

**Unit 1-2: Matter and Measurement**

1) Make this calculation and write your answer with the correct number of significant digits and units.

$$\text{b) } \frac{(3.1 \times 10^5 \text{ kg})(1.7 \times 10^{-4} \text{ m})}{6.5 \times 10^2 \text{ s}} =$$

2) What volume (in liters) will 1.4 Mg of quartz occupy given that its density is 2.6 g/cm<sup>3</sup> ?

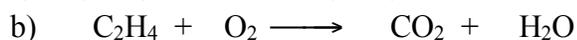
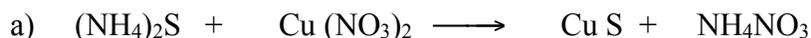
3) ? km = 1.55 nm

4) ? kg/dm<sup>3</sup> = 4.52 μg/cm<sup>3</sup>

**Unit 3: Moles and Stoichiometry (and a Specific Heat question)**

5) Describe what the law of definite proportions states.

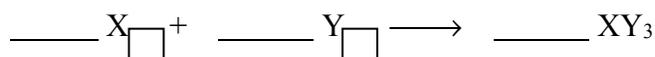
6) Balance the following equations:



7) What is the molar mass of Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>? \_\_\_\_\_

8) ? atoms of Cu = 6.0 moles of Cu

9) 2 L of Gas X is reacted with 3 L of Gas Y. The gases completely react and 2 L of Gas XY<sub>3</sub> is formed. Based on this information, complete this equation and explain how the coefficients & subscripts are determined.



10) Two balloons have the same volume but contain different gases (at same T + P). What measurement(s) of the two balloons must be the same?

- a) the density      b) molar mass      c) moles      d) # of molecules      e) mass

11) What is the molar mass of an unknown gas if 11.2 L of it (collected at STP) has a mass of 0.55 g?

12) Given this balanced equation:  $4 \text{FeO} + \text{O}_2 \longrightarrow 2 \text{Fe}_2\text{O}_3$

a) If you react 2.0 moles of FeO with excess O<sub>2</sub>, how many grams of Fe<sub>2</sub>O<sub>3</sub> is formed?

b) What is the limiting reactant, if you react 6.0 moles of FeO with 3.0 moles of O<sub>2</sub>? \_\_\_\_\_  
(Explain why.)

13) Given this balanced equation:  $2 \text{NaCl (s)} + 2 \text{H}_2\text{O (l)} \longrightarrow 2 \text{NaOH (s)} + \text{Cl}_2 \text{(g)} + \text{H}_2 \text{(g)}$

a) If 5.0 g of NaCl is reacted with excess water, how many grams of  $\text{Cl}_2$  should be formed?

b) If 0.34 g of NaCl are reacted with excess water, how many Liters of  $\text{H}_2\text{(g)}$  should be produced at STP?

14) Given this balanced equation:  $\text{N}_2 \text{(g)} + 4 \text{H}_2 \text{(g)} + \text{Cl}_2 \text{(g)} \rightarrow 2 \text{NH}_4\text{Cl (s)}$

a) If 3.5 g of  $\text{N}_2$  is reacted with 0.75 g of  $\text{H}_2$  (and with excess  $\text{Cl}_2$  also) what is the limiting reagent?

b) Given the same amounts as above, what is the theoretical yield of  $\text{NH}_4\text{Cl (s)}$ ?  
(How many grams of  $\text{NH}_4\text{Cl (s)}$  should be produced?)

c) Suppose that the reaction described above is actually done in lab and 4.8 g of  $\text{NH}_4\text{Cl(s)}$  is produced.  
What is the percent yield of  $\text{NH}_4\text{Cl}$ ?

15) What is the percent composition of oxygen (by mass) in  $\text{HNO}_3$ ?

16) What is the empirical formula for a compound that is 66.0 % Ca and 34.0 % P?

17) What is the molecular formula for a compound that has an empirical formula a  $\text{AgCO}_2$  and a molar mass of 304 g/mole?

18) Suppose a piece of iron with a mass of 21.5 g at a temperature of  $100.0^\circ\text{C}$  is dropped into an insulated container. The temperature of the water before adding the iron is  $20.0^\circ\text{C}$ . After adding the metal into the water, the final temperature of the metal and the water is  $21.4^\circ\text{C}$ . What mass of water must have been in the cup?  
*Specific heat of iron =  $0.449 \text{ J/g}^\circ\text{C}$       Specific heat of water =  $4.184 \text{ J/g}^\circ\text{C}$*

### **Unit 4 and 5: Basics of Atoms, History of atoms and Nuclear Chemistry**

19) An atom or ion of Aluminum has 14 neutrons and 10 electrons.

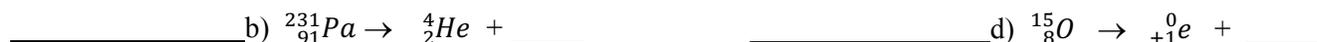
- a) How many protons does it have? \_\_\_\_\_ b) What is its mass number? \_\_\_\_\_  
c) What is its charge? \_\_\_\_\_ d) Write its symbol: \_\_\_\_\_

20) a) Who discovered the nucleus? \_\_\_\_\_ by what experiment? \_\_\_\_\_  
b) Who is the person credited with the concept of an "atom"? \_\_\_\_\_

21) What instrument can be used to determine that there are isotopes of elements? \_\_\_\_\_

22) What type of nuclear radiation (alpha, beta, gamma) is the least penetrating? \_\_\_\_\_

23) Complete the following nuclear decay equations and label each reaction as either alpha emission, beta emission, positron emission or electron capture.



24) The half-life of a fictional element, Rx, is 20 days. If you start with a sample of element Rx that has a mass of 80 g, calculate the mass of element Rx remaining after 60 days has elapsed.

25) What force holds the protons and neutrons together inside a nucleus? \_\_\_\_\_

26) Why is it necessary to use "E=mc<sup>2</sup>" to understand nuclear reactions? Does this equation also apply in chemical reactions?

27) A nuclear power plant is very efficient because they can produce a lot of energy from fissioning a small amount of  ${}^{235}\text{U}$ . However, one must be sure to use control rods.

- a) What specifically do control rods do?  
b) What might happen if control rods are not used? Explain.

28) What type of reaction takes place in the sun? \_\_\_\_\_  
Why is it so difficult to do this type of reaction on the earth?

29) What is a supernova? When will a supernova occur? What is produced and scattered by a supernova?

**Unit 6 and 7: Modern Atomic Structure, Periodic Table and Trends, types of substances, Lewis Dots**

- 30) a) As frequency gets higher, the wavelength gets \_\_\_\_\_  
 b) Which light waves are higher in energy? **infrared or ultraviolet?** \_\_\_\_\_  
 c) Do radio waves have very short or very long wavelengths? \_\_\_\_\_

31) If a photon of light has a wavelength of  $7.2 \times 10^{-7}$  m.

a) What is the frequency of the photon of light?

b) What is its energy in Joules?

32) In a gas discharge tube, electrons fall down after being pushed up into a higher energy level. The further an electron falls down the (**longer, shorter**) the wavelength of the light emitted.

33) a) If an object is green, what color light is being transmitted (reflected)? \_\_\_\_\_

b) If an object only absorbs red, orange and yellow light, what color is the object? \_\_\_\_\_

c) What happens to the electrons in an atom when light is absorbed? \_\_\_\_\_

34) Fill in this chart:

Element	Electron Configuration (Noble Gas Config is fine)	# of unpaired electrons
S		
Ni		
I		
Hg		

35) Complete this table below given the electron configurations shown.

Electron Configuration	Symbol	Group #	Period #	Metal, NM, Metalloid	# of valence electrons	Charge of common ion
a) $1s^2 2s^2 2p^1$						
b) $1s^2 2s^2 2p^6 3s^2 3p^5$						
c) $[\text{Ar}] 4s^2 3d^{10} 4p^4$						

- 36) a) Within a period, the size of atoms (**increases, decreases**) with increasing atomic number.  
 b) Within a group, the size of atoms (**increases, decreases**) with increasing atomic number.  
 c) When metal atoms lose electrons, they form ions which are (**smaller, larger**) than the original atoms.  
 d) When nonmetal atoms gain electrons, they form ions which are (**smaller, larger**) than the original atoms

37) a) A low ionization energy is characteristic of (**metals, nonmetals**).

b) Ionization energy tends to (**increase, decrease**) across a period of the table.

c) The radius of an atom tends to (**increase, decrease**) across a period of the table.

d) Which atom attracts electrons more strongly --**Mg or Ba?** \_\_\_\_\_

e) Which is more reactive—S or Cl? \_\_\_\_\_ f) Which is more reactive—Sr or Ca? \_\_\_\_\_

38) Lewis Dot Structures: For any ionics below, show the formation of the ions by showing Lewis Dots of elements and arrows for electron transfer. For covalent molecules, draw Lewis Dot Structures.

a)  $\text{MgBr}_2$

c)  $\text{N}_2$

b)  $\text{CF}_4$

d)  $\text{Li}_3\text{P}$