Atomic Theory - Review Sheet

You should understand the contribution of each scientist. I don't expect you to memorize dates, but I do want to know what each scientist contributed to the theory.

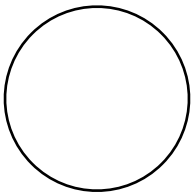
Democretus - 400 B.C.
- theory that matter is made of atoms

Boyle 1622 -1691
- defined element

Lavoisier 1743-1797
- pioneer of modern chemistry (careful and controlled experiments)
- conservation of mass (understand his experiment and compare to the lab "Does mass change in a chemical reaction?")

Proust 1799
- law of constant composition (or definite proportions)
- understand this law and relate it to the Hydrogen and Oxygen generation lab

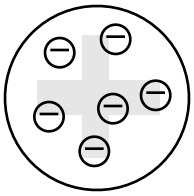
Dalton 1808
- Understand the meaning of each part of Dalton's atomic theory.
- You don't have to memorize the five parts, just understand what they mean.
- You should know which parts we now know are not true (according to modern atomic theory).



Black Box Model

Crookes 1870
- Crookes tube
- Know how this is constructed (Know how cathode rays are generated and what they are.)

J.J. Thomsen - 1890
- How did he expand on Crookes' experiment?
- discovered the electron
- negative particles in all of matter (all atoms)
- must also be positive parts



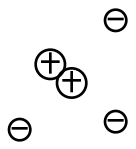
Plum Pudding Model

Lord Kelvin - near Thomsen's time
- plum pudding model

Henri Becquerel - 1896
- discovered radioactivity of uranium

Marie Curie - 1905
- received Nobel prize (shared with her husband Pierre Curie and Henri Bequerel) for her work in studying radiation.
- Name the three kinds of radiation and describe each type.

Rutheford - 1910
- Understand the gold foil experiment
  - How was it set up?
  - What did it show?
- Discovered the proton
- new model of atom (positively charged, very dense nucleus)



Hard Nucleus Model

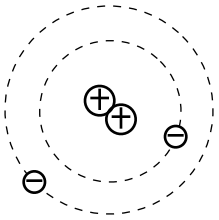
Niels Bohr - 1913
- Bohr model of the atom
- electrons in specific orbits with specific energies

James Chadwick - 1932
- discovered the electron

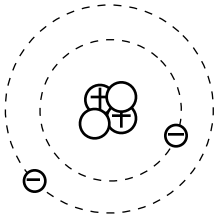
Modern version of atom - 1950
- similar nucleus (protons + neutrons)
- electrons in orbitals not orbits

Understand isotopes, atomic mass, mass #, atomic #, ions

Nature of light
- wavelength vs. frequency - how are they related?
- how is energy related to the above properties?
- How is electromagnetic radiation produced?
- What is emission spectroscopy and how does this help us to identify elements?



Bohr Model



Bohr Model
(with neutrons)

Modern Atom

Additional Practice Questions:

1) Draw a timeline for yourself showing the models of the atom, who did the definitive experiment to give us each new model, and what did that scientist discover to change our view of the atom?
2) What is the difference between the Law of Conservation of Mass and the Law of Constant Composition (or Definite Proportions)?
3) If you measure all the substances used in a reaction before and after the reaction, why should the mass stay the same?
4) Draw an example of an atom, and label all its parts. Separately list all the subatomic particles with their charge.
5) Which subatomic particle has almost no mass?
6) Describe cathode rays and explain why J.J. Thomson thought they were negatively charged.
7) What are the three types of nuclear radiation?
8) What is the difference between alpha particles and cathode rays? Which one was used in Rutheford's Goild Foil experiment?
9) Why did Rutheford's Gold Foil test results show a small, dense, positively charged nucleus?
10) Explain in your own words what an orbital is.
11) Explain how light is produced. Pretend you are talking to someone who doesn't know anything about atoms or electrons or energy. You need to start from scratch.
12)Name at least two ways you can excite and electron.
13) What is the difference between where nuclear radiation comes from and how electromagnetic radiation is generated?
14)Fill in the tables below:

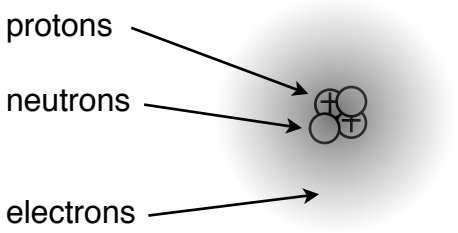
Isotope	Protons	Neutrons
$^{33}_{16}S$		
$^{238}_{92}U$		
$^{14}_{6}C$		

Atom	Protons	Electrons
F		
P^{+3}		
S^{-2}		

15) Which of the above atoms listed are ions?

Answers to numbered questions:

1) Democretus through Dalton we have the “Black Box Model”. It’s just and idea that a smallest piece of matter should exist. Then J.J. Thomsen discovered the electron, so we now have the “Plum Puddind Model”. The Rutherford discovered the proton and we switched to the “Hard Nucleus Model”. Then Bohr saw that excited electrons only give off energy at specific wavelengths/frequencies/energies so he determined that electrons orbit the nucleus at fix distances, giving us the “Bohr Model” of the atom. Then Chadwick discovered the neutron and this was added into the “Bohr Model (with neutrons)”. Eventually, through many other scientists and experiments we discovered that electrons don’t orbit the nucleus, but exist in regions of high probability called orbitals, thus giving us the “Modern Atom”.
2) The Law of Conservation of Mass states that no matter is created or destroyed during a chemical reaction, so if you keep track of everything in the reaction the mass won’t change from the beginning to the end of the experiment. The Law of Constant Composition (or Definite Proportions), states that the ratio of the masses of elements in a compound is constant. In other words, if you have a compound made from elements in a 2:1 ratio, then this ratio will stay fixed no matter where you find this compound or how you try to make it.
3) The mass should stay the same because atoms don’t change into other atoms during chemical reactions, they just rearrange how they are bonded. Because they are the same atoms from the beginning to the end the mass should stay the same.
4)



- protons are positive
- neutrons are neutral
- electrons are negative

5) The electron.
6) Cathode rays are actually beams of negatively charged electrons. Thomsen though they were negatively charged because they were attracted to a positively charged plate and repelled by a negatively charged one. Opposites attract, so the cathode rays/electrons must be negative.
7) **α - alpha** - positively charged particles that don’t penetrate very well and have the mass similar to a helium atom

   β - beta - negatively charged particles (actually electrons) that are ejected with very high velocity, can penetrate materials somewhat, have a very low mass

   ɣ - gamma - not a particle, a type of electromagnetic radiation, very high energy, can penetrate deeply into substances.
8) Alpha particles were positive and had a mass that was 8,000 times that of an electron. Cathode rays are actually beams of electrons, which are negatively charged and have almost no mass. Alpha particles were used by Rutherford.
9) He shot alpha particles toward a piece of gold foil. 1 in 20,000 alpha particles were deflected backward, so he assumed he was hitting something inside the gold atoms. He called this thing he was hitting the nucleus. The nucleus must be small because most of the time the alpha particles went straight through. It must be dense because something that small had enough mass to deflect the alpha particles, and it must be positive because the alpha particles were repelled by the nucleus and two positively charged things will repel from each other.
10) An orbital is a 3D region in space around and atom where you are likely to find an electron.
11) Light is produced when electrons lose energy. So, first you excite and electron causing it to absorb energy. When the electron goes back to its original lower energy state the energy it loses is shot out as a photon of electromagnetic radiation. The more energy the electron loses in one jump to a lower energy level, the higher the energy will be for the electromagnetic photon that is shot out from the atom.

12) You can excite an electron with electromagnetic radiation, with heat, and with other electrons in the form of cathode rays (produced by high voltage electricity).

13) Nuclear radiation is produced from the nucleus of the atom and electromagnetic radiation is produced from the electrons around the atom. All nuclear radiation is dangerous because the energy of nuclear radiation is high. Depending on how much energy the electron lost, some electromagnetic radiation is dangerous (ie x-rays which have high energy) and some is not (ie radio wave with low energy).

14)

Isotope	Protons	Neutrons
$^{33}_{16}S$	16	17
$^{238}_{92}U$	92	146
$^{14}_{6}C$	6	7

Atom	Protons	Electrons
F	9	9
P^{+3}	15	12
S^{-2}	16	18

15) P^{+3} and S^{-2} are ions because they are charged (not neutral)