



Lesson 1: Grade 10 Review (Done in the first day of class)

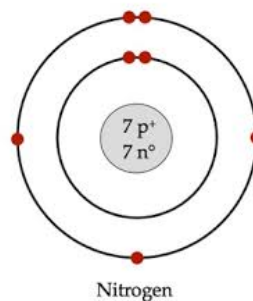
- Classification of matters
- Physical and chemical changes
- History of atomic model
- Atomic notation
- Brief introduction of Periodic table

Lesson 2: Ions, Octet rule, and Isotope Abundance

Bohr diagram

- Diagram showing arrangement of subatomic particles in an atom.
- Electron arrangement for first 20 elements is 2, 8, 8, 2.
- Row # = number of **orbitals** (energy levels)
- Period # number of **valence electrons***.
- Valence electrons: are the electrons in the outer shell of an atom. They determine how reactive an atom will be.
- The number of VE will help predict the following:
 - the number of unpaired electrons, so that number of bonds an atom will form
 - possible charges according to octet rule*
 - an atom's formal charge

	1A	2A	3A	4A	5A	6A	7A	8A
1	H 1 							He 2
2	Li 3 	Be 4 	B 5 	C 6 	N 7 	O 8 	F 9 	Ne 10



Nitrogen



Practice: Draw Bohr-Rutherford Diagrams for the following:

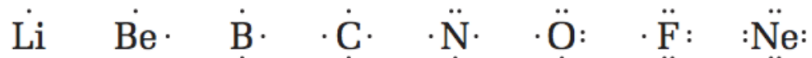
- a) magnesium atom
- b) the noble gas in the 3rd row
- c) sodium ion
- d) fluorine ion

Octet Rule

- A full valence shell contains 8 electrons. When this occurs, the atom is considered to be stable, also known as “stable octet” or “full octet”

Lewis diagram of element

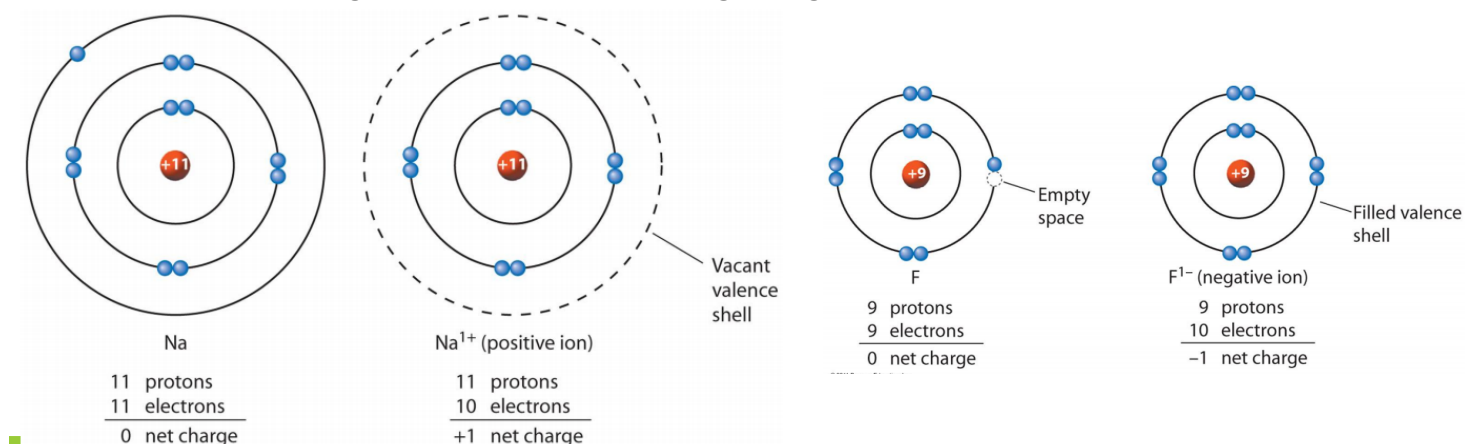
- Lewis diagram is a much simpler model to represent elements and the valence electrons.
- To draw a Lewis structures, you replace the nucleus and inner energy levels of an atom with its atomic symbol. Then you place dots around the atomic symbol to represent the valence electrons.





The formation of ions

- Atoms will gain or lose electrons in order to establish a stable octet. The number of valence electrons determine their level of reactivity.
- Cations: positive ions as a result of losing electrons to have a stable octet
- Anions: negative ions as a result of gaining electrons to have a stable octet.



- The human body required a balance of various ions to ensure its proper functioning.

The Most Common and Important Elements in the Body (listed in order)

Element	Atomic Symbol	Functions in Life
Oxygen	O	Part of water and most organic molecules. Also molecular oxygen.
Carbon	C	The backbone of all organic molecules.
Hydrogen	H	Part of all organic molecules and of water.
Nitrogen	N	Component of proteins and nucleic acids.
Calcium	Ca	Constituent of bone. Also essential for the action of nerves and muscles.
Phosphorus	P	Part of cell membranes & of energy storage molecules. Also a constituent of bone.
Potassium	K	Important in nerve action.
Sulfur	S	Structural component of most proteins.
Sodium	Na	The primary ion in body fluids. Also important for nerve actions.
Chlorine	Cl	Component of digestive acid. Also a major ion in body fluids.
Magnesium	Mg	Important for the action of certain enzymes and for muscle contraction.
Iron	Fe	A constituent of hemoglobin, the oxygen-carrying molecule.



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1.3 Questions

1. Draw a Bohr–Rutherford diagram for each of the following ions. Represent the ions correctly with square brackets and charge. **T/I C**
(a) K^+ (b) F^- (c) N^{3-} (d) Mg^{2+}
2. For each of the ions in Question 1, name the noble gas with the same electron arrangement. **T/I**
3. State the octet rule. **K/U**
4. Write the IUPAC name for each of the following ions: **K/U**
(a) O^{2-} (d) SO_4^{2-}
(b) Cu^+ (e) OH^-
(c) Sn^{4+} (f) NH_4^+
5. Manganese atoms can form a wide variety of ions, including Mn^{2+} , Mn^{3+} and Mn^{4+} . Propose how we can communicate which ion is present in a compound. **K/U**
6. Write the formula and charge for each of the following polyatomic ions. **K/U**
(a) nitrate (c) acetate
(b) carbonate (d) permanganate
7. Calcium carbonate, $CaCO_3$, is a critical component of the shells of various aquatic species. Identify the cation and anion in calcium carbonate. **T/I**
8. Which 4 atoms or ions from the following list have the same electron arrangement? O^{2-} S^{2-} Na^+ Al^{3+} Ne F **K/U**
9. Give two experimental techniques that might help to identify the presence of metal ions. **T/I**
10. Anemia is a health condition caused by an iron deficiency. Research common symptoms of anemia and suggest foods that could be added to a diet to provide more iron. **T/I A**





Lesson 3: Isotopes and Isotope Abundance

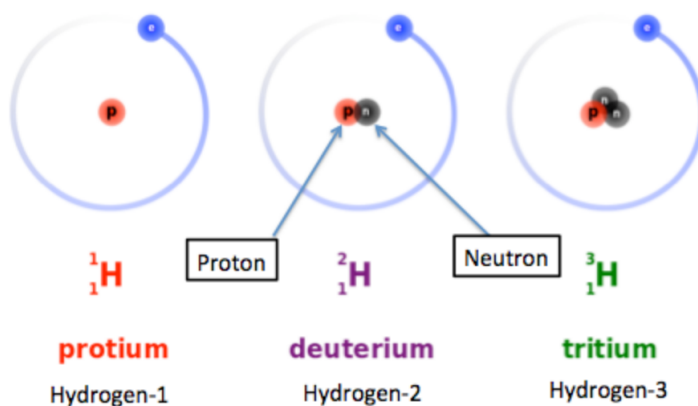
Before we start this lesson 3, you should know:

- 1) Proton, neutron, electron
- 2) Atomic notation, and the relationship between atomic mass, atomic number, number of proton, neutron and electrons.
- 3) Lewis diagrams and Bohr diagrams of elements

Isotopes:

- Isotopes are atoms of the same element that have different numbers of neutrons.
- The various isotopes of an element have almost identical chemical properties since they all have the same number of electrons and protons.

For example: Three different isotopes of hydrogen called Protium, Deuterium, and Tritium.

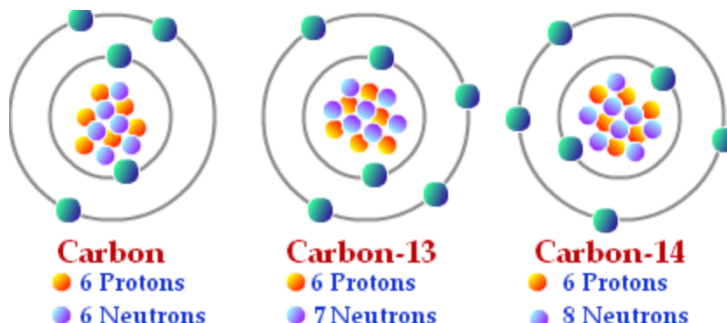


Since the isotopes of an element contain differing numbers of neutrons, the isotopes have different mass numbers (protons + neutrons)

Isotope	Proton	Neutrons	Atomic mass
Protium			
Deuterium			
Tritium			



Another example: Three different isotopes of carbon called carbon-12, carbon-13, and carbon-14



The various isotopes of the elements in nature occur in different proportions. Therefore the atomic mass on the periodic table is the weighted average of all the natural isotopes of that element.

Calculating average atomic mass

- **Atomic mass unit (AMU):** is based on the mass of an atom of carbon-12 and is defined as one twelfth (1/12) of the mass of a carbon-12 atom. Because the masses of all other atoms are compared to the mass of carbon-12, these masses are often called relative atomic masses.
- One atomic mass unit = $1.66 \times 10^{-24}g$, or $1 u = 1.66 \times 10^{-24}g$
- **Average atomic mass:** in order to determine the atomic mass of an element that has more than one naturally occurring stable isotope, each having a different value, we need to average them out in terms of isotopic abundance.
- **Isotopic abundance:** the amount of a given isotope of an element that exists in nature, expressed as a percentage of the total amount of this element.
 - Each isotope is a fraction of the mixture, and has its own isotopic abundance (expressed as a percentage of the whole)
 - The isotopic abundance is fixed so that every sample of the element in the universe has the same proportions of isotopes.



Example:

The table below provides the atomic mass of each naturally occurring isotope of copper and the percentage of each isotope in a sample of copper. What is the average atomic mass of copper?

Mass and Isotopic Abundance of Each Isotope of Copper

Isotope	Mass (u)	Isotopic Abundance (%)
copper-63	62.93	69.2
copper-65	64.93	30.8

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1.4 Questions

- There are three isotopes of hydrogen: hydrogen-1, hydrogen-2 (known as deuterium), and hydrogen-3 (known as tritium). Create a table listing the number of protons and neutrons in an atom of each of hydrogen's isotopes. [T/I](#) [C](#)
- The atomic mass of chlorine is 35.45 u. Is it possible for any single atom of chlorine to have a mass number of exactly 35.45? Explain. [K/U](#)
- Silver exists in nature as two isotopes: Ag-107 and Ag-109. If the average atomic mass of silver is 107.9 u, which isotope is more abundant? Explain your answer. [K/U](#)
- Silicon naturally exists as three isotopes (**Table 1**). Determine the atomic mass of silicon. [T/I](#)

Table 1 Percentage Abundance of Three Silicon Isotopes

Isotope	% abundance
Si-28	92.23
Si-29	4.67
Si-30	3.10

- Imagine an element, X, that has two naturally occurring isotopes. If you know the mass and the percentage abundance of one of the isotopes, how would you determine the percent abundance of the other isotope? Describe your problem-solving process. [T/I](#) [C](#)
- The atomic mass of carbon is 12.0107 u. It exists naturally as three isotopes: C-12, C-13, and C-14. Based on your understanding of isotopes and atomic mass, determine which isotope would have the greatest abundance. Explain your choice. [T/I](#) [C](#)
- Naturally occurring chlorine consists primarily of two isotopes: Cl-35 and Cl-37. Determine the number of protons, electrons, and neutrons for an atom of each isotope. [T/I](#)
- Distinguish between an isotope and a radioisotope. [K/U](#)
- Potassium naturally consists of 93.10 % K-39 and 6.90 % K-41. Calculate the atomic mass for potassium. [T/I](#)

- Research three different careers in which people handle radioisotopes (**Figure 9**). List safety precautions they take to ensure minimal exposure to radiation. [G](#) [T/I](#) [A](#)

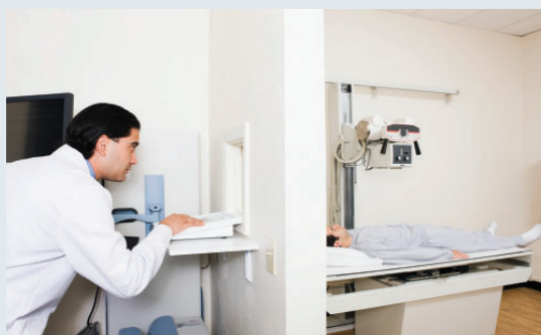


Figure 9 Many medical careers involve radioisotopes.

- In 1951, Canadian scientists developed a revolutionary new medical procedure known as the Cobalt bomb. Research this technology and compare its risks and benefits. [G](#) [T/I](#) [A](#)
- A Geiger counter is a device that is used to detect radiation from radioisotopes. Research how a Geiger counter works and list three specific circumstances in which a Geiger counter would be useful. [G](#) [T/I](#) [A](#)
- The town of Port Hope in Ontario is home to Cameco (previously named Eldorado), a major producer of uranium. In the 1940s, Eldorado supplied weapons-grade uranium to the United States. The radioactive waste from the mine was used as backfill for ravine properties in Port Hope. The town is still dealing with the radioactive contamination today. Investigate the present situation in Port Hope and what Cameco has done to help the situation. [G](#) [T/I](#) [A](#)





Radioactive element and Radioisotopes are unstable forms of elements that undergo spontaneous decay, creating different elements and releasing radioactive particles such as alpha radiation and beta radiation.

For example:

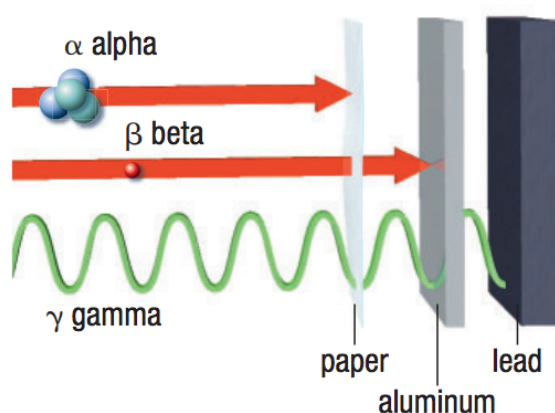
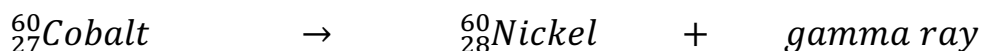
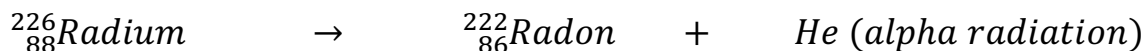
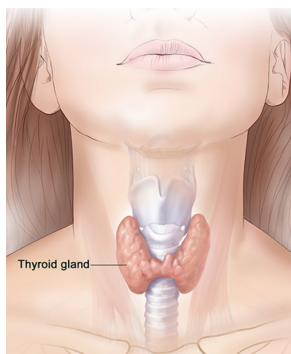


Figure 7 The three types of radiation have different penetrating abilities.

Cobalt-60 has been used in the treatment of cancer within an instrument known as Gamma knife.

Radioactive I-131 has been used to cure Thyroid cancer – intake of pill circulates in blood, pick up by thyroid cells. Then emission release energy to kill both health and cancerous cell.



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