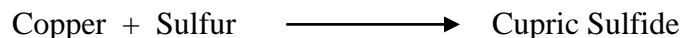


### Examination 3

#### *Multiple Choice Questions*

**Subatomic Particle Data and a Periodic Table of the Elements can be found at the End of the Exam.**

1. Elemental Copper and Sulfur, when combined in a crucible and heated, form Cupric Sulfide:



2.00g of Copper and 9.50g of Sulfur are combined and form 3.01g of Cupric Sulfide. Copper is found to be the limiting reagent. How much excess Sulfur has been used?

- a) 3.11g  
b) 5.71g  
c) **8.49g** \*\*\*\*\*  
d) 12.19g

$$9.50 \text{ g} + 2.00 \text{ g} - 3.01 \text{ g} = 8.49 \text{ g}$$

2. Phosphorus Pentoxide is 43.7% Phosphorus. How many grams of Phosphorus is required to form 10.0g of the Pentoxide?

- a) 8.61g  
b) 5.63g  
c) **4.37g** \*\*\*\*\*  
d) 2.11g

$$10.0 \text{ g} \times (0.437) = 4.37 \text{ g}$$

3. Tin (IV) Oxide is 78.8% Tin. How many grams of Oxygen is required to react with 5.00g of Tin?

- a) 0.28g  
b) 0.98g  
c) **1.34g** \*\*\*\*\*  
d) 2.14g

$$\text{mass cmpd} = 5.00\text{g} / 0.788 = 6.34 \text{ g}$$

$$\text{mass Oxygen} = 6.34 \text{ g} - 5.00 \text{ g} = 1.34 \text{ g}$$

4. The chemical formula for elemental Sulfur is:
- $S_2$
  - $S_4$
  - $S_6$
  - $S_8$  \*\*\*\*\***
5. What did Thomson directly measure in his Cathode Ray experiment? What did he infer from this measurement?
- oil drop expansion; mass of the electron
  - $\alpha$ -particle rebound; charge of the electron
  - oil drop charge; mass of the electron
  - Cathode Ray deflection; mass/charge for the electron \*\*\*\*\***
6. Which subatomic particle has negligible mass?
- electron \*\*\*\*\***
  - proton
  - neutron
  - quark
7. An atom of  $^{75}\text{As}$  contains how many protons?
- 75
  - 99
  - 23
  - 33 \*\*\*\*\***
- Atomic Number = #  $p^+$  = 33**
8. An atom of  $^{109}\text{Ag}$  contains how many neutrons?
- 34
  - 41
  - 62 \*\*\*\*\***
  - 88
- Atomic Number = 47**  
**# n = Mass Number - #  $p^+$  = 109 - 47 = 62**
9. An atom of  $\text{Sc}^{3+}$  contains how many electrons?
- 24
  - 21
  - 18 \*\*\*\*\***
  - 15
- Atomic Number = 21**  
**Three fewer electrons than protons.**

10. The charge of a  $P^{3-}$  atom is:

- a)  $+ 2.4 \times 10^{-16} \text{ C}$
- b)  $- 8.1 \times 10^{-17} \text{ C}$
- c)  $-1.3 \times 10^{-18} \text{ C}$
- d)  **$- 4.8 \times 10^{-19} \text{ C}$  \*\*\*\*\***

$$-3 \times (1.6 \times 10^{-19} \text{ C}) = -4.8 \times 10^{-19} \text{ C}$$

11. Which subatomic particles are located in an atom's nucleus?

- a) protons and electrons
- b) **protons and neutrons \*\*\*\*\***
- c) neutrons and electrons

12. An atom's nucleus is:

- a) large.
- b) **dense. \*\*\*\*\***
- c) uncharged.
- d) light.

13. Which of the postulates of Dalton's Atomic Theory is currently considered to be true? (May have multiple correct answers.)

- a) Elements are composed of indivisible atoms.
- b) Atoms are alike for a given element.
- c) **Atoms for different elements differ in size, mass, etc. \*\*\*\*\***
- d) **Compounds are formed from two or more atoms of different elements. \*\*\*\*\***
- e) **Atoms combine in simple numerical ratios to form compounds. \*\*\*\*\***

14. Berthollet used the following evidence to argue against Proust's Law of Definite Composition.

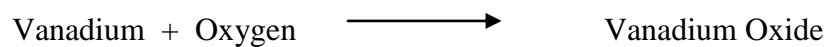
- a) **Brass has a variable composition of Copper and Zinc. \*\*\*\*\***
- b) Water is a compound.
- c) The composition of Copper Carbonate does not depend on its method of preparation.
- d) Air is composed of variable amounts of Oxygen and Nitrogen.

15. The relative charge of a Calcium atom that has lost 2 electrons is:

- a)  $\text{Ca}^{2-}$
- b)  $\text{Ca}^-$
- c)  $\text{Ca}^+$
- d)  **$\text{Ca}^{2+}$  \*\*\*\*\***

### Short Answer Questions

1. When roasted in Air, elemental Vanadium reacts with Oxygen to form Vanadium Oxide:



When 5.0575g Vanadium is roasted in an excess of air, 9.059g of Vanadium Oxide is formed.

- a) How much oxygen is consumed in this reaction?

$$\text{mass Oxygen} = 9.059 \text{ g} - 5.075 \text{ g} = 3.984 \text{ g}$$

- b) What is the elemental composition (mass percentage) of Vanadium Oxide?

$$\% \text{ V} = 5.075 \text{ g} / 9.059 \text{ g} \times 100 = 56.02 \%$$

$$\% \text{ O} = 100 \% - 56.02 \% = 43.98 \%$$

2. Water has a composition of 11.2% Hydrogen and 88.8% Oxygen and a chemical formula of H<sub>2</sub>O.

- a) What mass of Oxygen is required to combine with 1.00g of Hydrogen?

$$\text{mass Water} = 1.00 \text{ g} / 0.112 = 8.93 \text{ g}$$

$$\text{mass Oxygen} = 8.93 \text{ g} - 1.00 \text{ g} = 7.93 \text{ g}$$

- b) If we set the mass of a Hydrogen atom to be 25 ja (ja = "jeff altig" mass units), what is the mass of an Oxygen atom in ja's?

$$7.93 \text{ g} / 1.00 \text{ g} = 7.93 = \text{mass O atom} / (2 \times \text{mass H atom})$$

$$\text{mass O atom} = 7.93 \times 2 \times \text{mass H atom} = 7.93 \times 2 \times 25 \text{ ja} = 396 \text{ ja}$$

3. One of the postulates of Dalton's Atomic Theory states:

*The atoms of a given element are all alike.*

In what sense is this true? And, how is this false?

**The atoms of a given element are all alike in the sense that they have the same number of protons.**

**Atoms of a given element can have different numbers of neutrons (isotopes) and different numbers of electrons (ions).**

4. The chemical formula for the compound Calcium Phosphate is:



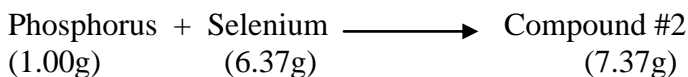
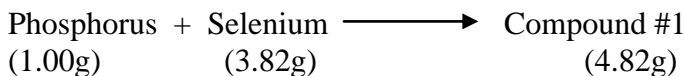
How many atoms of each constituent element is in a "formula unit" of the compound?

Calcium      **3**

Phosphorus    **2**

Oxygen        **8**

5. Phosphorus can react with Selenium in the following proportions:

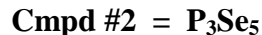


- a) Determine the following ratio according to the Law of Multiple Proportions:

$$(\text{Mass Se in \#2} / \text{Mass P}) / (\text{Mass Se in \#1} / \text{Mass P}) =$$

$$(6.37\text{g} / 1.00\text{g}) / (3.82\text{g} / 1.00\text{g}) = 1.667 = 5 / 3$$

- b) Assume the chemical formula for Compound #1 is given by Dalton's Rule of Greatest Simplicity; Compound #1 = PSe. What is a reasonable chemical formula for Compound #2.



6. Provide a basic description of the Rutherford Gold Foil experiment. Your discussion should address the following:

- i) What was measured?
- ii) How were the measurements interpreted?
- iii) Why were the results so "shocking?"

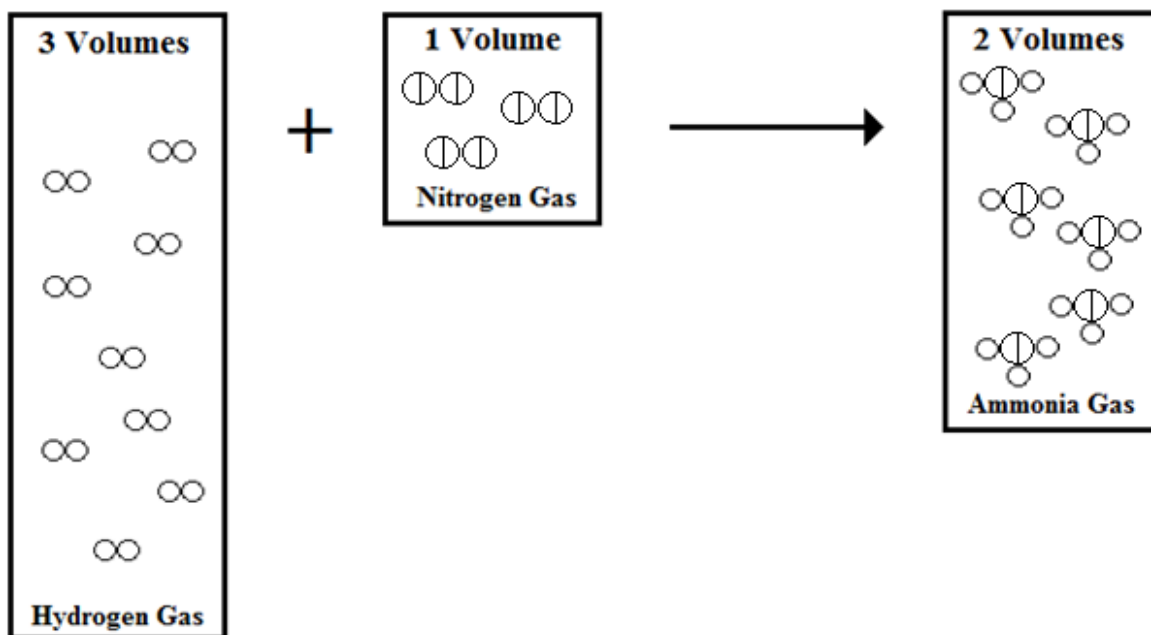
**$\alpha$ -Particles were fired at a thin sheet of Gold foil. The deflection of the particles was then measured. The deflection results, which were unexpected because they thought the particles would simply plow right through the low density material, indicated the atom has a small high density core, or nucleus.**

7. Gay-Lussac found that 1 volume of Nitrogen gas combines with 3 volumes of Hydrogen to produce 2 volume of Ammonia.

a) If Nitrogen and Hydrogen are assumed to be diatomic,  $N_2$  and  $H_2$ , what is the chemical formula of Ammonia?



b) Illustrate your result schematically below:





## Subatomic Particle Data

	<u>Charge (C)</u>	<u>Mass (kg)</u>
$e^-$	$-1.602 \times 10^{-19}$	$9.1095 \times 10^{-31}$
$p^+$	$+1.602 \times 10^{-19}$	$1.673 \times 10^{-27}$
$n$	0	$1.675 \times 10^{-27}$