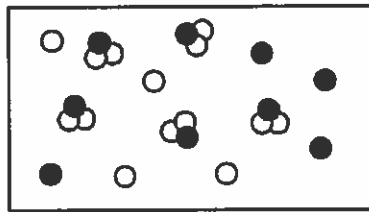
5) _____



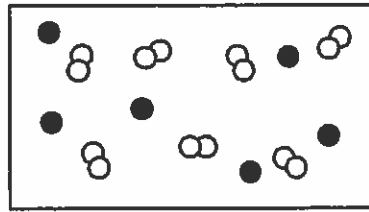
6) _____



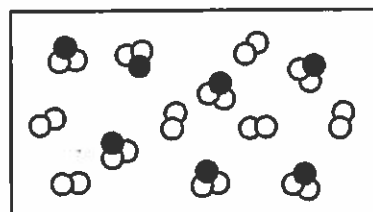
7) _____



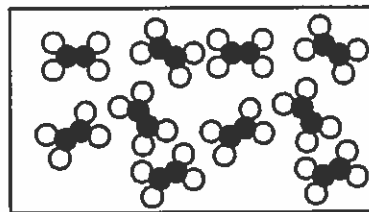
8) _____



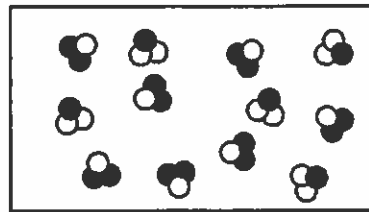
9) _____



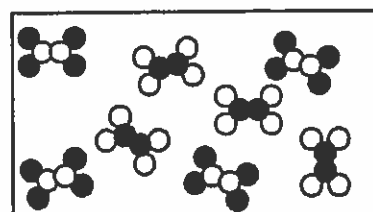
10) _____



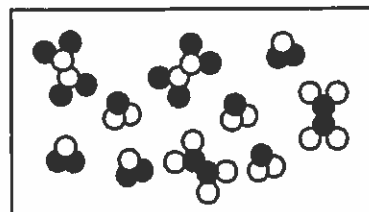
11) _____



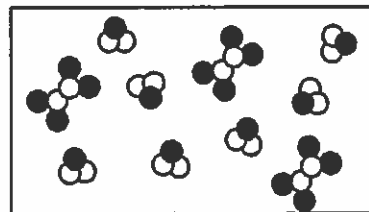
12) _____



13) _____



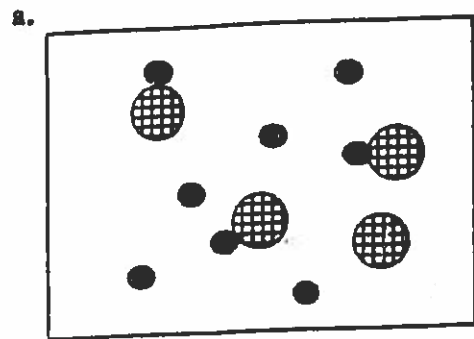
14) _____



15) _____

Directions: Read each question carefully & write your answers in the space provided.

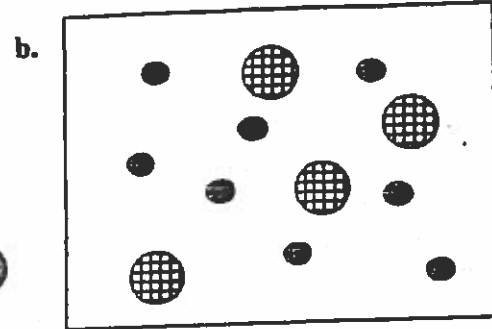
Look at the following models. Identify each as a substance or mixture. Then describe its composition as elements only, compounds only, or elements & compounds.



Choose: Substance or Mixture _____

Describe as elements only, compounds only, or elements & compounds. _____

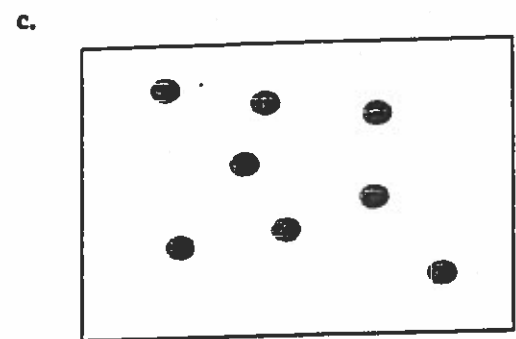
Defend: _____



Choose: Substance or Mixture _____

Describe as elements only, compounds only, or elements & compounds. _____

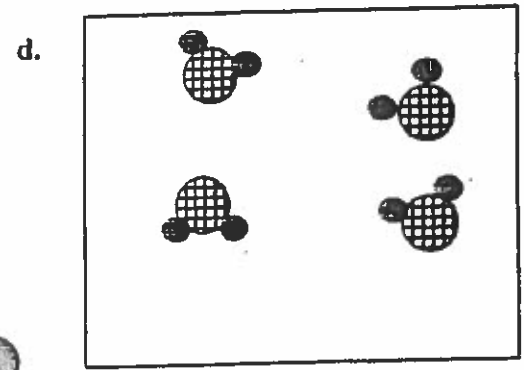
Defend: _____



Choose: Substance or Mixture _____

Describe as elements only, compounds only, or elements & compounds. _____

Defend: _____



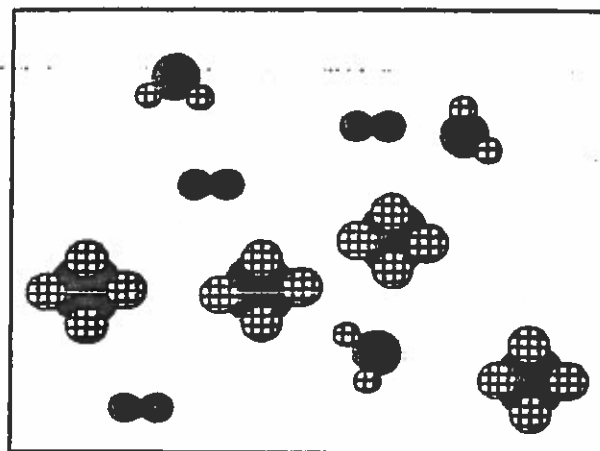
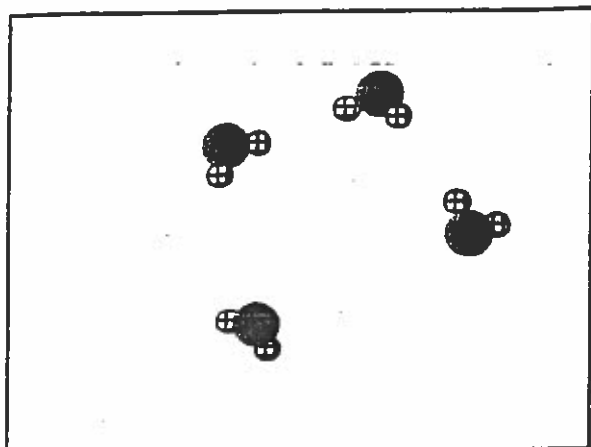
Choose: Substance or Mixture _____

Describe as elements only, compounds only, or elements & compounds. _____

Defend: _____

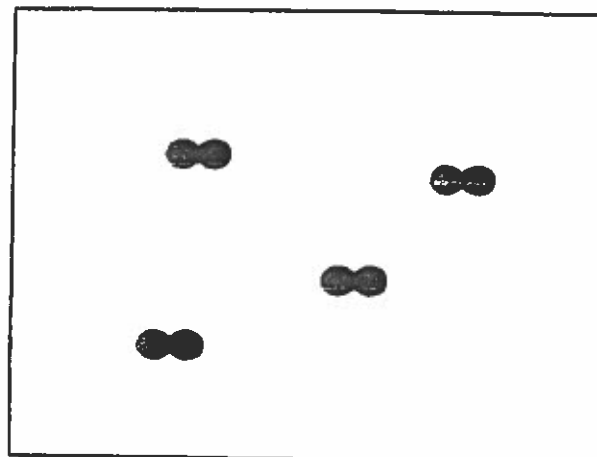
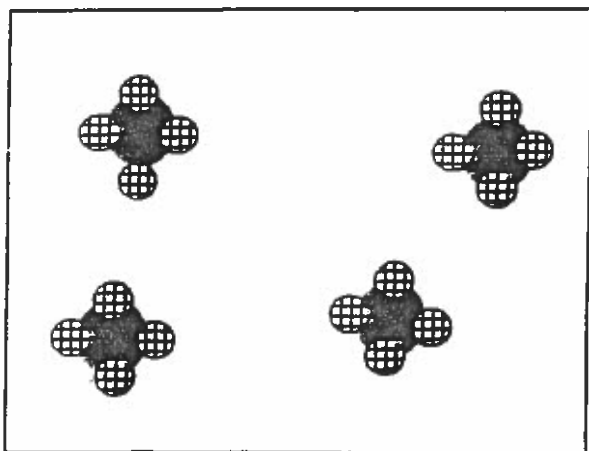
2. Match each description, i.e, a through d, with the appropriate diagram by writing in the box provided. Identify if it represents an compound, element, or both. Also, defend your answer.

- a. $N_2(g)$
- b. $CH_4(g)$
- c. mixture of gases
- d. $H_2O(g)$



Description (choice a-d): _____
 Elements, Compounds, or both _____
 Defend: _____

Description (choice a-d): _____
 Elements, Compounds, or both _____
 Defend: _____



Description (choice a-d): _____
 Elements, Compounds, or both _____
 Defend: _____

Description (choice a-d): _____
 Elements, Compounds, or both _____
 Defend: _____

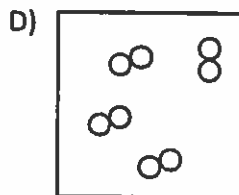
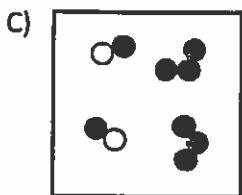
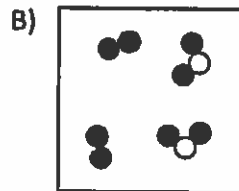
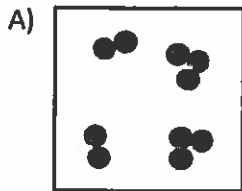
3. The following diagram represents a mixture of substances. Classify the components of the mixture by redrawing each one in the appropriate box.

Each circle represents a different type of particle or atom.

	Monatomic elements
	Diatomic elements
	Compounds

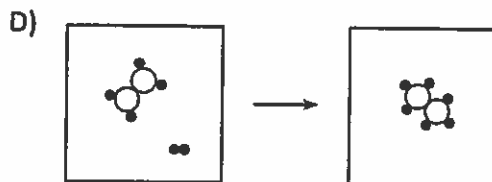
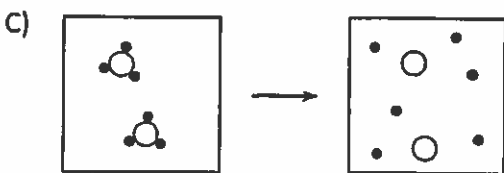
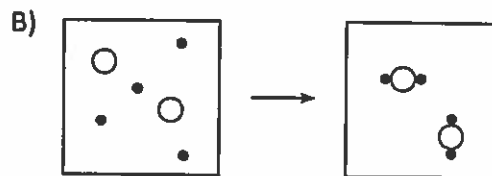
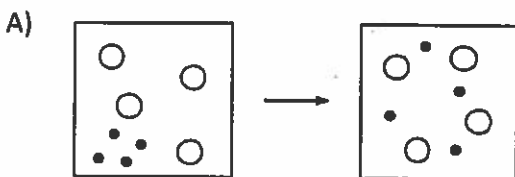
1. Which diagram represents a mixture of two different molecular forms of the same element?

Key	
●	= atom of element X
○	= atom of element Z

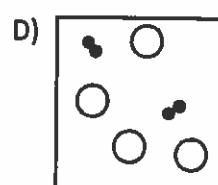
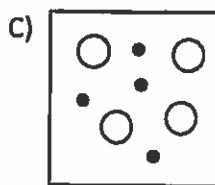
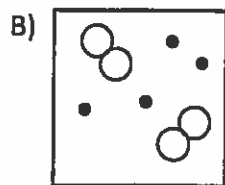
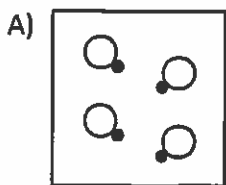


2. Which diagram represents a physical change, only?

Key	
●	= an atom of an element
○	= an atom of a different element

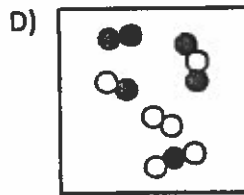
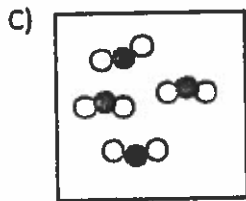
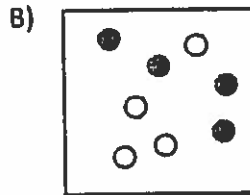
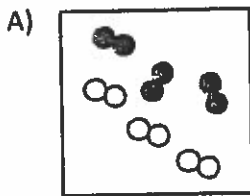


3. Which particle diagram represents one pure substance, only?



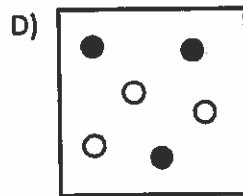
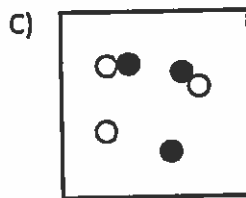
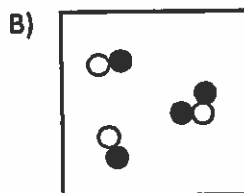
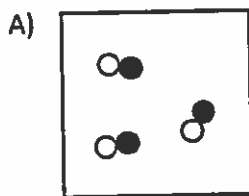
4. Which particle model diagram represents only one compound composed of elements X and Z?

Key	
●	= atom of element X
○	= atom of element Z



5. Which particle diagram represents a mixture of element X and element Z, only?

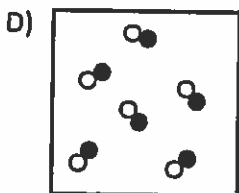
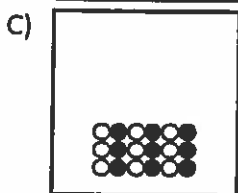
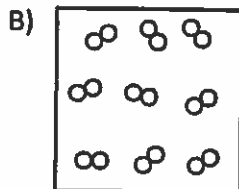
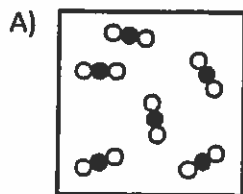
Key	
●	= atom of X
○	= atom of Z



6. Given the key:

Key	
○	= Atom of oxygen
●	= Atom of carbon

Which particle diagram represents a sample containing the compound CO(g)?

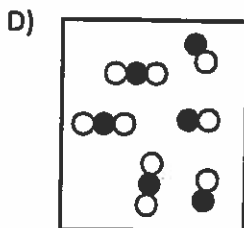
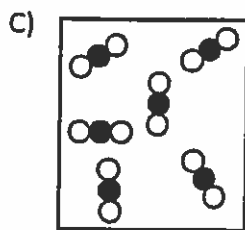
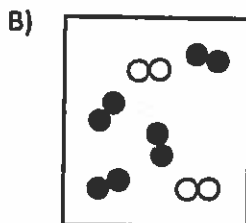
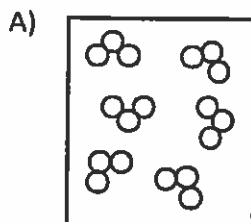


7. Given the simple representations for atoms of two elements:

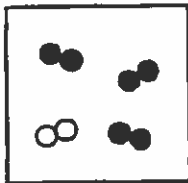
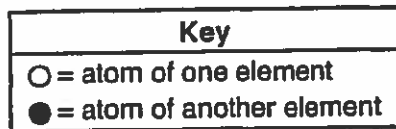
○ = an atom of an element

● = an atom of a different element

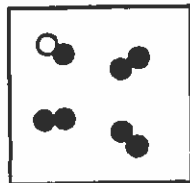
Which particle diagram represents molecules of only one compound in the gaseous phase?



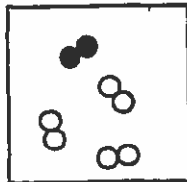
8. Which two particle diagrams represent mixtures of diatomic elements?



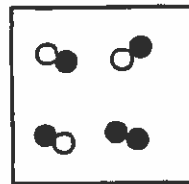
A



B



C



D

A) A and B

B) A and C

C) B and C

D) B and D

Name: _____

Date: _____

Elements, Compounds, and Mixtures

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

A= Element

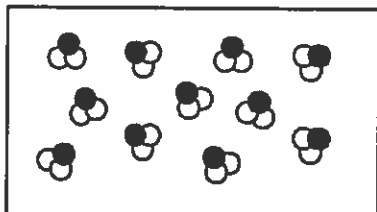
D= Mixture of compounds

B= Compound

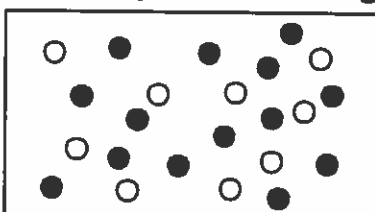
E= Mixture of elements and compounds

C= Mixture of elements

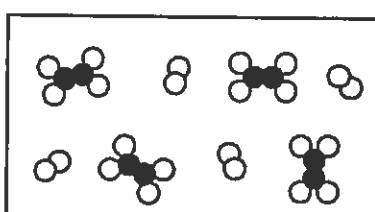
Each circle represents an atom and each different color represents a different kind of atom. If two atoms are touching then they are bonded together.



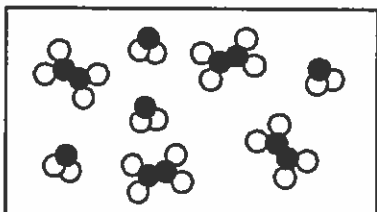
1) _____



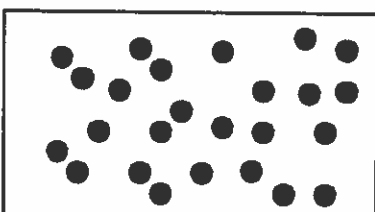
2) _____



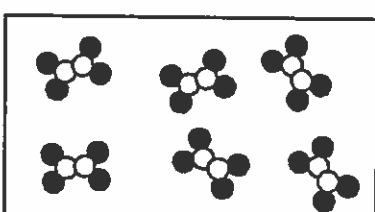
3) _____



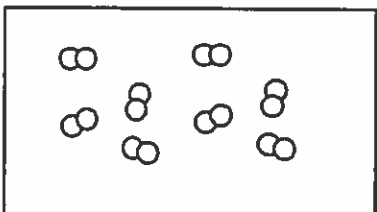
4) _____



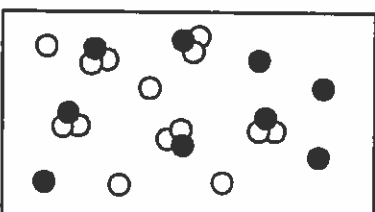
5) _____



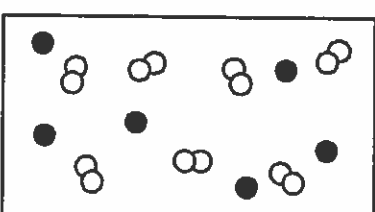
6) _____



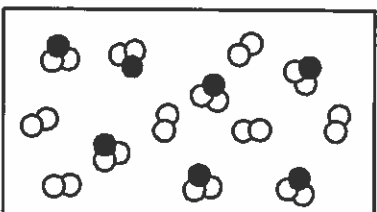
7) _____



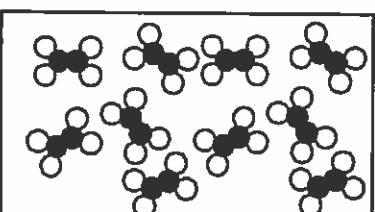
8) _____



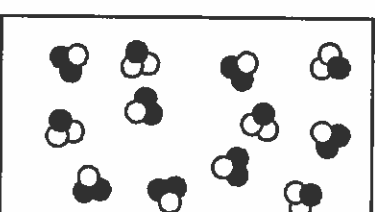
9) _____



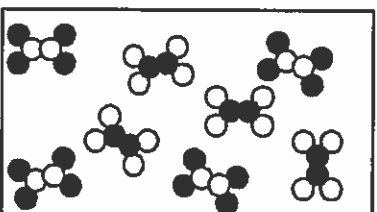
10) _____



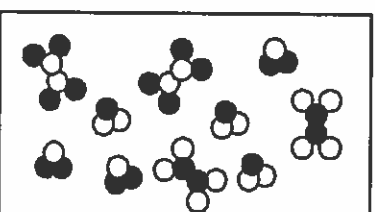
11) _____



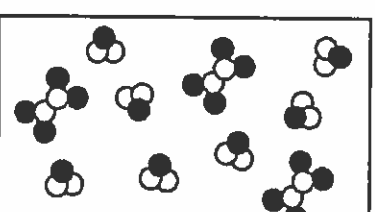
12) _____



13) _____



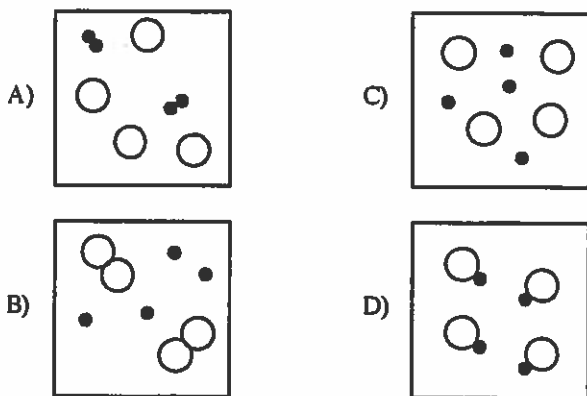
14) _____



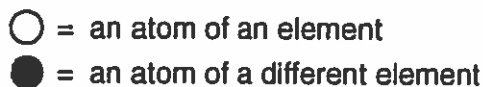
15) _____

Name: _____

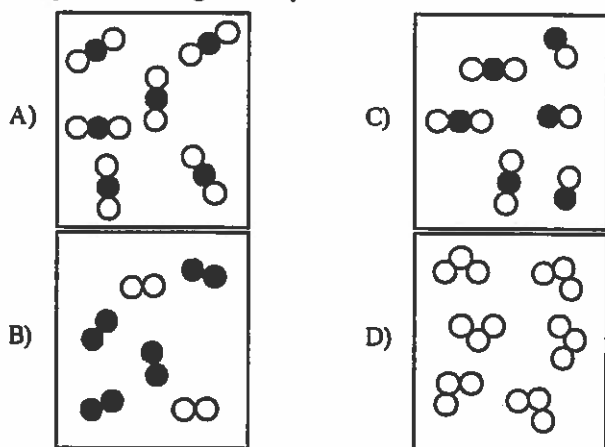
- 1) Which particle diagram represents one pure substance, only?



- 2) Given the simple representations for atoms of two elements:

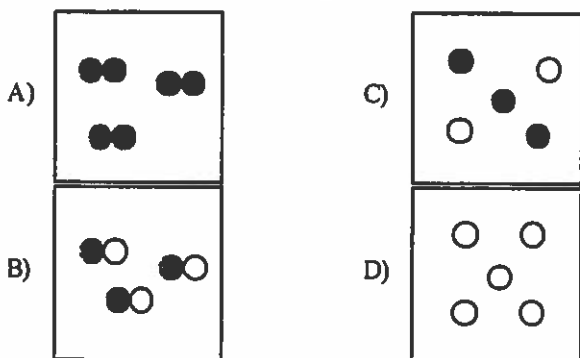


Which particle diagram represents molecules of only one compound in the gaseous phase?



- 3) Given: ● = particle X
○ = particle Y

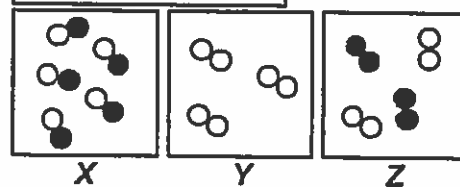
Which diagram represents a mixture?



- 4) Given the diagrams X, Y, and Z below:

KEY:

Atom of element A = ○
Atom of element B = ●

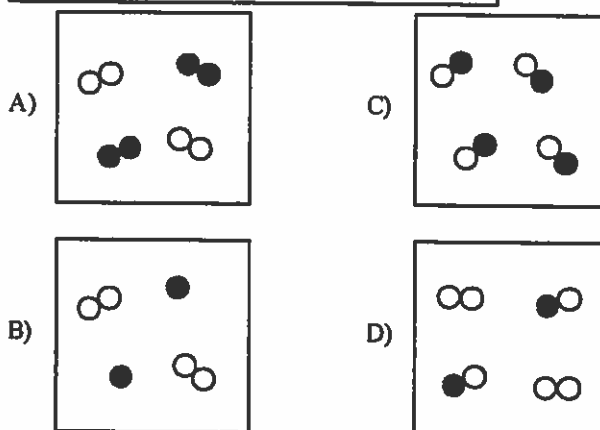


Which diagram or diagrams represent a mixture of elements A and B?

- A) X and Y
B) X and Z
C) Z, only
D) X, only
- 5) Which particle diagram represents a mixture of an element and a compound?

KEY:

○ = an atom of an element
● = an atom of a different element

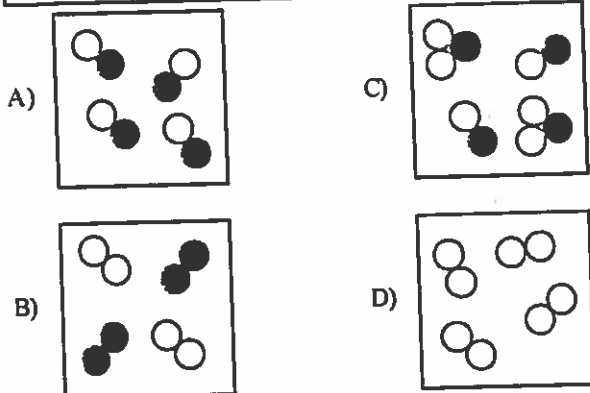


- 6) Which of the following elements has the *greatest* density at STP?
- A) radium
B) beryllium
C) magnesium
D) barium

- 7) Which particle diagram represents a sample of one compound, only?

KEY:

○ = atom of one element
● = atom of a different element



- 8) Which statement describes a chemical property of iron?
- Iron can be drawn into a wire.
 - Iron conducts electricity and heat.
 - Iron combines with oxygen to form rust.
 - Iron can be flattened into sheets.
- 9) An example of a physical property of an element is the element's ability to
- react with an acid
 - form a compound with chlorine
 - form an aqueous solution
 - react with oxygen

- 10) Which substance can *not* be decomposed by a chemical change?

A) Ne
B) H₂O
C) HF
D) N₂O

- 11) Which substance can be decomposed by a chemical change?

A) Cr
B) Co
C) CO
D) Cu

- 12) Which terms are used to identify pure substances?

A) a solution and a mixture
B) a solution and a compound
C) an element and a mixture
D) an element and a compound

- 13) Which species represents a chemical compound?

A) Na
B) N₂
C) NaHCO₃
D) NH₄⁺

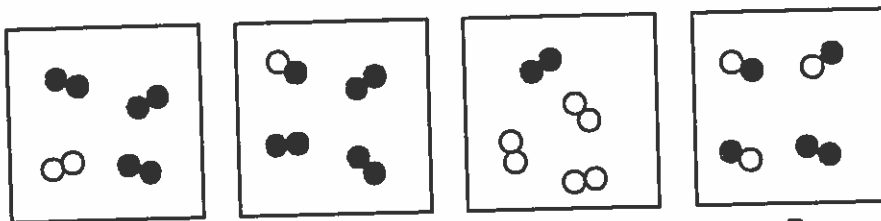
- 14) A sample is prepared by completely dissolving 10.0 grams of NaCl in 1.0 liter of H₂O. Which classification *best* describes this sample?

A) heterogeneous compound
B) homogeneous mixture
C) heterogeneous mixture
D) homogeneous compound

- 15) Which two particle diagrams represent mixtures of diatomic elements?

KEY:

○ = atom of one element
● = atom of another element



A) B and D

B) A and B

C) B and C

D) A and C

PHYSICAL VS. CHEMICAL PROPERTIES

A physical property is observed with the senses and can be determined without destroying the object. For example, color, shape, mass, length and odor are all examples of physical properties.

A chemical property indicates how a substance reacts with something else. The original substance is fundamentally changed in observing a chemical property. For example, the ability of iron to rust is a chemical property. The iron has reacted with oxygen, and the original iron metal is changed. It now exists as iron oxide, a different substance.

Classify the following properties as either chemical or physical by putting a check in the appropriate column.

	Physical Property	Chemical Property
1. blue color		
2. density		
3. flammability		
4. solubility		
5. reacts with acid to form H_2		
6. supports combustion		
7. sour taste		
8. melting point		
9. reacts with water to form a gas		
10. reacts with a base to form water		
11. hardness		
12. boiling point		
13. can neutralize a base		
14. luster		
15. odor		

PHYSICAL VS. CHEMICAL CHANGES

In a physical change, the original substance still exists, it has only changed in form. In a chemical change, a new substance is produced. Energy changes always accompany chemical changes.

Classify the following as being a physical or chemical change.

1. Sodium hydroxide dissolves in water. _____
2. Hydrochloric acid reacts with potassium hydroxide to produce a salt, water and heat. _____
3. A pellet of sodium is sliced in two. _____
4. Water is heated and changed to steam. _____
5. Potassium chlorate decomposes to potassium chloride and oxygen gas.

6. Iron rusts. _____
7. When placed in H_2O , a sodium pellet catches on fire as hydrogen gas is liberated and sodium hydroxide forms. _____
8. Evaporation _____
9. Ice melting _____
10. Milk sours. _____
11. Sugar dissolves in water. _____
12. Wood rotting _____
13. Pancakes cooking on a griddle _____
14. Grass growing in a lawn _____
15. A tire is inflated with air. _____
16. Food is digested in the stomach. _____
17. Water is absorbed by a paper towel. _____

Name: _____

Date: _____

Physical/Chemical Properties and Changes

1. What does it mean to say that a given compound always has the same composition?
2. Copper is a reddish-brown metal that is easily stretched to make wires. These characteristics are examples of _____ (physical/chemical) properties of copper.
3. When copper metal is heated in concentrated nitric acid, the copper dissolves to form a deep blue solution, and a brown gas is released from the acid. These characteristics are examples of _____ (physical/chemical) changes.

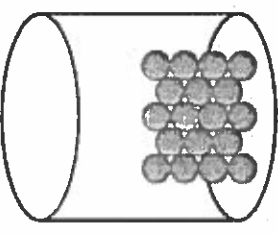
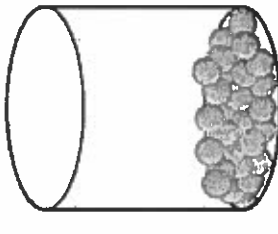
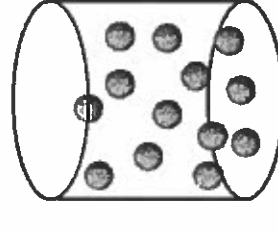
Answer questions 4 and 5 based on the reading below:

Solutions of the substance potassium dichromate are bright orange in color. If a potassium dichromate solution is added to an acidic solution of iron (II) sulfate, the orange color of the potassium dichromate disappears, and the mixture takes on a bright green color as chromium (III) ions form.

4. From the information above, indicate one *physical property* of potassium dichromate in solution.
5. From the information above, indicate one *chemical property* of potassium dichromate in solution.
6. Classify the following as *physical* or *chemical* changes/properties.
 - a. A shirt scorches when you leave the iron on one spot too long.
 - b. The tires on your car seem to be getting flat in very cold weather.
 - c. Your grandmother's silver tea set gets black with tarnish over time.
 - d. Spray-on oven cleaner converts grease in the oven into a soapy material.
 - e. An ordinary flashlight battery begins to leak with age and cannot be recharged.
 - f. Acids produced by bacteria in plaque cause teeth to decay.
 - g. Sugar will char if overheated while making home-made candy.
 - h. Hydrogen peroxide "fizzes" when applied to a wound.
 - i. Dry ice "evaporates" without melting as time passes.
 - j. Chlorine laundry bleaches will sometimes change the color of brightly colored clothing.

Properties of the States of Matter and Intermolecular Forces of Attraction

<p>Why? <i>Most substances go through a phase change when heated or cooled. Molecules of a substance are held together as a solid, liquid or gas at certain temperatures by forces of attraction between molecules or particles. These forces are referred to as intermolecular forces. It is necessary to discuss what is occurring at the molecular level in order to explain how an ice cube is melted or how water is boiled.</i></p>	<p>Learning Objective:</p> <ul style="list-style-type: none"> To determine what is occurring on the molecular level for molecules in a specific phase (solid, liquid or gas) <p>Success Criteria:</p> <ul style="list-style-type: none"> Students will be able to discuss the behavior of particles with regards to movement, spacing and attractions for each phase. <p>Prerequisites:</p> <ul style="list-style-type: none"> Temperature (a measure of average kinetic energy)
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<u>MODEL 1</u>	SOLID	LIQUID	GAS
<p>PARTICLE DIAGRAM</p>			
<p>DISTANCE BETWEEN PARTICLES AND MOVEMENT</p>			
<p>SHAPE AND VOLUME IN A CONTAINER</p>			
<p>STRENGTH OF INTERMOLECULAR FORCES</p>			



Name: _____ Date: _____

Properties of the States of Matter and Intermolecular Forces of Attraction

1. In which phase of matter is there the least spacing between particles?
2. In which phase of matter is there the most potential for movement?
3. Which phase of matter does not have a definite shape yet the particles will not fill the container?
4. a. In terms of spacing, what would be necessary to change from a solid to a liquid?
b. What is this change called and how is this accomplished in terms of energy (of the molecules)?
5. a. In terms of spacing, what would be necessary to change a liquid to a gas?
b. What is this change called and how is this accomplished in terms of energy (of the molecules)?
6. a. In terms of spacing, what would be necessary to change a liquid to a solid?
b. What is this change called and how is this accomplished in terms of temperature and kinetic energy (of the molecules)?

Name: _____

-26-

Date: _____

Properties of the States of Matter and Intermolecular Forces of Attraction

Model 2: States of Matter and Intermolecular Forces of Attraction

	<p>Kinetic Energy: Energy of motion.</p> <ul style="list-style-type: none"> • The kinetic energy allows the particles to move. • Highest kinetic energy is found in gases. <p>Intermolecular forces: Forces of attraction.</p> <ul style="list-style-type: none"> • Attractive forces between atoms or molecules. • These forces exist between atoms or molecules when they are close to one another. • Determine the phase of matter.
--	---

1. Based on the information from model 2, In your own words, explain what intermolecular forces are.

2. Intermolecular forces are _____ (stronger/weaker) when particles are closer together.

3. Rank the states of matter (high, medium, low) for each of the two categories below. *Include a brief explanation.*

Table 1	Solid	Liquid	Gas
Kinetic energy of particles	<hr style="width: 80%; margin: 0 auto;"/> <p><i>Explain:</i></p>	<hr style="width: 80%; margin: 0 auto;"/> <p><i>Explain:</i></p>	<hr style="width: 80%; margin: 0 auto;"/> <p><i>Explain:</i></p>
Intermolecular forces	<hr style="width: 80%; margin: 0 auto;"/> <p><i>Explain:</i></p>	<hr style="width: 80%; margin: 0 auto;"/> <p><i>Explain:</i></p>	<hr style="width: 80%; margin: 0 auto;"/> <p><i>Explain:</i></p>

4. Look at your descriptions for the spacing, movement and ability to fill a container in model 1. Are they consistent with the type of intermolecular forces for each phase? Explain why or why not.

Name: _____

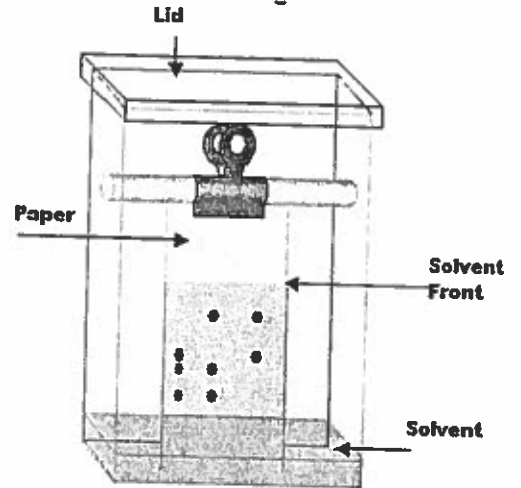
Separation of Mixtures

Aim: How can mixtures be separated by physical means?

Common Separation Techniques

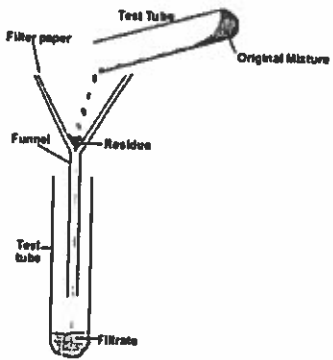
- _____
- _____
- _____
- _____

Chromatography



Mixture 1: How can we separate a mixture of iron, sand and salt?

- _____
- _____



- _____
- _____
- _____
- _____



- _____
- _____
- _____

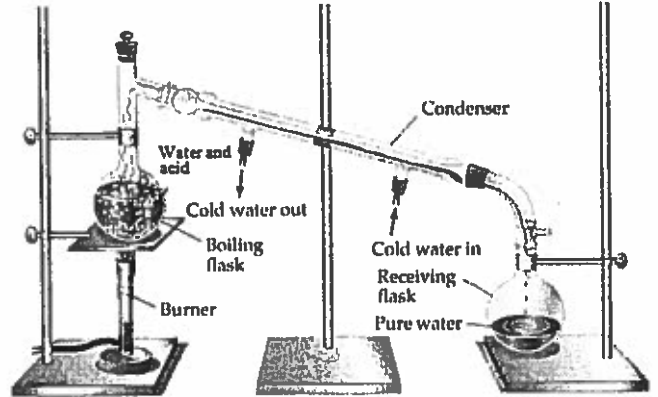
Name: _____

Separation of Mixtures

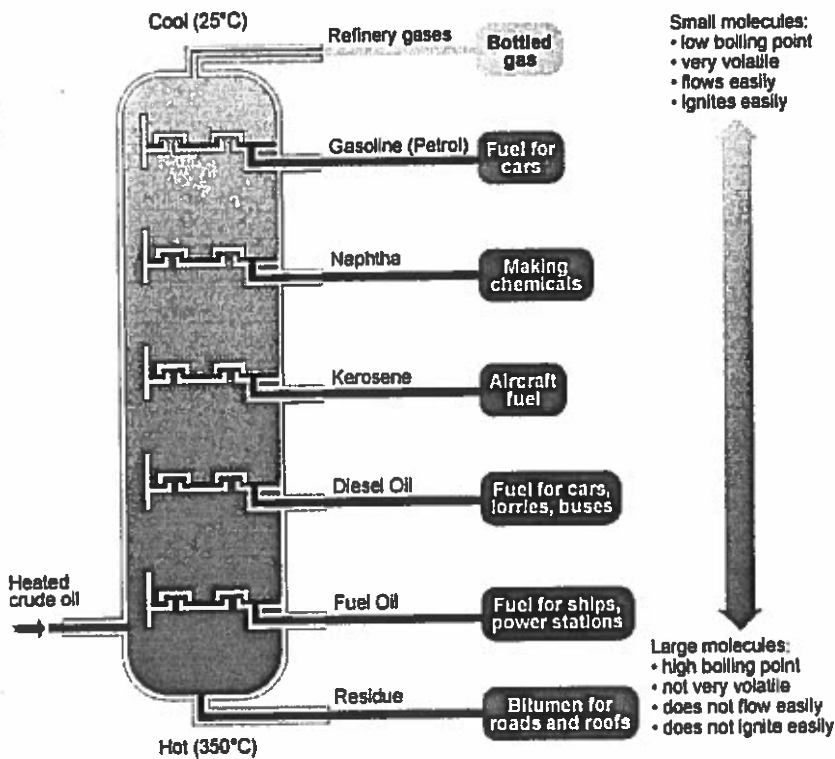
Distillation

Distillation: _____

A thermometer will hold a constant temperature for each liquid that boils off at it's respective boiling point.



Distillation only works when _____



Fractional Distillation

Fractional Distillation: _____

1. A sample of $\text{CO}_2(\text{s})$ and a sample of $\text{CO}_2(\text{g})$ differ in their
- A) chemical compositions
 - B) empirical formulas
 - C) molecular structures
 - D) physical properties
2. A large sample of solid calcium sulfate is crushed into smaller pieces for testing. Which two physical properties are the same for both the large sample and one of the smaller pieces?
- A) mass and density
 - B) mass and volume
 - C) solubility and density
 - D) solubility and volume
3. Which 5.0-milliliter sample of NH_3 will take the shape of and completely fill a closed 100.0-milliliter container?
- A) $\text{NH}_3(\text{s})$
 - B) $\text{NH}_3(\ell)$
 - C) $\text{NH}_3(\text{g})$
 - D) $\text{NH}_3(\text{aq})$
4. A mixture of crystals of salt and sugar is added to water and stirred until all solids have dissolved. Which statement best describes the resulting mixture?
- A) The mixture is homogeneous and can be separated by filtration.
 - B) The mixture is homogeneous and cannot be separated by filtration.
 - C) The mixture is heterogeneous and can be separated by filtration.
 - D) The mixture is heterogeneous and cannot be separated by filtration.
5. Which of these contains only one substance?
- A) distilled water
 - B) sugar water
 - C) saltwater
 - D) rainwater
6. Which statement is an identifying characteristic of a mixture?
- A) A mixture can consist of a single element.
 - B) A mixture can be separated by physical means.
 - C) A mixture must have a definite composition by weight.
 - D) A mixture must be homogeneous.
7. Any substance composed of two or more elements that are chemically combined in a fixed proportion is
- A) an isomer
 - B) an isotope
 - C) a solution
 - D) a compound
8. When a mixture of water, sand, and salt is filtered, what passes through the filter paper?
- A) water, only
 - B) water and sand, only
 - C) water and salt, only
 - D) water, sand, and salt
9. Two substances in a mixture differ in density and particle size. These properties can be used to
- A) separate the substances
 - B) chemically combine the substances
 - C) determine the freezing point of the mixture
 - D) predict the electrical conductivity of the mixture
10. Which property makes it possible to separate the oxygen and the nitrogen from a sample of liquefied air?
- A) boiling point
 - B) conductivity
 - C) hardness
 - D) electronegativity
11. A bottle of rubbing alcohol contains both 2-propanol and water. These liquids can be separated by the process of distillation because the 2-propanol and water
- A) have combined chemically and retain their different boiling points
 - B) have combined chemically and have the same boiling point
 - C) have combined physically and retain their different boiling points
 - D) have combined physically and have the same boiling point

Base your answers to questions 12 and 13 on the information below.

A student prepared two mixtures, each in a labeled beaker. Enough water at 20.°C was used to make 100 milliliters of each mixture.

Information about Two Mixtures at 20.°C

	Mixture 1	Mixture 2
Composition	NaCl in H ₂ O	Fe filings in H ₂ O
Student Observations	<ul style="list-style-type: none"> • colorless liquid • no visible solid on bottom of beaker 	<ul style="list-style-type: none"> • colorless liquid • black solid on bottom of beaker
Other Data	<ul style="list-style-type: none"> • mass of NaCl(s) dissolved = 2.9 g 	<ul style="list-style-type: none"> • mass of Fe(s) = 15.9 g • density of Fe(s) = 7.87 g/cm³

12. Describe a procedure to physically remove the water from mixture 1.

13. Determine the volume of the Fe filings used to produce mixture 2.

14. A student prepared two mixtures, each in a labeled beaker. Enough water at 20.°C was used to make 100 milliliters of each mixture.

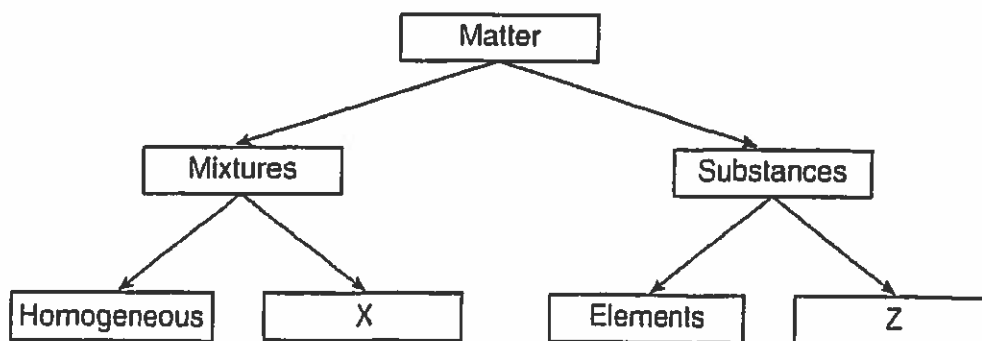
Information about Two Mixtures at 20.°C

	Mixture 1	Mixture 2
Composition	NaCl in H ₂ O	Fe filings in H ₂ O
Student Observations	<ul style="list-style-type: none"> • colorless liquid • no visible solid on bottom of beaker 	<ul style="list-style-type: none"> • colorless liquid • black solid on bottom of beaker
Other Data	<ul style="list-style-type: none"> • mass of NaCl(s) dissolved = 2.9 g 	<ul style="list-style-type: none"> • mass of Fe(s) = 15.9 g • density of Fe(s) = 7.87 g/cm³

Classify each mixture using the term "homogeneous" or the term "heterogeneous" and explain each classification using observations from the data table on the left.

Base your answers to questions 15 and 16 on the diagram below concerning the classification of matter.

Classification of Matter



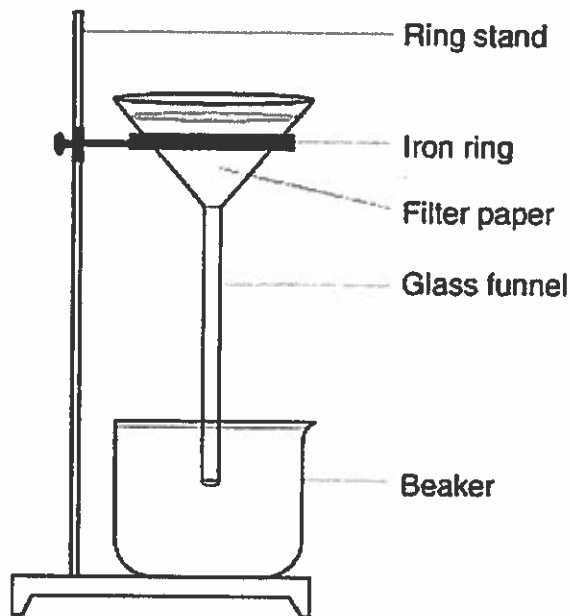
15. Given a mixture of sand and water, state one process that can be used to separate water from the sand.

16. Explain, in terms of particle arrangement, why NaCl(aq) is a homogeneous mixture.

Matter Review

- Two grams of potassium chloride are completely dissolved in a sample of water in a beaker. This solution is classified as
 - a homogeneous mixture
 - a heterogeneous mixture
 - an element
 - a compound
- A 1-gram sample of which substance in a sealed 1-liter container will occupy the container completely and uniformly?
 - $\text{H}_2\text{O}(l)$
 - $\text{Hg}(l)$
 - $\text{H}_2\text{O}(g)$
 - $\text{Ag}(s)$
- Powdered sulfur is yellow, and powdered iron is gray. When powdered sulfur and powdered iron are mixed at 20°C , the powdered iron
 - remains ionic
 - remains magnetic
 - becomes yellow
 - becomes a liquid
- A mixture of sand and table salt can be separated by filtration because the substances in the mixture differ in
 - density at STP
 - solubility in water
 - boiling point
 - freezing point
- Which must be a mixture of substances?
 - solid
 - aqueous solution
 - liquid
 - gas
- Bronze contains 90 to 95 percent copper and 5 to 10 percent tin. Because these percentages can vary, bronze is classified as
 - an element
 - a mixture
 - a compound
 - a substance

7. Which mixture can be separated by using the equipment shown below?



- $\text{CO}_2(aq)$ and $\text{NaCl}(aq)$
 - $\text{CO}_2(aq)$ and $\text{C}_6\text{H}_{12}\text{O}_6(aq)$
 - $\text{NaCl}(aq)$ and $\text{SiO}_2(s)$
 - $\text{NaCl}(aq)$ and $\text{C}_6\text{H}_{12}\text{O}_6(aq)$
- Which statement describes a mixture of sand and water at room temperature?
 - It is heterogeneous, and its components are in different phases.
 - It is homogeneous, and its components are in different phases.
 - It is heterogeneous, and its components are in the same phase.
 - It is homogeneous, and its components are in the same phase.
 - Which substance can *not* be broken down by a chemical change?
 - silicon
 - propanone
 - ethane
 - water

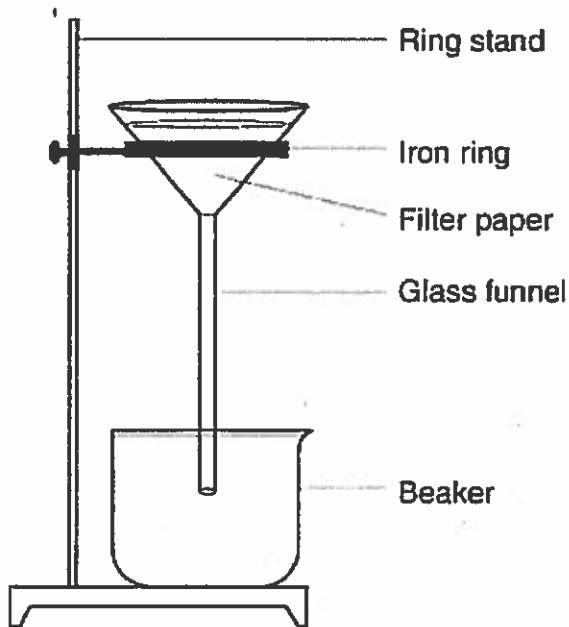
10. Which is a chemical property of water?

- A) It boils.
- B) It evaporates.
- C) It freezes.
- D) It decomposes into hydrogen gas and oxygen gas.

11. Which formula represents a homogeneous mixture?

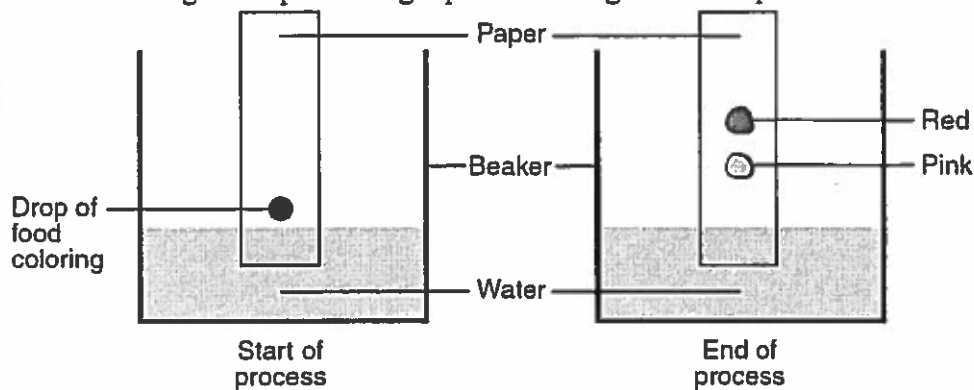
- A) $\text{H}_2\text{O}(l)$
- B) $\text{HCl}(aq)$
- C) $\text{NaH}(s)$
- D) $\text{H}_2\text{S}(g)$

12. Which mixture can be separated by using the equipment shown below?



- A) $\text{NaCl}(aq)$ and $\text{C}_6\text{H}_{12}\text{O}_6(aq)$
- B) $\text{NaCl}(aq)$ and $\text{SiO}_2(s)$
- C) $\text{CO}_2(aq)$ and $\text{C}_6\text{H}_{12}\text{O}_6(aq)$
- D) $\text{CO}_2(aq)$ and $\text{NaCl}(aq)$

13. Given the diagram representing a process being used to separate the colored dyes in food coloring:



Which process is represented by this diagram?

- A) chromatography
 B) titration
 C) distillation
 D) electrolysis

14. Which statement describes a chemical property of oxygen?

- A) Oxygen gas is slightly soluble in water.
 B) Oxygen gas can be compressed.
 C) Oxygen can combine with a metal to produce a compound.
 D) Oxygen has a melting point of 55 K.

When sample *X* is passed through a filter paper a white residue, *Y*, remains on the paper and a clear liquid, *Z*, passes through. When liquid *Z* is vaporized, another white residue remains. Sample *X* is best classified as

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

16. Which set of procedures and observations indicates a chemical change?

- A) A solid is gently heated in a crucible and the solid slowly turns to liquid.
 B) Ethanol is added to an empty beaker and the ethanol eventually disappears.
 C) A cool, shiny metal is added to water in a beaker and rapid bubbling occurs.
 D) Large crystals are crushed with a mortar and pestle and become powder.

17. Which statement is an identifying characteristic of a mixture?

- A) A mixture can be separated by physical means.
 B) A mixture can consist of a single element.
 C) A mixture must have a definite composition by weight.
 D) A mixture must be homogeneous.

18. Which substance has a definite shape and a definite volume at STP?

- A) NaCl(aq)
 B) AlCl₃(s)
 C) Cl₂(g)
 D) CCl₄(l)

19. Distillation is a process used to separate a mixture of liquids based on different

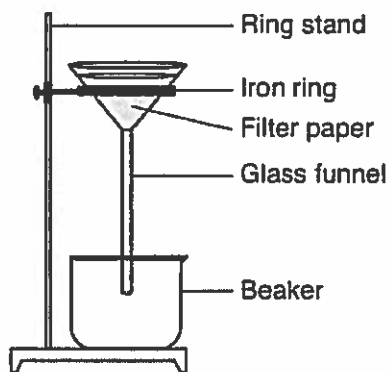
- A) boiling points
 B) solubilities
 C) freezing points
 D) densities

20. When a substance is made up of constantly vibrating particles arranged in a regular geometric pattern, the substance is classified as a

- A) supercooled liquid
 B) liquid
 C) gas
 D) true solid

Base your answers to questions 21 and 22 on the information below and on your knowledge of chemistry.

In a laboratory investigation, a student is given a sample that is a mixture of 3.0 grams of NaCl(s) and 4.0 grams of sand, which is mostly $\text{SiO}_2\text{(s)}$. The purpose of the investigation is to separate and recover the compounds in the sample. In the first step, the student places the sample in a 250-mL flask. Then, 50. grams of distilled water are added to the flask, and the contents are thoroughly stirred. The mixture in the flask is then filtered, using the equipment represented by the diagram below.



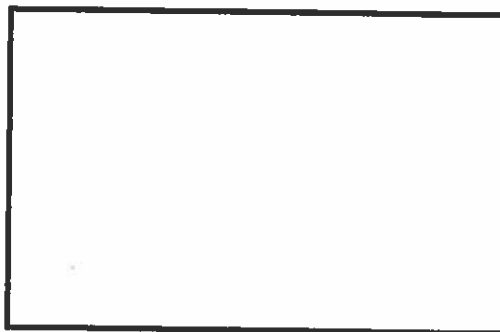
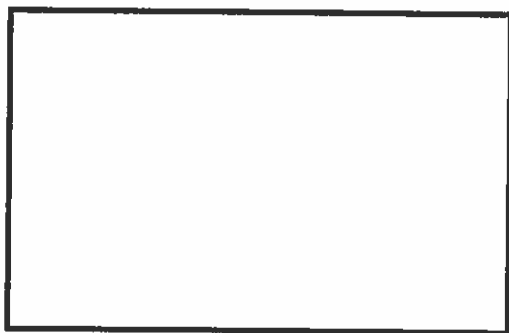
21. Explain, in terms of solubility, why the mixture in the flask remains heterogeneous even after thorough stirring.

22. Describe a procedure to remove the water from the mixture that passes through the filter and collects in the beaker.

Base your answers to questions 23 and 24 on the information below and on your knowledge of chemistry.

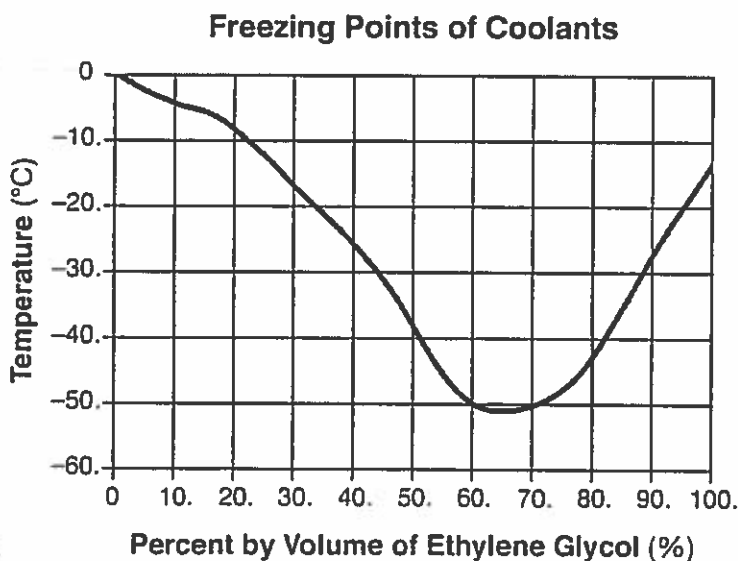
Paintball is a popular recreational activity that uses a metal tank of compressed carbon dioxide or nitrogen to launch small capsules of paint. A typical tank has a volume of 508 cubic centimeters. A 340.-gram sample of carbon dioxide is added to the tank before it is used for paintball. At 20.°C, this tank contains both $\text{CO}_2(\text{g})$ and $\text{CO}_2(\text{l})$. After a paintball game, the tank contains only $\text{CO}_2(\text{g})$.

23. Calculate the density of the carbon dioxide gas when it is added to the tank.
24. In the boxes provided, use the key to draw a particle diagram to represent the two phases of CO_2 in a newly filled tank. Your response must include *at least* six molecules of CO_2 in each phase. You must label the name of the phase you are drawing.



Base your answers to questions 25 through 27 on the information below and on your knowledge of chemistry.

A solution of ethylene glycol and water can be used as the coolant in an engine-cooling system. The ethylene glycol concentration in a coolant solution is often given as percent by volume. For example, 100. mL of a coolant solution that is 40.% ethylene glycol by volume contains 40. mL of ethylene glycol diluted with enough water to produce a total volume of 100. mL. The graph below shows the freezing point of coolants that have different ethylene glycol concentrations.



25. One engine-cooling system has a volume of 6400 mL. Determine the volume of ethylene glycol in the completely filled engine-cooling system when the concentration of ethylene glycol is 50.% by volume.

26. Explain, in terms of particle distribution, why a coolant solution is a homogeneous mixture.

27. Identify the percent by volume of ethylene glycol in a solution that freezes at $-10.^{\circ}\text{C}$.

28. Base your answer to the following question on the information below and on your knowledge of chemistry.

The melting points and boiling points of five substances at standard pressure are listed on the table below.

Melting Points and Boiling Points of Five Substances

Substance	Melting Point (K)	Boiling Point (K)
HCl	159	188
NO	109	121
F ₂	53	85
Br ₂	266	332
I ₂	387	457

State in terms of the strength of the intermolecular forces, why I₂ has a higher boiling point than F₂.

29. Base your answer to the following question on the information below and on your knowledge of chemistry.

At standard pressure, water has unusual properties that are due to both its molecular structure and intermolecular forces. For example, although most liquids contract when they freeze, water expands, making ice less dense than liquid water. Water has a much higher boiling point than most other molecular compounds having a similar gram-formula mass.

Explain why H₂O(s) floats on H₂O(l) when both are at 0°C.

30. Identify a laboratory process that can be used to separate a liquid mixture of methanol and water, based on the differences in their boiling points.