Notes and WS 4.2! *Name:*_____ *p.*____

(The "Chapter 4" worksheets cover material from chapters 4 and 5 of your textbook.)

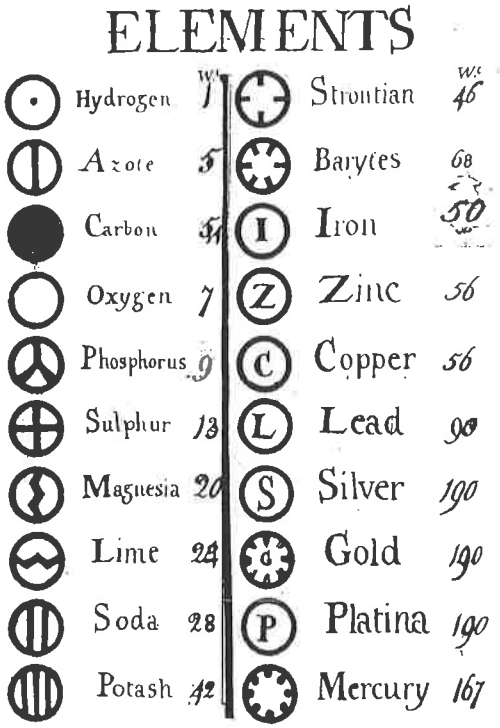
John Dalton (Manchester, England, early 1800s; He published most of these ideas between 1804 and 1808)

1. Dalton proposed that all matter consists of tiny particles called _____.
(from the Greek "atomos", meaning "indivisible.)

He was the first known person to use experimental evidence to argue for the existence of atoms.

Evidence included percent composition data, and the Law of Multiple Proportions.
Dalton suggested that the law of multiple proportions is evidence that matter consists of atoms, and that these atoms combine in small, whole number ratios.

He published the first table of atomic masses (shown to the right):



2a. Dalton's atomic model is often referred to as the _____ model, and his atom is often described as a "hard, inpenetrable sphere."

b. Draw a picture of a "Dalton atom."

c. Examine the proposed atomic masses in the above chart.
Dalton had no idea what the mass of one atom was (in fact, scientists didn't have good info for this until the early 1900s!). So when he said that gold's mass was 190, what did he mean by that?

d. Dalton listed iron's mass as _____. What did he mean by that?

3. Example with the "Law of Multiple Proportions."

	"Nitrous oxide" "Laughing Gas"	"Nitric oxide" "nitrous air"	"nitrogen oxide"
Old Name(s) "Proper" name:	dinitrogen monoxide	nitrogen monoxide	nitrogen dioxide
Formula:	N_2O	_____	_____
Masses:	28 grams N per 16 g O	_____	_____
Ratio: mass Nitrogen / mass oxygen	_____	_____	_____

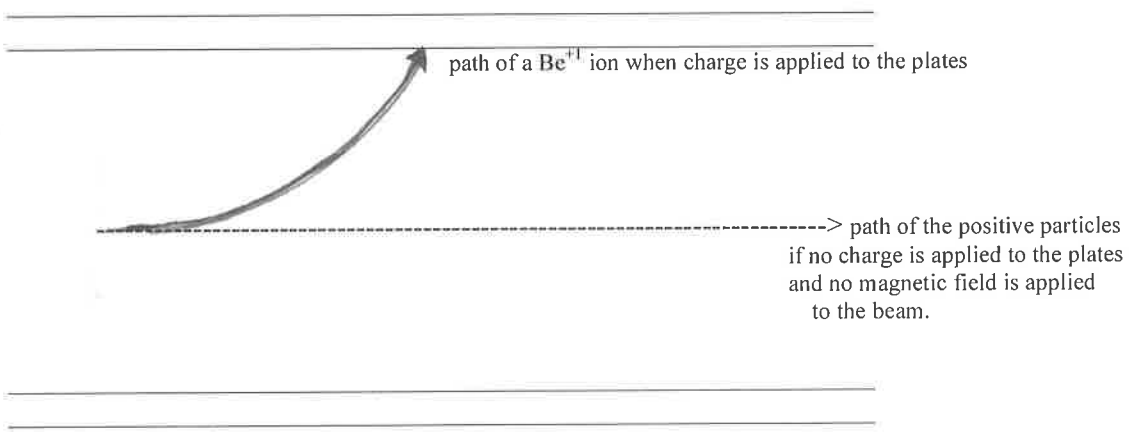
Ratio of ratios: _____ to _____ to _____

JJ Thomson, Cambridge, ≈ 1900
(Thomson was awarded the 1906 Nobel Prize in Physics)

1. a. Draw a Cathode Ray Tube:

b. Show the beam of cathode rays when it is not being deflected by charged plates or by a magnetic field.
c. Show the beam if a positive plate is place on top of the cathode ray tube, and a negative plate is placed underneath.
d. Thomson proposed that cathode rays consist of tiny particles called _____.
e. What is the charge on these particles?_____
f. How does he know this?_____

2. Thomson also studied beams of **positive ions** called "canal rays." Consider the picture/setup below.



a. Based on the path of the Beryllium (Be^{+1}) ion as it is deflected, which plate is positively charged, and which is negatively charged? Label each plate with a few + or – symbols.

b. If the beryllium rays were replaced by H^{+1}, C^{+1}, Li^{+1}, or O^{+1}, and the plates were still charged, show the path of each of these ions in the picture above.

c. Explain how you figured out the trajectories of the various ions – what concept did you use?

d. Based on his experiments with cathode rays and canal rays, and by comparing the trajectories of each type of ray, Thomson concluded that the electron is nearly 2000 times *more* *less* massive than the rest of the atom.

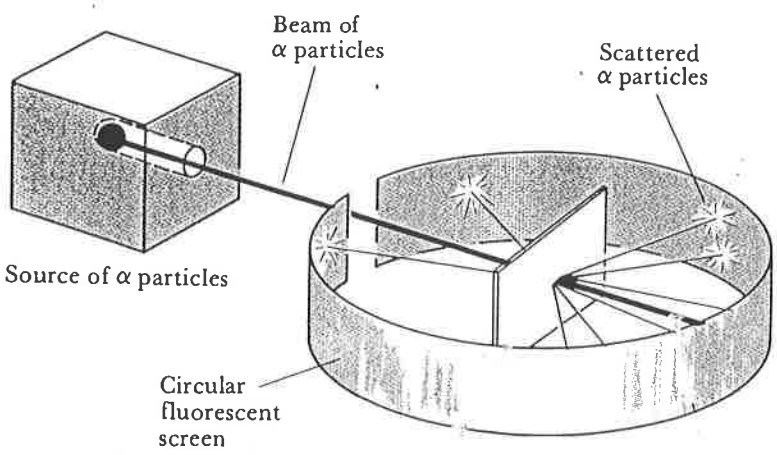
e. Thomson's atomic model is often called the "plum pudding" model.
Draw a picture showing an atom according to his model, and label the parts.

Ernest Rutherford, 1911

(Rutherford was originally from New Zealand. He worked at the Cavendish in Cambridge (under JJ Thomson), at McGill University in Canada, and at the University of Manchester. He became the director of the Cavendish lab in 1919. He was awarded the 1908 Nobel Prize in Chemistry)

Rutherford's Gold Foil Experiment

(much of the work on this expt was performed by Hans Geiger and Ernest Marsden in 1909 at McGill)



Experiment: Rutherford shot positive particles called alpha particles at a thin sheet of gold foil. The foil was surrounded by a screen coated in zinc sulfide, a material which glows when hit by high energy particles, such as the alphas.

Results: _____

_____

_____

Conclusion: _____

Logic behind his conclusion: _____

_____

_____

_____

Draw a picture of the atom according to Rutherford's model:

Review!

1. a. Which subatomic particle did JJ Thomson discover?_____

b. What is the charge on this particle?_____

c. This particle accounts for _____ the mass of the atom.

a. about half of b. nearly all of c. a tiny fraction of

d. What piece of equipment did he use in his experiments?_____

e. Thomson knew the charge of his particle because it was attracted to the _____ charged plate.

2a. What did John Dalton discover/propose:_____

b. Dalton's main evidence for his discovery was the Law of _____.

3. a. What about the atom did Ernest Rutherford discover?_____

b. What is the charge on this particle?_____

c. This particle accounts for _____ the mass of the atom.

a. about half of b. nearly all of c. a tiny fraction of

c. This particle accounts for _____ the volume of the atom.

a. about half of b. nearly all of c. a tiny fraction of

d. What was the name of his experiment?_____

e. How did Rutherford determine the charge of his particle/what was his logic?

_____

_____

6. In general, opposite charges will be attracted to each other (there will be an "attractive force" between the two particles), and if two particles have the same charge, there will be a "repulsive force" between the two particles.

a. Is the force between an atom's electrons and its nucleus attractive, or repulsive? (which one?) _____
Explain why.

b. Is the force between a given electron and the other electrons in the atom attractive, or repulsive? _____
Explain why.

c. If an electron is pulled further away from its atom's nucleus, it must gain/absorb potential energy.
Explain why.

Niels Bohr, 1913

(Bohr was awarded the 1922 Nobel Prize in Physics. He worked at Cambridge, Manchester, Copenhagen...)

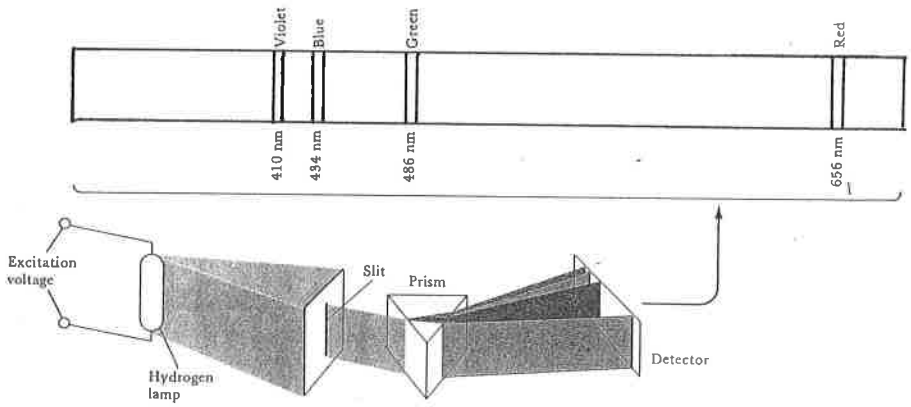
1. Calculate the energy of the first two photons. (Show work.)

a. $\lambda = 656$ nm E = _____

b. $\lambda = 486$ nm E = _____

c. $\lambda = 434$ nm E = 4.58×10^{-19} J

d. $\lambda = 410.$ nm E = $4.85\ 10^{-19}$ J



2. a) Draw a picture of Bohr's atomic model and explain how the n-levels are related to the energy of an electron.
b) What the electrons are doing when the atom produces light?
c) How do the light spectra of elements provide evidence for quantized energy levels(n-levels) in the atom? Explain the logic.
Vocab to include: Photon, quantum, ground state, excited state, potential energy, absorb, emit

3. Determine whether an atom will **absorb** or **emit** energy if the following changes occur.

a. an electron jumps from n = 2 to n = 4_____

b. an electron jumps from n = 5 to n = 4_____

c. an electron jumps from n = 6 to n = 3_____

d. if an electron jumps from n =1 to any other n-level_____

e. If an electron in a sodium atom starts out at n=3 and then leaves the atom (because the sodium atom became a sodium ion (Na^{+1}) by losing an electron)_____

4. Why does the electron generally have lower potential energy when it is at a lower n-level?

5a. Niels Bohr determined that the n=1 level can hold up to 2 electrons, n=2 can hold up to 8 electrons, n=3 can hold up to 18 electrons, and n=4 can hold up to 32 electrons. Determine which n-level the electrons are in for the following atoms. Assume that the electrons are in the "ground state." Then determine how many valence electrons each atom has. The valence electrons are the electrons that are in the outermost shell (n-level) of the atom.

Atom	Total # of e-	n = 1	n = 2	n = 3	n = 4	# of valence electrons
Li						
As						
Mg						
F						
Ne						
Kr						
C						
Na						
N						
Al						
Cl						

b. Which elements in the above chart have 8 valence electrons?_____

Where are these elements found on the periodic table? (Which column or row?)_____

c. Which elements in the above chart have 1 valence electron?_____

Where are these elements found on the periodic table? (Which column or row?)_____

d. Which elements in the above chart have 7 valence electrons?_____

Where are these elements found on the periodic table? (Which column or row?)_____