Name:_____

SCH 3U Test – Subatomic Particles, Models of the Atom, Percent Composition Calculations

PLEASE CHOOSE THE BEST ANSWER TO EACH MULTIPLE CHOICE QUESTION

1. In the late 1800s, experiments using vacuum technology and high voltage led to the discovery of the
a) neutron
b) proton
c) positron
d) electron

2. Which subatomic particles are located in the nucleus of a carbon atom?
a) protons and electrons
b) protons, only
c) neutrons, only
d) protons and neutrons

3. Which subatomic particle is negatively charged?
a) neutron
b) electron
c) proton
d) positron

4. Which total mass is the smallest?
a) the mass of 1 electron plus the mass of 1 proton
b) the mass of 1 neutron plus the mass of 1 electron
c) the mass of 2 neutrons
d) the mass of 2 electrons

5. Which two particles each have a mass approximately equal to one atomic mass unit?
a) proton and electron
b) electron and neutron
c) electron and positron
d) proton and neutron

6. Which statement is true about a proton and an electron?
a) They have different masses and different charges.
b) They have different masses and the same charges.
c) They have the same masses and different charges
d) They have the same masses and the same charges

7. Which conclusion was a direct result of the gold foil experiment?

a) An electron has a positive charge and is located inside the nucleus.

b) An atom is composed of at least three types of subatomic particles.

c) An electron has properties of both waves and particles.

d) An atom is mostly empty space with a dense, positively charged nucleus.

8. Which statement best describes electrons?

a) They are negative subatomic particles and are found in the nucleus.

b) They are negative subatomic particles and are found surrounding the nucleus.

c) They are positive subatomic particles and are found surrounding the nucleus.

d) They are positive subatomic particles and are found in the nucleus.

9. Which subatomic particle has no charge?

a) beta particle

b) alpha particle

c) neutron

d) electron

10. Compared to the entire atom, the nucleus of the atom is

a) larger and contains most of the atoms mass

b) smaller and contains little of the atom's mass

c) larger and contains little of the atom's mass

d) smaller and contains most of the atom's mass

11. Write a complete atomic symbol for an atom that has 35 protons and 53 neutrons.

$$^{88}_{35}\mathrm{Br}$$

12. For the atomic symbol shown, state the number of each type of subatomic particle for a neutral atom.

$^{251}_{98}\mathrm{Cf}$	# of p^+ = 98 # of e^- = 98 # of n = 153

13. Complete each nuclear equation and state the type of decay process involved:

$$^{211}_{84}\mathrm{Po} \Rightarrow {}^{207}_{82}\mathrm{Pb} + {}^{4}_{2}\mathrm{He} \qquad \text{alpha decay}$$

$$^{214}_{82}\mathrm{Pb} \Rightarrow {}^{214}_{83}\mathrm{Bi} + {}^{0}_{1-}\mathrm{e} \qquad \text{beta decay}$$

$$^{207}_{79}\mathrm{Au}^{*} \Rightarrow {}^{207}_{79}\mathrm{Au} + {}^{0}_{0}\gamma \qquad \text{gamma decay}$$

$$^{236}_{92}\mathrm{U} \Rightarrow {}^{232}_{90}\mathrm{Th} + {}^{4}_{2}\mathrm{He} \qquad \text{alpha decay}$$

$$^{1}_{0}\mathrm{n} + {}^{258}_{101}\mathrm{Md} \Rightarrow {}^{126}_{51}\mathrm{Sb} + {}^{130}_{50}\mathrm{Sn} + 3\,{}^{1}_{0}\mathrm{n}$$

14. Using this table, place each name that represents a scientist or group of scientists in chronological order (this means in order of oldest to most recent). Then in the second column, indicate the main points or discovery that goes with each model. Point form is preferred. Include in your answer (in the correct location) the name of two fundamental laws and the main points in Dalton's Model.

Alchemists, Bohr, Dalton, Democritus, Empedocles, Rutherford, Thomson

Name	Main Points or Discovery
Democritus	proposed the existence of atoms
Empedocles	proposed the four humour model of matter: earth air fire and water
Alchemists	played with chemistry and discovered The Law of Constant Composition: when elements combine to form compounds they do so in a fixed proportion by mass. Law of Conservation by Mass: in a chemical reaction, matter is neither created nor destroyed
Dalton	all matter is composed of atoms atoms of an element are the same, particularly with respect to mass atoms of different elements are different, particularly with respect to mass atoms combine in simple whole number ratios (H_2O) atoms cannot be destroyed or changed into different types of atoms
Thomson	discovered the electron (proposed the plumb pudding model of the atom)
Rutherford	discovered the nucleus (hard dense positive center to the atom)
Bohr	fixed locations for electron orbits (explained line spectra)

15. Answer these questions two about the Rutherford Gold Foil Scattering experiment. What I have provided is the two main observations for Rutherfords experiment. What I am looking for is conclusion that was reached based on the particular observation.

The vast majority of alpha particles were observed to pass directly through the gold foil as if the goil foil was not even there!!
Conclusion: atoms are mostly empty space

The occasional blip was seen suggesting that a few of the alpha particles were deflected or reflected off course:
Conclusion: atoms contain a small dense positively charged nucleus

16. Perform a complete percent composition calculation based on chemical formula and periodic table masses. Hint: The table will provide you with an organized space for the FOUR SEPARATE CALCULATIONS REQUIRED, THREE OF WHICH ARE THREE LINE CALCULATIONS THAT START WITH A BLANK FORMULA. – $Au(IO_3)_3$ is the formula

Au: 1 x 1.01 g = 196.97 g I: 3 x 126.90 g = 380.70 g O: 9 x 16.00 g = 144.00 g $Au(IO_3)_3$ 721.67 g	$\% Au = \frac{\text{mass Au}}{\text{mass } Au(IO_3)_3} \times 100\ \%$ $\% Au = \frac{196.97\ g}{721.67\ g} \times 100\ \%$ % Au = 27.29 %
$\% I = \frac{\text{mass I}}{\text{mass } Au(IO_3)_3} \times 100\ \%$ $\% I = \frac{380.70\ g}{721.67\ g} \times 100\ \%$ % I = 52.75 %	$\% O = \frac{\text{mass O}}{\text{mass } Au(IO_3)_3} \times 100\ \%$ $\% O = \frac{144.00\ g}{721.67} \times 100\ \%$ % O = 19.95 %

17. Perform an empirical formula calculation for a molecule with the following composition: 46.160% carbon, 5.165% hydrogen and 48.675% fluorine. Complete a molecular formula determination given that the molar mass of the compound is 312.28 g/mol. Use full problem solving format.

In a 100 g sample:

C: 46.160 g x $\frac{1\ mol}{12.01\ g}$ = 3.843 mol ÷ 2.562 mol = 1.500 x 2 = 3.000 ≃ 3

H: 5.165 g x $\frac{1\ mol}{1.01\ g}$ = 5.114 mol ÷ 2.562 mol = 1.996 x 2 = 3.992 ≃ 4

F: 48.675 g x $\frac{1\ mol}{19.00\ g}$ = 2.562 mol ÷ 2.562 mol = 1.000 x 2 = 2.000 ≃ 2

Therefore the empirical formula is $C_3H_4F_2$

The empirical mass is:

C: 3 x 12.01 g = 36.03 g
H: 4 x 1.01 g = 4.04 g
F: 2 x 19.00 g = 38.00 g
78.07 g

Number of Molecular Units are:

$\frac{\text{molecular mass}}{\text{empirical mass}} = \frac{312.28\ g}{78.07\ g} = 4$

Therefore the molecular formula is: 4 x ($C_3H_4F_2$) = $C_{12}H_{16}F_8$