

Name:

Mid-Semester Review: Units 1 - 4

Part I: Classify each of the following substances as; an element, a compound, a solution, or a heterogeneous mixture.

1. Sand Heter	2. Salt Compound	3. Pure Water Compound	4. Soil Hetero
5. Soda Homogen Solution	6. Pure Air SOLUTION Homogen	7. Carbon Dioxide Compound	8. Gold Element
9. Bronze SOLUTION Homogen	10. Oxygen Element	11. Salad Dressing Hetero	12. Salt Water SOLUTION Homogen

Part II: Identify each of the following changes and chemical or physical.

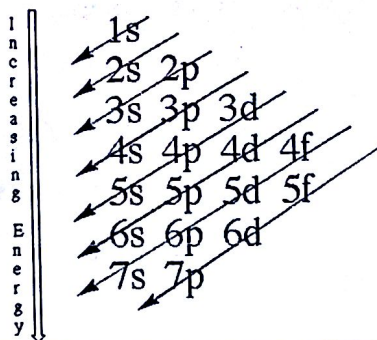
13. Freezing of H <sub>2</sub> O P	14. Burning wood C
15. Rusting of a nail C	16. Melting Metal P
17. Dissolving salt in water P	18. Distilling water P

Part III: Determine the atomic structure of the following atoms and provide the shorthand notation.

Element	Nuclear Shorthand Notation	#p <sup>+</sup>	#n <sup>0</sup>	#e <sup>-</sup>	Valence Electrons	Lewis Dot Diagram
Sodium	<sup>23</sup> <sub>11</sub> Na	11	12	11	1	Na •
Chlorine	<sup>35</sup> <sub>17</sub> Cl	17	18	17	7	•• • Cl • ••
Copper	<sup>64</sup> <sub>29</sub> Cu	29	35	29	1	Cu •

Part V: Electron Configurations

For the following elements, please determine the longhand notation and the number of valence electrons. Please be sure to use the diagonal rule!



Element	Longhand Configuration	Number of Valence Electrons
Phosphorous (P) 15	$1s^2 2s^2 2p^6 3s^2 3p^3$	5
Magnesium (Mg) 12	$1s^2 2s^2 2p^6 3s^2$	2

For the following elements, please write out the orbital diagram.

Element	Orbital Diagram
Silicon (Si) 14	$\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow$ $\uparrow$ $\underline{\hspace{1cm}}$ 1s    2s            2p            3s            3p
Manganese (Mn) 25	$\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow$ $\uparrow$ $\uparrow$ $\uparrow$ $\uparrow$ 1s    2s            2p            3s            3p            4s            3d

For the following elements write out the Noble Gas Shorthand Configurations

Element	Noble Gas Shorthand Configuration
Calcium (Ca)	$[Ar] 4s^2$
Magnesium (Mg)	$[Ne] 3s^2$

Part VII: Open Response

MATTER THAT CAN'T be separated  
 MATTER made of 2 chemically bonded elements  
 2 or more types of matter that are completely uniformly combined  
 2 or more types of matter that are not completely mixed

- 1) Define the following terms: Element, compound, homogeneous mixture and heterogeneous mixture. Classify the following using the previous terms and explain your reasoning: chocolate chip cookie, lead, Sugar (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>), and salt water solution.

CHOCOLATE CHIP COOKIE - Heterogeneous can see chips in cookie  
 LEAD - Element - on table  
 SUGAR - Compound - 3 elements bound  
 SALT WATER - Homogeneous uniform throughout

- 2) Compare Nuclear Fusion and Fission. BOTH MAKE ENERGY

FUSION combines 2 small atoms and makes 1 bigger atom - SUN

FISSION TAKES 1 large atom and splits into 2 smaller atoms - nuclear power plants

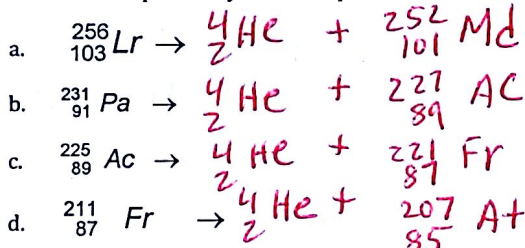
- 3) What are the 3 main states of Matter and discuss their properties with respect to Particle interactions, Particle Motion, Volume and Shape. Solid - Lowest energy & motion highest attraction

GAS - highest energy & motion low attraction - fixed volume and shape  
 LIQUID - middle energy & motion some attraction fixed volume not shape

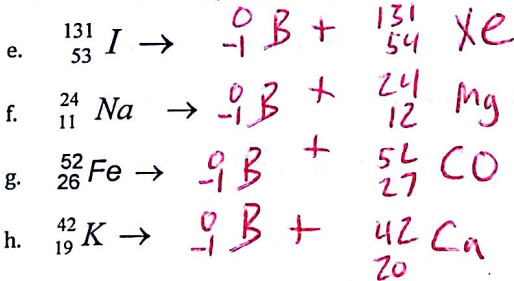
- 4) Describe the 3 particles that make up an Atom.

PROTON - positive charge in nucleus / gives mass found Rutherford  
 NEUTRON - neutral in nucleus / gives mass found Chadwick  
 ELECTRON - positive in electron cloud gives atom volume found J.J. Thompson

- 5) Please write the alpha decay nuclear equation for the following nuclides:



- 6) Please write the beta decay nuclear equation for the following:



Please perform the following calculations using the density equation. Your final answer should have a label and be reported using the proper significant figures.

- 2) 7) Osmium, a hard, heavy metal used to make durable alloys, has a density of 22.5 g/cm<sup>3</sup>. If a sample of osmium has a volume of 43.2 cm<sup>3</sup>, what is its mass?

$d = 22.5 \text{ g/cm}^3$   
 $m = ?$   
 $V = 43.2 \text{ cm}^3$   
 $m = 22.5 \frac{\text{g}}{\text{cm}^3} \times 43.2 \text{ cm}^3 = 97.2 \text{ g}$

- 3) 8) One of the largest gold nuggets ever discovered was found in Australia in 1872.

The nugget had a mass of 286 kg. Given that gold has a density of 19.32 g/cm<sup>3</sup>, calculate the volume of the gold nugget.

$m = 286 \text{ kg} \Rightarrow 286000 \text{ g}$   
 $d = 19.32 \text{ g/cm}^3$   
 $V = ?$

$V = \frac{m}{d} = \frac{286000 \text{ g}}{19.32 \text{ g/cm}^3}$   
 $V = 14803 \text{ cm}^3 \Rightarrow 14800 \text{ cm}^3$





- 4) 9) The volume of a liquid that fills a flask is  $750 \text{ cm}^3$ . The mass of the liquid is  $525 \text{ g}$ . What is the liquid's density?

$$m = 525 \text{ g}$$

$$V = 750 \text{ cm}^3$$

$$d = ?$$

$$d = \frac{525 \text{ g}}{750 \text{ cm}^3} = 0.70 \text{ g/cm}^3$$

- 5) 10) Lithium is the lightest of the metals and the least dense of all the non-gaseous elements. A pure lithium sample with a volume of  $13.0 \text{ cm}^3$  has a mass of  $6.94 \text{ g}$ .

What is the density of lithium?

$$m = 6.94 \text{ g}$$

$$V = 13.0 \text{ cm}^3$$

$$d = ?$$

$$d = \frac{6.94 \text{ g}}{13.0 \text{ cm}^3} = 0.534 \text{ g/cm}^3$$

- 1) Carbon tetrachloride is a solvent used for degreasing electronic parts. If  $25.0 \text{ mL}$  of carbon tetrachloride has a mass of  $39.75 \text{ g}$ , what is the density of the liquid? ( $1.59 \text{ g/mL}$ )

$$m = 39.75 \text{ g}$$

$$V = 25.0 \text{ mL}$$

$$d = \frac{39.75 \text{ g}}{25.0 \text{ mL}} = 1.59 \text{ g/mL}$$

- 2) An automobile battery contains  $1275 \text{ mL}$  of sulfuric acid. If the density of battery acid is  $1.84 \text{ g/mL}$ , how many grams of acid are in the battery? ( $2350 \text{ g}$ )

$$m = d \cdot V$$

$$1.84 \times 1275 = 2350 \text{ g}$$

- 3) Trinitrotoluene, TNT, is a white crystalline substance that explodes at  $240^\circ \text{C}$ . Calculate the percent composition of TNT,  $\text{C}_7\text{H}_5(\text{NO}_2)_3$ . ( $37.01\% \text{ C}$ ,  $2.22\% \text{ H}$ ,  $18.50\% \text{ N}$ , &  $42.26\% \text{ O}$ )

- 4) Iron can react with chlorine to give two different compounds,  $\text{FeCl}_2$  or  $\text{FeCl}_3$ . Under the given conditions,  $0.558 \text{ g}$  of metallic iron react with chlorine gas to yield  $1.621 \text{ g}$  of iron chloride. Which iron compound is produced in this experiment? ( $\text{FeCl}_3$ )

- 5) A quadrillion is approximately the number of red blood cells in  $50,000$  people. Which is greater: a quadrillion,  $1 \times 10^{15}$ , red blood cells or the number of nickel atoms in a  $5 \text{ g}$  nickel coin? ( $5 \text{ g}$  nickel coin,  $5 \times 10^{22}$  atoms Ni)

$$\frac{5 \text{ g}}{68.6 \text{ g/mol}} = 0.0728 \text{ mol}$$

$$0.0728 \times 6.022 \times 10^{23} = 4.38 \times 10^{22}$$

- 6) Small amounts of phosphoric acid,  $\text{H}_3\text{PO}_4$ , are used in common soft drinks. Calculate the mass of acid present in  $0.731$  moles of acid. ( $71.6 \text{ g H}_3\text{PO}_4$ )

$$3 + 31 + 64 = 98 \text{ g/mol}$$

$$0.731 \times 98 \text{ g/mol} = 71.6 \text{ g}$$

- 7) Small amounts of phosphoric acid,  $\text{H}_3\text{PO}_4$ , are used in common soft drinks. Calculate the mass of acid present in  $0.731$  moles of acid. ( $71.6 \text{ g H}_3\text{PO}_4$ )

$$2(26.98) + 3(32) + 12(16) = 121.96$$

- 8) What is the molar mass of  $\text{Al}_2(\text{SO}_4)_3$ ? ( $342 \text{ g/mol}$ )

$$342 \text{ g/mol}$$

- 9) How many atoms of  $\text{Mg}_3\text{N}_2$  are in  $4.56 \text{ g}$  of  $\text{Mg}_3\text{N}_2$ ? ( $2.72 \times 10^{22}$  atoms  $\text{Mg}_3\text{N}_2$ )

$$4.56 \text{ g} \left| \frac{1 \text{ mol}}{3(24.3) + 28} \right| = 0.0451 \text{ mol} \times 6.022 \times 10^{23} = 2.72 \times 10^{22}$$