Name _____ Date _____ Period _____

Need to know Chapter 2.1 Atoms and Their Structure

Early Models of the Atom

Greek philosophers thought that four elements formed all matter: Earth, water, fire and air. Furthermore, Democritus of Abeda: (4^{th} century B.C.) proposed that the world is ultimately made up of two things: empty space and indivisible particles (atoms).
Aristotle believed that matter was continuous and not made out of smaller particles.

Problem with either idea *(experiments)*_____

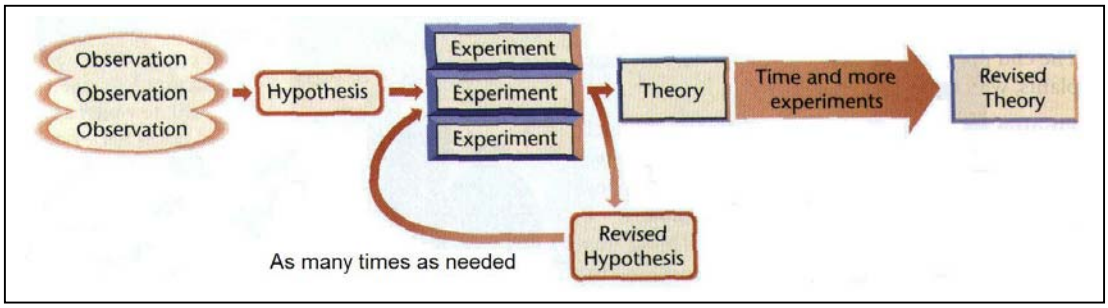
_____

Dalton's Atomic Theory

1. All elements are composed of indivisible particles called atoms
2. Atoms of the same element are identical. Atoms of any one element are different from those of any other element.
3. Atoms of different elements can physically mix together or can chemically combine in simple whole-number ratios to form compounds.
4. Chemical reactions occur when atoms are rearranged, but atoms of one element are never be changed into atoms of another element as a result of a chemical reaction.

Atoms are tiny!!!!!! 100 000 000 copper atoms (1×10^8) placed side by side form a line only 1 cm long

Scientific Method



Fill in the blanks, choosing from the following:

Experiment Hypothesis Observation Scientific method Theory Scientific law

_____ A logical approach to the solution of scientific problems

_____ To use your senses to obtain information,

_____ A proposed reason or explanation for what is observed… an educated guess.

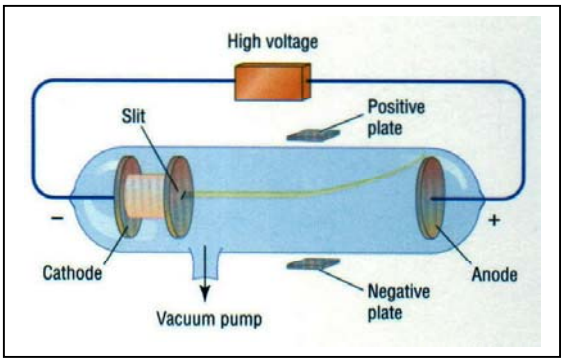
_____ A means of testing a hypothesis (knowledge and experience are often necessary to design good experiments)

_____ A thoroughly tested explanation of why numerous experiments give certain results. It depends on existing knowledge and technology. Improved experiments may have different results, which leads to revisions. For example the atomic theory

_____ A fact of nature that is observed so often that it is accepted as the truth (often a mathematical formula). Ex. Charles Law or law of conservation of matter

Structure Of The Atom

Modern atomic theory differs from Dalton's atomic theory due to the discovery of subatomic particles and isotopes.



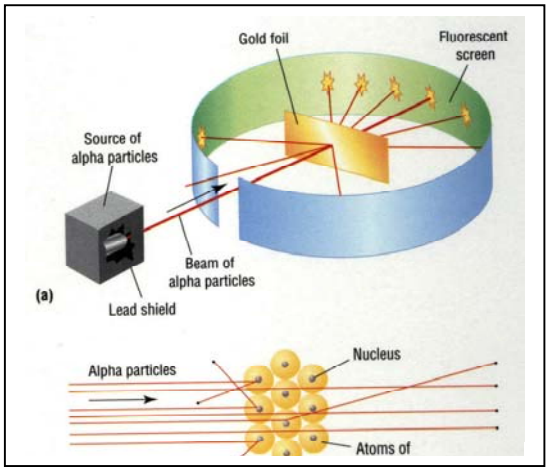
The English physicist J.J. Thompson discovered electrons in 1897. He used a cathode-ray tube (a TV tube is somewhat similar) Thompson found that Cathode rays are attracted to metal plates with a positive charge and repelled by a metal plate that carry a negative charge.
Since he knew that opposite charges attract and like charges repel, he proposed that cathode rays are a stream of tiny negatively charged particles moving at high speed.
He also showed that the production of the cathode rays is independent of the gas in the tube or the metal of electrodes
He called these particles electrons.
The American scientist Robert A. Millikan found the quantity of charge in an electron and that the mass of an electron is only 1/1840 of the mass of that of a proton (about 2000 times smaller).

Since atoms are electrically neutral, there must be particles inside the atoms with a positive charge …
Protons were later discovered as particles that carry a positive charge.
Neutrons were discovered last as subatomic particles with no charge.

Properties of Subatomic Particles

Particle	Symbol	Relative charge	Relative mass	Actual mass (g)
Electron	e^-	1-	1/1840	9.11×10^{-28}
Proton	p^+	1+	1	1.67×10^{-24}
Neutron	n^0	0	1	1.67×10^{-24}

Rutherford suggested that the atoms are mostly empty space and almost all mass is concentrated in the center, the nucleus. (textbook p. 63-65)
Describe the gold foil experiments with your own words:

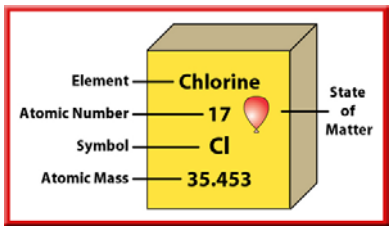


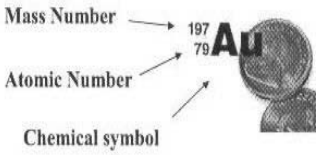
Atomic number of an element is the number of protons in the nucleus of that element.
Since atoms are electrically neutral, the number of electrons in an atom is equal to the number of protons in an atoms and thus equal to its atomic number.

Mass number of an atom is equal to the number of protons plus the number of neutrons in the nucleus of the atom.
You find the number of neutrons in an atom by subtracting the atomic number from the mass number.

Remember:

Atomic number	**# of protons**
Number of protons	**# of electrons**
Mass number	**# of protons plus # of neutrons**
Mass number minus atomic number	**# of neutrons**





Isotopes: Atoms with the same number of protons (same element) but different numbers of neutrons

The atomic mass unit (u) is defined as 1/12of the mass of one Cabon –12 isotope.

The **atomic mass** or average atomic mass of an element is a weighted average mass of the atoms in a naturally occurring sample of the element.

Complete the tables

Particle	Symbol	Relative charge	Relative mass	Actual mass (g)
Electron				9.11×10^{-28}
Proton				1.67×10^{-24}
Neutron				1.67×10^{-24}

Name	Symbol	Atomic #	Mass #	Protons	Neutrons	Electrons
Hydrogen	H	1	1			
Helium	He	2	4			
Lithium	Li	3	7			
Beryllium	Be	4	9			
Boron	B	5	11			
Carbon		6	12			
Bromine	Br			35	45	
Oxygen					8	8
Chlorine		17			18	

Atomic #	Mass #	# of protons	# of electrons	# of neutrons	Atom
					$^{195}_{78}\mathbf{Pt}$

Which shorthand notion is correct?
Why?

$^{14}_{7}\mathbf{N}$ $^{7}_{14}\mathbf{N}$

Another shorthand for isotopes is the "name of the element"-massnumber e.g. nitrogen-14 or carbon-12

Calculate the u for the isotopes

chlorine-37

potassium-39

lithium-7

calcium-40