Chapter 20: Introduction to Atoms

Section 1: Development of the Atomic Theory

Democritus: Greek philosopher 440 B.C.
Said all matter was made of small, indivisible particles
He named them **atoms** from the greek word atomos meaning "uncuttable"

John Dalton: 1700's English scientist
Devised the **Atomic Theory**

1. All substances are made of atoms. Atoms cannot be created, divided, or destroyed.
2. Atoms of the same element are exactly alike, and atoms of different elements are different.
3. Atoms join with other atoms to make new substances.

Much of Dalton's atomic theory is still accepted. However, new discoveries since have led to modifications. Over time, Dalton's work evolved into the **Modern Atomic Theory.**

JJ. Thomson – 1897
Believed there were particles inside atoms (that atoms are divisible)
Used cathode ray tube experiments to show that a positively charged plate attracted a beam of electrical energy. Concluded that the negatively charged particles were present in atoms. Termed these particles **electrons.** Suggested a model of an atom called the **Plum Pudding Model** where atoms contained negatively charged electrons embedded in a positive sphere.

Ernest Rutherford – a former student of Thomson's 1909
Tested Rutherford's plum pudding model by shooting a beam of positive charge at a thin sheet of gold foil. If Thomson's model was correct, then the positive particles should pass right through. **Rutherford's Gold Foil Experiment** showed that while most positive particles went right through, some were deflected at sharp angles. Rutherford proposed a new model of the atom, with electrons circling a dense positive region called the **nucleus**. From his results, Rutherford calculated that the diameter of the nucleus was 100,000x smaller than the diameter of the atom.

Niels Bohr – worked with Rutherford in 1913
Studied how electrons react to light. Proposed that electrons move in paths around the nucleus. Called those paths **energy levels**. Bohr's model of the atom is also known as the **planetary model** which showed electrons in energy levels around the nucleus. Also proposed that electrons "jump" between energy levels but cannot exist between them.

James Chadwick – 1935
Determined that the nucleus contains electrically neutral particles called **neutrons**

Schrödinger and Heisenberg – further developed the Modern Atomic Theory by showing that electrons do not travel in definite paths, but in regions called electron clouds. Called these areas **regions of probability.**

Section 2: The Atom

Parts of an atom: **protons, neutrons, electrons**.
The diameter of the nucleus is 1/100,000 the diameter of the atom!

Particle Name	Symbol	Location	Charge	Mass (amu)
Proton	p^+	Nucleus	+	1
Neutron	n^0	Nucleus	Neutral	1
Electrons	e^-	Around nucleus	-	negligible

amu = atomic mass unit (because the masses of particles in atoms are so small, scientists made a new unit for them.

1 amu = 1.7×10^{-24} g

The charges of p^+ and e^- are opposite but equal; n^0 have no charge.
Atoms are **neutra**l ($p^+ = e^-$)
If you alter the # of p^+ in an atom, the **identify** of the element changes
If you alter the # e^- in an atom, the atom becomes an **ion**
Ions are charged ($p^+ \neq e^-$)
+ ions have lost e^-
- ions have gained e^-
If you alter the # n^0 in an atom, you create an **isotope.**
Isotopes of the same element have different masses.

Isotopes
Each element has a limited # of isotopes found in nature.
Some isotopes are unstable. These are radioactive because they will spontaneously fall apart and give off energy over time.
Isotopes have different masses.
To name an isotope, write the name followed by a hyphen and the mass #
Ex. Hydrogen-1 or Hydrogen-2

Atomic Mass = weighted average of all naturally occurring isotopes of that element.

Energy Levels
e^- exist in distinct energy levels around the nucleus.

Each energy level can hold a specific # of e^-
The first energy level can hold 2 e^-
Each successive energy level after that can hold 8 e^-
After 8 e^- have filled the energy level, the e^- start filling the next level.
The e^- in the outermost energy level are called **valence electrons**

Be able to draw **Bohr Diagrams** (for neutral atoms, isotopes, and ions) and **Lewis Structures** (neutral atoms only) for your assessment on this information.