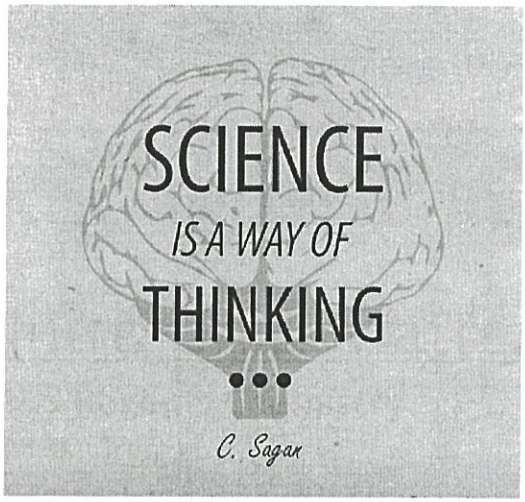
Intro Unit: Matter & Measurement

IHS Regents Chemistry

Miss Virga

September 6 – 21, 2018



Name: Key

Period/Class Color: _____

Assessment

Your unit exam will be on Fri 9/21.

Key topics and vocabulary

- Measurement
  - Units, precision, accuracy, uncertainty
- Significant Figures
- Elements, compounds, and mixtures
- Homogeneous and heterogeneous mixtures
- Particle diagrams
- Physical properties & changes
  - phases of matter
  - melting/freezing point
  - boiling/condensation point
- Physical separations
  - filtration
  - distillation
  - chromatography

Key scientific skills

- Modeling using diagrams
- Modeling using formulas and equations
- Mathematically manipulating equations
- Interpreting tables and graphs

Reference Tables

- Periodic Table
- Table S
- Table T: density

Intro Unit: Vocabulary

Definitions are found on Miss Virga's website: ***missvirga.weebly.com***

Scientific notation ex: $0.0000056 = 5.6 \times 10^{-6}$ the way that scientists easily handle very large #'s or very small #'s	**Dimensional analysis** method of converting between units
Significant figures how precise a # is (most precise →) ex: 3 (1 SF) 3.0 (2 SF) 3.00 (3 SF)	**Pure substance** element & compound (all particles are identical)
Metric system units of measurement used in science (R.T. D and C)	**Element** pure substance made up of just one type of atom
Compound pure substance made up of 2 or more atoms chemically bonded together	**Homogeneous Mixture** particles are evenly mixed, proportions can vary
Heterogeneous Mixture particles are NOT evenly mixed, proportions can vary	**Percent Error** $\%\text{ error} = \frac{\text{measured value} - \text{accepted value}}{\text{accepted value}} \times 10$
Filtration separates heterogeneous mixtures	**Distillation** separates homogeneous mixtures
Chromatography physical separation technique	**Physical vs Chemical Change** ↓ no new substance produced (i.e. melting) ↓ new substance produced

CALENDAR – BLUE CLASS

HOMEWORK POLICY: After almost every topic we cover in class, there is a one page assignment that follows it in your unit packet. It is in your best interest to keep up with the assignments as we cover the topic, however Miss Virga will not be checking homework until the day of the Unit test when unit packets are collected. Unit packets must be turned in ***before*** the test begins or they will be considered late (5 pts off per day).

Monday	Tuesday	Wednesday	Thursday	Friday
3	*4*	*5*	*6*	*7*
			A	B
			Introductions & Syllabus Overview Team Building Exercise	The Nature of Science (Mystery Box activity)
			Student Survey Elements Game	
10	*11*	*12*	*13*	*14*
A	B	A	B	A
Nature of Science cont'd *11th grade assembly*	**0.1** Uncertainty and measurement HW: Assign. #1	0.2 Significant Figures HW: Assign. #2	0.3 Dimensional Analysis HW: Assign. #3	0.4 Elements, Compounds, and Mixtures HW: Assign. #4
Nature of Science cont'd		Lab Safety		Matter & Measurement Lab Fire Drill
17	*18*	*19*	*20*	*21*
B	A	B	A	B
0.5 Homogenous vs Heterogeneous Matter HW: Assign. #5	0.6 Physical Separations HW: Assign. #6	0.7 Physical and Chemical Changes HW: Assign. #7	Review Day	Intro Unit Exam ***Intro Unit Packet and Study Guide DUE***
	0.6 Lab		Chem Work Period	

CALENDAR – RED & ORANGE CLASS

HOMEWORK POLICY: After almost every topic we cover in class, there is a one page assignment that follows it in your unit packet. It is in your best interest to keep up with the assignments as we cover the topic, however Miss Virga will not be checking homework until the day of the Unit test when unit packets are collected. Unit Packets must be turned in ***before*** the test begins or they will be considered late (5 pts off per day).

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				Nature of Science cont'd
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Student Survey Elements Game	**0.1** Uncertainty and measurement HW: Assign. #1	0.2 Significant Figures HW: Assign. #2	**0.3** Dimensional Analysis HW: Assign. #3	0.4 Elements, Compounds, and Mixtures HW: Assign. #4
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Matter & Measurement Lab		**0.6** Lab		Chem Work Period

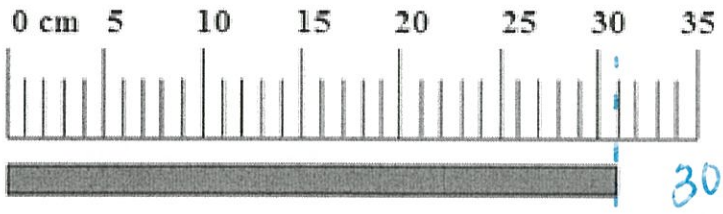
TOPIC 0.1

UNCERTAINTY AND MEASUREMENT

How do scientists perform measurements?

Uncertainty in Measurement

- Measurements are only as precise as the instrument used
- The last number which you estimate is the uncertain number
- Record the following measurements. Circle the uncertain number!



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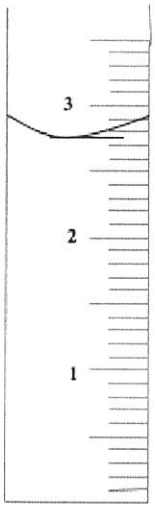


2.75

Accuracy vs Precision

Accurate: how close the measured value is to the "accepted" value

Precise: how close the measurements are to one another

Good accuracy
Good precision

Poor accuracy
Good precision

Poor accuracy
Poor precision

Example: Two chemistry students made the following measurements. The accepted value is given.

	Student A	Student B
Trial 1	2.5 cm	1.8cm
Trial 2	2.4 cm	1.7cm
Trial 3	2.3 cm	1.8cm
Average:	2.4cm	1.76cm

Actual/accepted value: 2.4 cm

1. Were either of the students accurate? Which one? Explain why.

Student A - Their average was closest to the accepted value.

2. Were either of the students precise? Which one? Explain why.

Student B - Their measurements were all close to one another.

Units

There are different systems of measurement. You are familiar with the English system (pounds, inches, etc.). In Chemistry, we will be using the SI system, aka the metric system.

Quantity being Measured	*Length*	*Mass*	*Volume*	*Temperature*	*Time*
Unit (Table D)	meter	gram	liter	Kelvin Celsius	seconds, minutes, hours, day, year
Symbol (Table D)	m	g	L	K °C	s, min, h, d, y
Instrument	ruler	digital balance	graduated cylinder	thermometer	stop watch

Scientific notation (exponential notation)

- It looks like: **N** x 10^{M}
- N is a number between 1 and 10
- If M is positive it's greater than 1
- If M is negative it's less than 1

Ex. 1: The distance from the earth to the sun is 93,000,000 miles

9.3×10^{7} miles

Ex. 2 The diameter of an atom is 0.00000000562cm

5.62×10^{-9} cm

Ex. 3: Convert 2.3×10^{2} to standard notation

230

Ex. 4: 3.6×10^{-4} in to standard notation

3.6

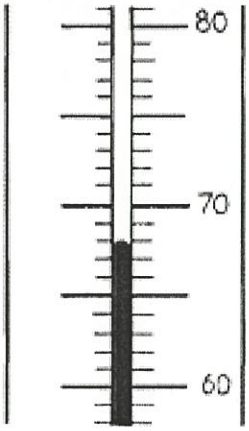
0.00036

ASSIGN. #1

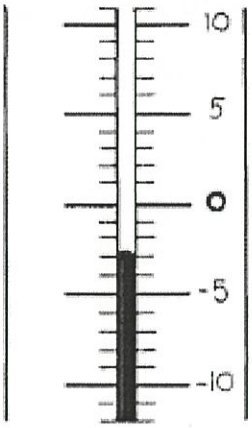
Measurement Practice

1. Perform the indicated measurements. Make sure to estimate the last number and write down the uncertainties.

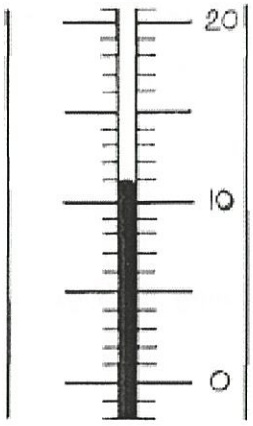
What temperature is indicated on each of the thermometers below?



a) 67.9

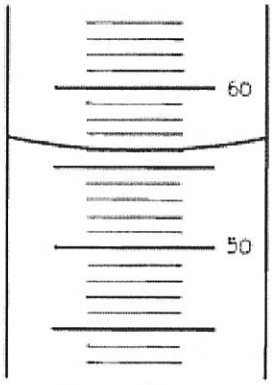


b) -2.9

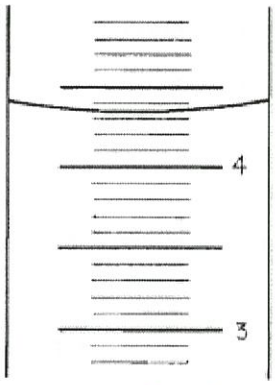


c) 11.0

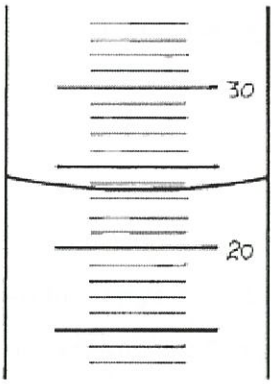
What volume is indicated on each of the graduated cylinders below? The unit of volume is mL.



a) 56.0 mL



b) 4.35 mL



c) 23.6 mL

2. For each of the following problems convert to standard to scientific or vice versa:

a) 2.3×10^4 — 23,000

b) 45000000 — 4.5×10^7

c) 6×10^{-2} — 0.06

d) 0.00023 — 2.3×10^{-4}

e) 4.1×10^8 — 410,000,000

f) 0.000000000005 — 5×10^{-12}

g) 1.23×10^{-7} — 0.000000123

h) 230100000000 — 2.301×10^{11}

TOPIC 0.2

SIGNIFICANT FIGURES

How reliable are the measurements we make?

Instruments we use in the Chemistry lab are only so precise. The number of digits reported are considered to be significant figures. There are rules for determining the number of significant figures...let's explore them below.

RULE #	1 SIG FIG	2 SIG FIGS	3 SIG FIGS	4 SIG FIGS	5 SIG FIGS
1	6	17	183	34.25	12,375
2	10	1500	103	5001	12,305
3	50	50.	125,000	12.00	12.000
4	0.00001	0.0068	502	502.0	502,340,000

Rules for Determining "Sig Figs"

1.) Non-zero #s are always significant

2.) zeros between non-zero #s are always significant

3.) All zeros after (to the right of) non-zero #s are sig. IF there is a decimal

4.) zeros before (to the left of) non-zero #s are NOT significant

Let's try some together: How many significant digits are in these numbers?

1. 35 g 2
2. 3.57 m 3
3. 3.507 km 4
4. 0.0035 kg 2
5. 2406 L 4
6. .0004 m 1
7. 240.00 g 5
8. 20.04080 g 7

Rounding Numbers: Often your calculator will give you more digits than necessary. In these cases, you will round.

1. Round 3.515014 to 5 significant figures: 3.5150
2. Round 3.5150 to 3 significant figures: 3.52
3. Round 3.52 to 1 significant figure: 4
4. Round 3430 to 2 significant figures: 3400

Practice: Round all the numbers to **four** significant figures.

a. 84791 kg 84790

b. 38.5432 g 38.54

c. 256.75 cm 256.8

d. 4.9356 m 4.936

Rule for Using Significant Figures in Calculations:

For multiplication and division, the answers should be rounded off to the same number of significant figures in the measurement with the **fewest** significant figures.

Ex 1.) $3.01^{3} \times 2.0^{2} = 6.02 = 6.0$

Ex 2.) $45^{2} / 9.00^{3} = 5.0$

Now you try!

1) 3.4 x 2.32 = 7.888 = 7.9

2) 7.77 / 2.3 = 3.37826 = 3.4

3) 3.890 / 121 = 0.032148 = 0.0321

4) 1200 x 23.4 = 28,080 = 28,000

ASSIGN. #2

Significant Figures
Practice

1. **Determine the number of significant figures in the following measurements:**

a.) 0.00235 g ___3___

b.) 2500 km ___2___

c.) 146.0 mL ___4___

d.) 1,020. KPa ___4___

2. **Perform the following calculations and round to the appropriate number of sig figs:**

a.) (20.8 cm) (5.0 cm) (123.3 cm) = ___13000___ cm^3

b.) (6.058 mm^2) / (0.027 mm) = ___220___ mm

c.) 1.35 m x 2.467 m = ___3.33___ m^2

d.) (1.035 m^2) / (42 m) = ___0.025___ m

e.) 0.021 cm x 3.2 cm x 100.1 cm = ___10.7___ cm^3

f.) (150 L^3) / (4 L) = ___40___ L^2

3. **Round the following measurements to 3 significant figures.**

a.) 6755 mL = ___6760___

b.) 4,507 g = ___4510___

c.) 10,595 km = ___10600___

d.) 0.06782 g = ___0.0678___

e.) 1.0549 m = ___1.05___

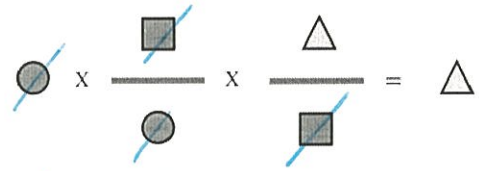
f.) 0.10649 kJ = ___0.106___

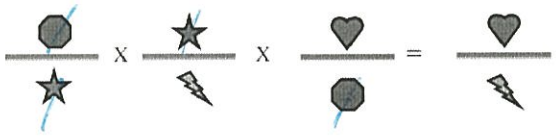
g.) 45,949 mm = ___45,900___

TOPIC 0.3

DIMENSIONAL ANALYSIS

How can we mathematically convert between units?

1. 

2. 

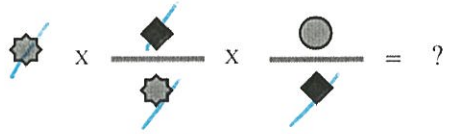
Look at problem 1 and 2. Describe a pattern that you notice. Use this pattern to answer problem 3 and 4.

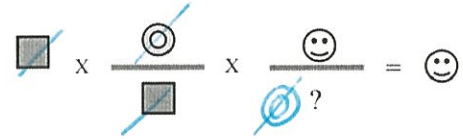
Pattern in 1 & 2:

Shapes were cancelled out, answer was whatever was leftover

Answer to 3: 

Answer to 4: 

3. 

4. 

Dimensional Analysis: *What is it good for?*

- Used to convert between units
- Equivalence statement: relates the same amount (quantity) in 2 different units
  Ex) 1 inch = 2.54 cm
- **Conversion factors**: relates equivalence in a ratio
  Ex) $\frac{1\text{ in}}{2.54\text{ cm}}$ $\frac{2.54\text{ cm}}{1\text{ in}}$
- 3 steps:
  - What do I know? (underline)
  - What do I want to know? (circle)
  - How do I get there? (equivalence statements)

- Example 1: How many centimeters are in 4.5 inches?

  1 in = 2.54 cm

  $4.5\text{ in} \times \left(\frac{2.54\text{ cm}}{1\text{ in}}\right) = 11.43\text{ cm}$

- Example 2: How many seconds are in 2 days?

  1 day = 24 h 1 h = 60 min 1 min = 60 sec

  $2\text{ d} \times \left(\frac{24\text{ h}}{1\text{ d}}\right) \times \left(\frac{60\text{ min}}{1\text{ h}}\right) \times \left(\frac{60\text{ sec}}{1\text{ min}}\right)$

  $= 172{,}800\text{ sec}$

Regents Ready: Metric system (Table C) Conversions

How many kilojoules are in 10 joules?

1 KJ = 10^3 J

1 KJ = 1000 J

$10\text{ J} \times \left(\frac{1\text{ KJ}}{1000\text{ J}}\right) = 0.01\text{ KJ}$

ASSIGN. #3

Dimensional Analysis

Practice

Directions: Solve the following problems. Make sure to show your work including underlining and circling, use units, and round using sig fig rules!

Here are some equivalence statements you made need. **Be sure to check out Table C when converting between metric system units!!!**

Equivalence statements: 2.54 cm = 1 in ; 12 in = 1 ft ; 60 min = 1 hr ; 60 s = 1 min ; 10 mm = 1 cm

1. Convert 45,200 mm to cm.

$$45{,}200\ mm \times \left(\frac{1\ cm}{10\ mm}\right) = 4520\ cm$$

2. What is the equivalent of 6.3 kilograms in grams?

$$6.3\ kg \times \left(\frac{10^3\ g}{1\ kg}\right) = 6300\ g$$

3. How many seconds are in 45.0 hours?

$$45.0\ h \times \left(\frac{60\ min}{1\ h}\right) \times \left(\frac{60\ sec}{1\ min}\right) = 162{,}000\ sec$$

4. Convert 16.5 feet to centimeters.

$$16.5\ ft \times \left(\frac{12\ in}{1\ ft}\right) \times \left(\frac{2.54\ cm}{1\ in}\right) = 502.92 = 503\ cm$$

5. How many millimeters are in 24 inches?

$$24\ in \times \left(\frac{2.54\ cm}{1\ in}\right) \times \left(\frac{10\ mm}{1\ cm}\right) = 609.6 = 610\ mm$$

6. Convert 4,500,000 seconds to days.

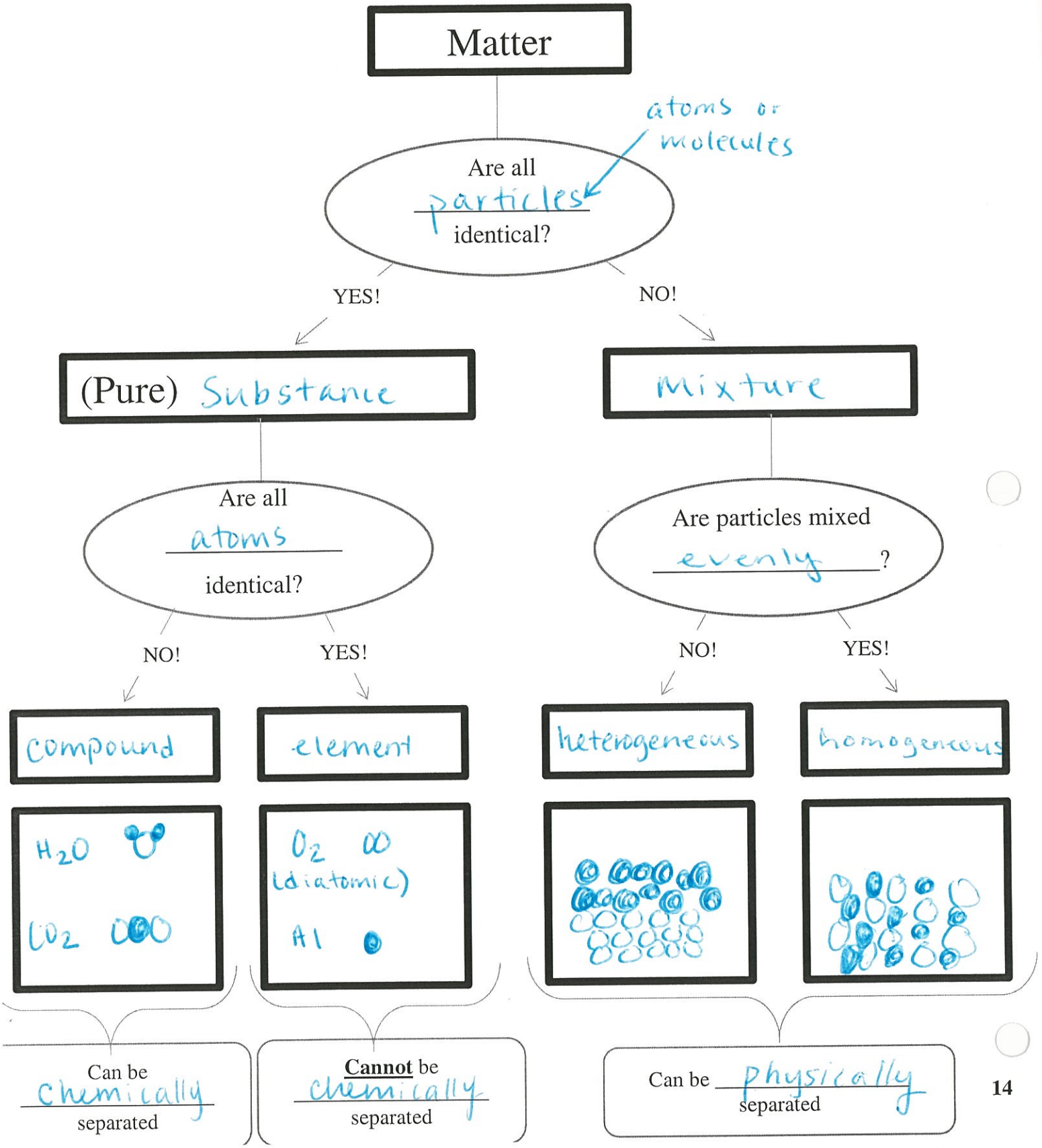
$$4{,}500{,}000\ s \times \left(\frac{1\ min}{60\ s}\right) \times \left(\frac{1\ h}{60\ min}\right) \times \left(\frac{1\ d}{24\ h}\right) = 52\ d$$

TOPIC 0.4

ELEMENTS, COMPOUNDS, AND MIXTURES

How is matter classified and described?

Everything that takes up space and has mass is matter. That's a lot of stuff here on Earth. In order to better describe and predict how matter is going to behave, chemists classify matter into different categories.

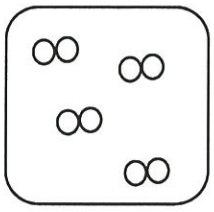


ASSIGN. #4

Elements, Compounds and Mixtures

Regents Practice

1. Explain, in terms of composition, why N_2 (modeled below), is classified as an element, not a compound (this means you should discuss the *composition* of N_2—what it is made of).



N_2 is made up of only one type of atom.

2. Which chemical symbol represents a compound? How do you know?

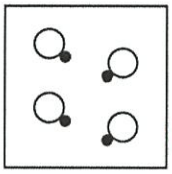
(1) C (2) Co (3) CO (4) O_2

Explain: Made up of more than one type of atom (carbon & oxygen)

3. Which terms are used to identify pure substances?

(1) An element and a mixture
(2) an element and a compound
(3) a solution and a mixture
(4) a solution and a compound

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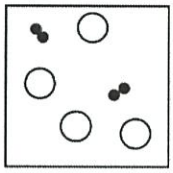
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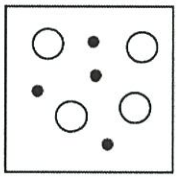
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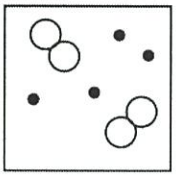
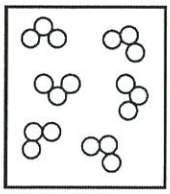

(4)

Use the simple representations for atoms of two elements shown below to answer questions 5 and 6:

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

5. Which particle diagram represents molecules of only one compound?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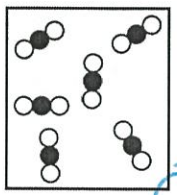
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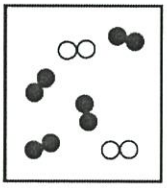
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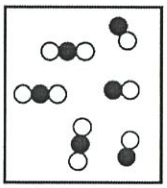
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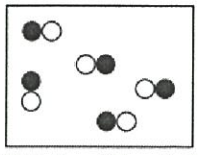
6. Which particle diagram represents a sample of matter that can *not* be broken down by chemical means?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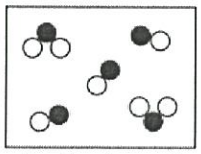
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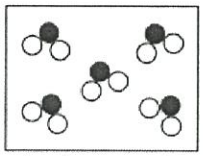
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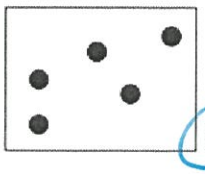

(4)

7. Which of the following can be broken down by chemical means?

(1) methane (2) tungsten (3) lead (4) tin

all elements

TOPIC 0.5

HOMOGENEOUS VS. HETEROGENEOUS MATTER

How does the arrangement of particles in a mixture affect what we see?

Let's recall what a mixture is:

2 or more substances mixed together

There are two main classes of mixtures: **homogeneous** and **heterogeneous**.

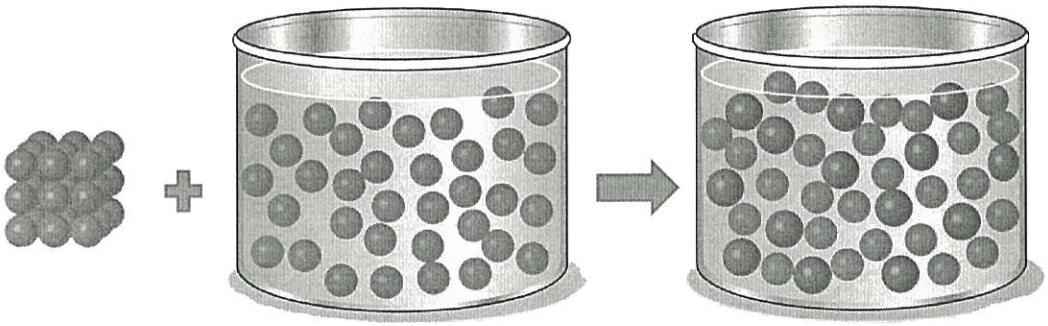
Homogeneous mixtures: UNIFORM

particles are evenly mixed ; looks the same throughout

Heterogeneous mixtures: NON-UNIFORM

- particles are NOT evenly mixed/distributed
- looks different

You have probably experienced the difference in these two types of mixtures—think of properly made Kool-Aid versus Kool-Aid made with so much powder it is clumpy and chunky on the bottom of the glass. We will call all homogeneous mixtures that are made by dissolving some solid powder into water **solutions**.



mixed evenly

Solid + water → solution

By the way, we will use a symbol to represent solids dissolved **in water** → (aq) = aqueous

i.e. $NaCl(s) + H_2O(\ell) \rightarrow NaCl(aq)$

ASSIGN. #5

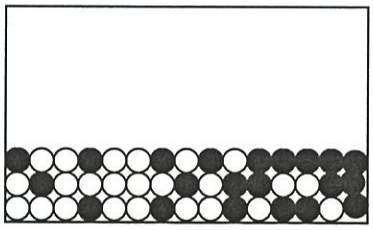
Homogeneous vs. Heterogeneous Mixtures

Regents Practice

1. A solution of sodium chloride (NaCl) in water is best classified as a
   (1) Homogeneous compound
   (2) Homogeneous mixture
   (3) Heterogeneous compound
   (4) Homogeneous mixture

2. What is formed when two atoms of bromine bond together?
   (1) A monatomic molecule
   (2) A diatomic molecule
   (3) A heterogeneous mixture
   (4) A homogeneous mixture

3. The diagram below shows a mixture.

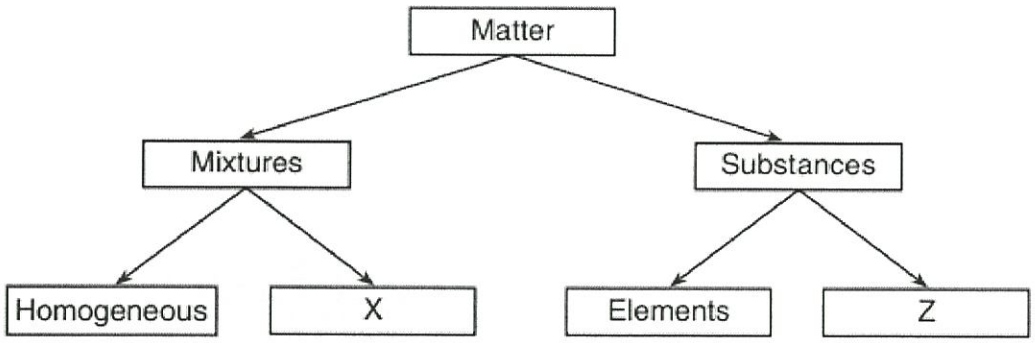


Explain, in terms of particle arrangement, why this mixture is *not* homogeneous.

Particles are not arranged evenly.

Base your answers to questions 4-6 on the diagram below concerning the classification of matter.

Classification of Matter



4. What type of mixture is represented by X? heterogeneous

5. What type of substance is represented by Z? compound

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

Particles are mixed/arranged evenly.

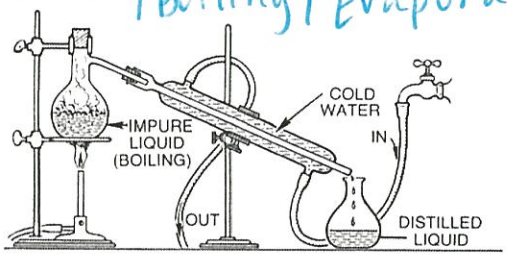
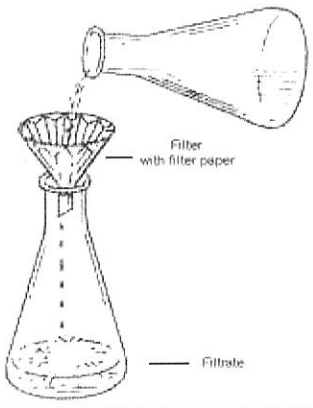
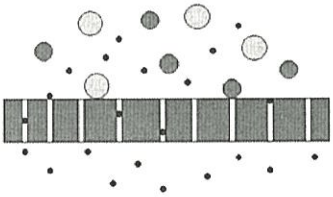
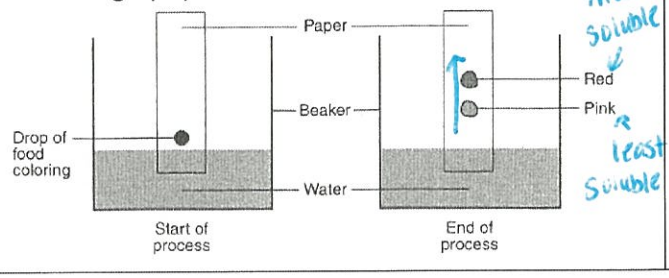
TOPIC 0.6

PHYSICAL SEPARATIONS

How can we use physical properties to isolate useful substances?

As it turns out, most things on Earth are mixtures. The elements we mine are usually found as part of compounds, which are in turn part of rocky mixtures. The liquids that fill our streams, rivers, and oceans are mixtures. If we are only interested in using one substance from a mixture—say, purified gold or water—then we need to know how to separate (**isolate**) individual components of mixtures.

You have most certainly separated things before. Usually, we separate using some kind of organizational category: odor to separate clean from dirty clothes, for example. Separations in chemistry are similar. They take advantage of the fact that **different substances have different properties**, and they use differences in a particular property to separate one thing from another. Let's look at some examples of separation techniques:

Technique	Physical Property Used to Separate	Examples
Using a Magnet	magnetism	iron filings
Distillation / Boiling / Evaporation 	boiling point	homogeneous mixtures - salt water - crude oil
Filtration  	particle size, ability to dissolve (solubility)	heterogeneous mixtures - pasta & water - sand & water - solid & liq.
Chromatography 	Solubility	ink dye

ASSIGN. #6

Separating Mixtures

Regents Practice

1.) When a mixture of water, sand, and salt is filtered, what passes through the filter paper?
(1) water, only
(2) water and sand, only
(3) water and salt, only
(4) water, sand, and salt

2.) Which property makes it possible to separate the oxygen and the nitrogen from a sample of liquefied air?
(1) boiling point
(2) conductivity
(3) hardness
(4) electronegativity

3.) Which physical property makes it possible to separate the components of crude oil by means of distillation?
(1) melting point
(2) conductivity
(3) solubility
(4) boiling point

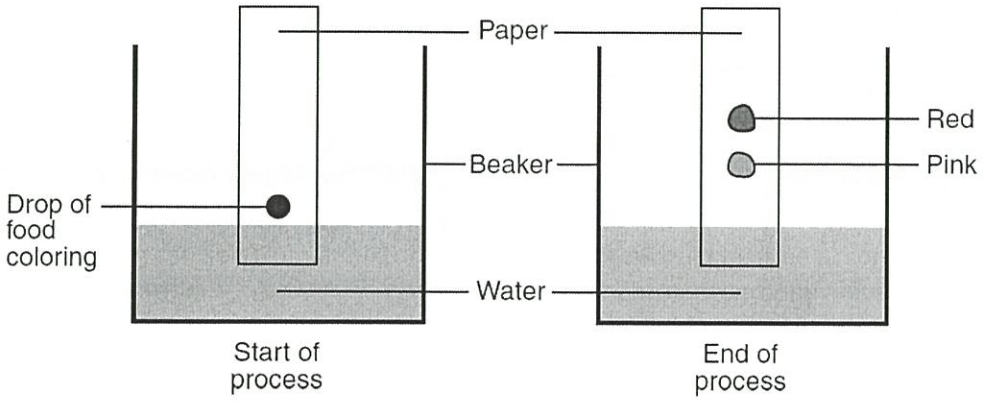
4.) Which of these contains only one substance?
(1) distilled water
(2) sugar water
(3) saltwater
(4) rainwater

5.) Bronze contains 90 to 95 percent copper and 5 to 10 percent tin. Because these percentages can vary, bronze is classified as
(1) a compound
(2) an element
(3) a mixture
(4) a substance

6.) Recovering the salt from a mixture of salt and water could best be accomplished by
(1) evaporation
(2) filtration
(3) paper chromatography
(4) density determination

7.) At room temperature, a mixture of sand and water can be separated by
(1) ionization
(2) combustion
(3) filtration
(4) sublimation

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



Which process is represented by this diagram?
(1) chromatography
(2) electrolysis
(3) distillation
(4) titration

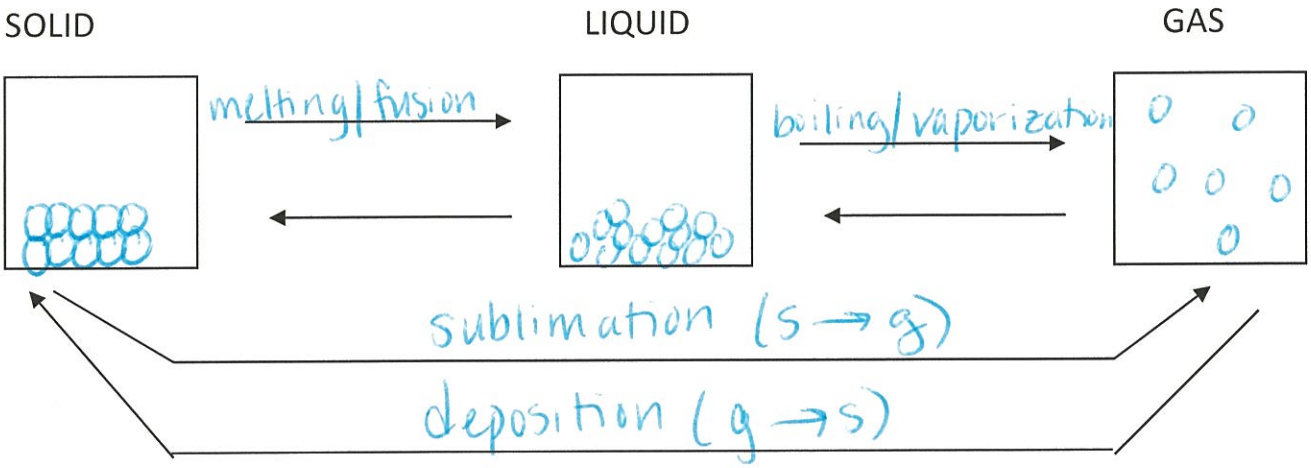
TOPIC 0.7

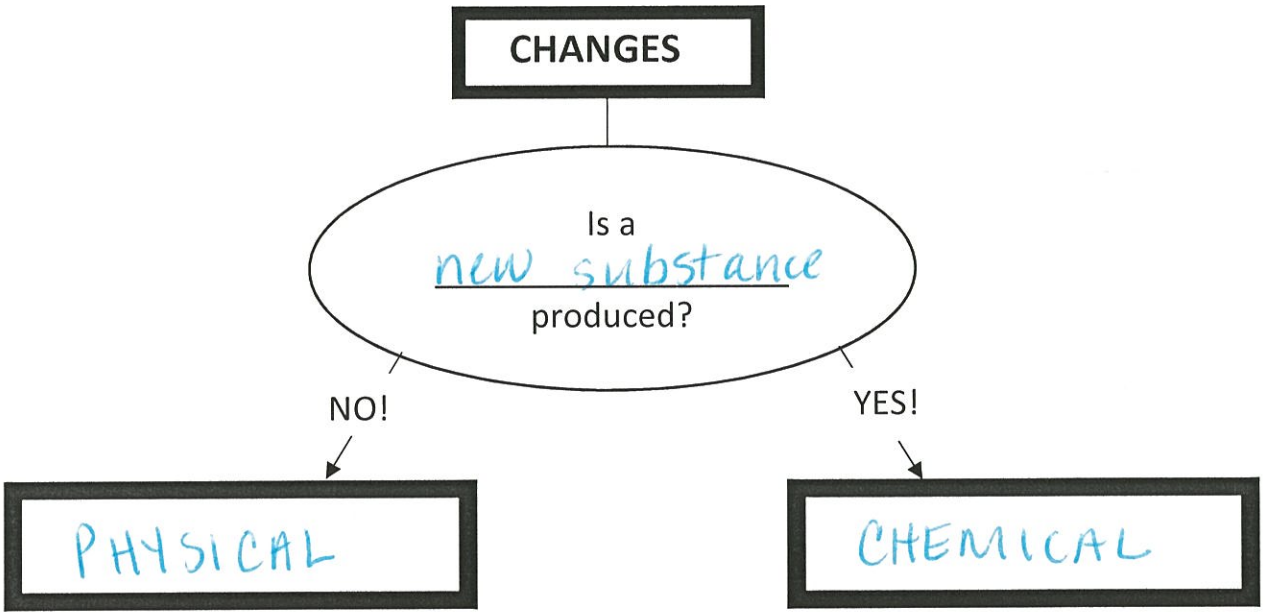
PHYSICAL & CHEMICAL CHANGES

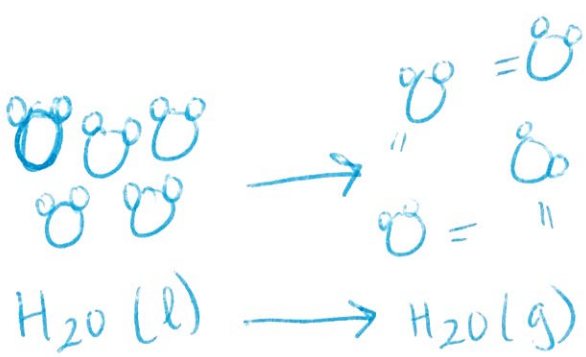
How can we distinguish between a physical and chemical change?

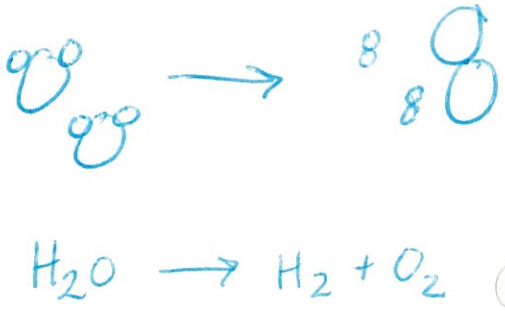
Phase Changes

Phase changes are **physical changes.** When you fill an ice cube tray with water and put it in the freezer, the liquid wate changes into a solid –but it is still just water (H_2O). Since **no new substance** was created, it is considered a physical change. You will need to know the names of the different phase changes.









ASSIGN. #7

Physical and Chemical Changes

Practice

Directions: Complete the chart to the best of your ability.

Situation	Type of Change (P or C)	Explanation (~~Write a sentence.~~)
Cooking an egg	C	new substance w/ new properties
Digesting your lunch	C	break down of food
Mixing the ingredients for a cake	P	can physically separate, no new substance created
Rusting of a nail	C	new substance (rust) created
Dew forming on the lawn	P	g → l phase change
Melting ice off a windshield	P	S → l phase change
Combustion (burning) of gasoline	C	new substance created
Purifying salt water by evaporation	P	separating a mixture
CO_2 (s) → CO_2 (g)	P	sublimation
H_2O (g) → H_2O (l)	P	condensation
H_2O NaCl (s) → NaCl (aq)	P	dissolving (solubility is a physical property)