HOLT MODERN CHEMISTRY -- CHAPTER 3 REVIEW

***The following pages contain the bulk (but not all) of the information for the chapter 3 test.
Focus on this content, but make sure to review class notes, activities, handouts, questions, etc.
If you study this document and NOTHING else, you should at least be able to PASS the test.
***** Test items will be <u>recall</u>, <u>examples</u>, and/or <u>application</u> of this content. ********

OUTCOMES
- 3.1: Explain law of conservation of mass *(T & R)*
- 3.1-3.2: Explain how the atom changed over time (Rutherford - Bohr models) *(F & PK)*
- 3.3: Contrast the nature and properties of the three subatomic particles: proton, neutron, and electron *(T & R)*
- 3.3: Use atomic number and mass number to find the number of subatomic particles of any given atom *(F & PK)*
- 3.3: Draw contrasting Bohr models of isotopes *(F & PK)*
- 3.3: Define mole and Avogadro's number *(T & R)*

3.1 THE ATOM: FROM PHILOSOPHICAL IDEA TO SCIENTIFIC THEORY
- *Vocabulary*
  - **law of conservation of mass** -- the law that states that mass cannot be created or destroyed in ordinary chemical and physical changes
  - **law of definite proportions** -- the law that states that a chemical compound always contains the same elements in exactly the same proportions by weight or mass
  - **law of multiple proportions** -- the law that states that when two elements combine to form two or more compounds, the mass of one element that combines with a given mass of the other is in the ratio of small whole numbers
- *Chapter Highlights*
  - The idea of atoms has been around since the time of the ancient Greeks. In the nineteenth century, John Dalton proposed a scientific theory of atoms that can still be used to explain properties of most chemicals today.
  - Matter and its mass cannot be created or destroyed in chemical reactions.
  - The mass ratios of the elements that make up a given compound are always the same, regardless of how much of the compound there is or how it was formed.
  - If two or more different compounds are composed of the same two elements, then the ratio of the masses of the second element combined with a certain mass of the first element can be expressed as a ratio of small whole numbers.

3.2 THE STRUCTURE OF THE ATOM
- *Vocabulary*
  - **atom** -- the smallest unit of an element that maintains the chemical properties of that element
  - **nuclear forces** -- the interaction that binds protons and neutrons, protons and protons, and neutrons and neutrons together in a nucleus
- *Chapter Highlights*
  - Cathode-ray tubes supplied evidence of the existence of electrons, which are negatively charged subatomic particles that have relatively little mass.
  - Rutherford found evidence for the existence of the atomic nucleus by bombarding gold foil with a beam of positively charged particles.
  - Atomic nuclei are composed of protons, which have an electric charge of +1, and (in all but one case) neutrons, which have no electric charge.
  - Atomic nuclei have radii of about 0.001 pm (pm = picometers; 1 pm × 10^{-12} m), and atoms have radii of about 40^{-270} pm.

3.3 COUNTING ATOMS

- *Vocabulary*
  - **atomic number** -- the number of protons in the nucleus of an atom; the atomic number is the same for all atoms of an element
  - **isotope** -- an atom that has the same number of protons (or the same atomic number) as other atoms of the same element do but that has a different number of neutrons (and thus a different atomic mass)
  - **mass number** -- the sum of the numbers of protons and neutrons that make up the nucleus of an atom
  - **nuclide** -- an atom that is identified by the number of protons and neutrons in its nucleus
  - **atomic mass unit** -- a unit of mass that describes the mass of an atom or molecule; it is exactly 1/12 of the mass of a carbon atom with mass number 12 (abbreviation, amu)
  - **average atomic mass** -- the weighted average of the masses of all naturally occurring isotopes of an element
  - **mole** -- the SI base unit used to measure the amount of a substance whose number of particles is the same as the number of atoms of carbon in exactly 12 g of carbon-12
  - **Avogadro's number** -- 6.022×10^{23}, the number of atoms or molecules in 1 mol
  - **molar mass** -- the mass in grams of 1 mol of a substance
- *Chapter Highlights*
  - The atomic number of an element is equal to the number of protons of an atom of that element.
  - The mass number is equal to the total number of protons and neutrons that make up the nucleus of an atom of that element.
  - The relative atomic mass unit (amu) is based on the carbon-12 atom and is a convenient unit for measuring the mass of atoms. It equals 1.660540×10^{-24} g.
  - The average atomic mass of an element is found by calculating the weighted average of the atomic masses of the naturally occurring isotopes of the element.
  - Avogadro's number is equal to approximately 6.022×10^{23}. A sample that contains a number of particles equal to Avogadro's number contains a mole of those particles.
  - Isotopes of the same element have the same number of protons but a different number of neutrons. The images below correctly illustrate the Bohr models for Aluminum-25, Aluminum-27, and Aluminum-30.

Aluminum-25	Aluminum-27	Aluminum-30
13 p+ 12 n0	13 p+ 14 n0	13 p+ 17 n0
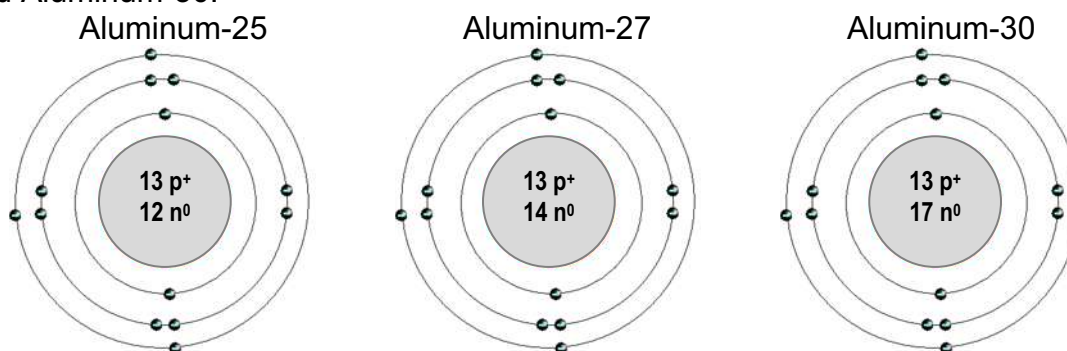
****** Notice that these images are exactly the same **except** for the number of **neutrons** in the nucleus. ******