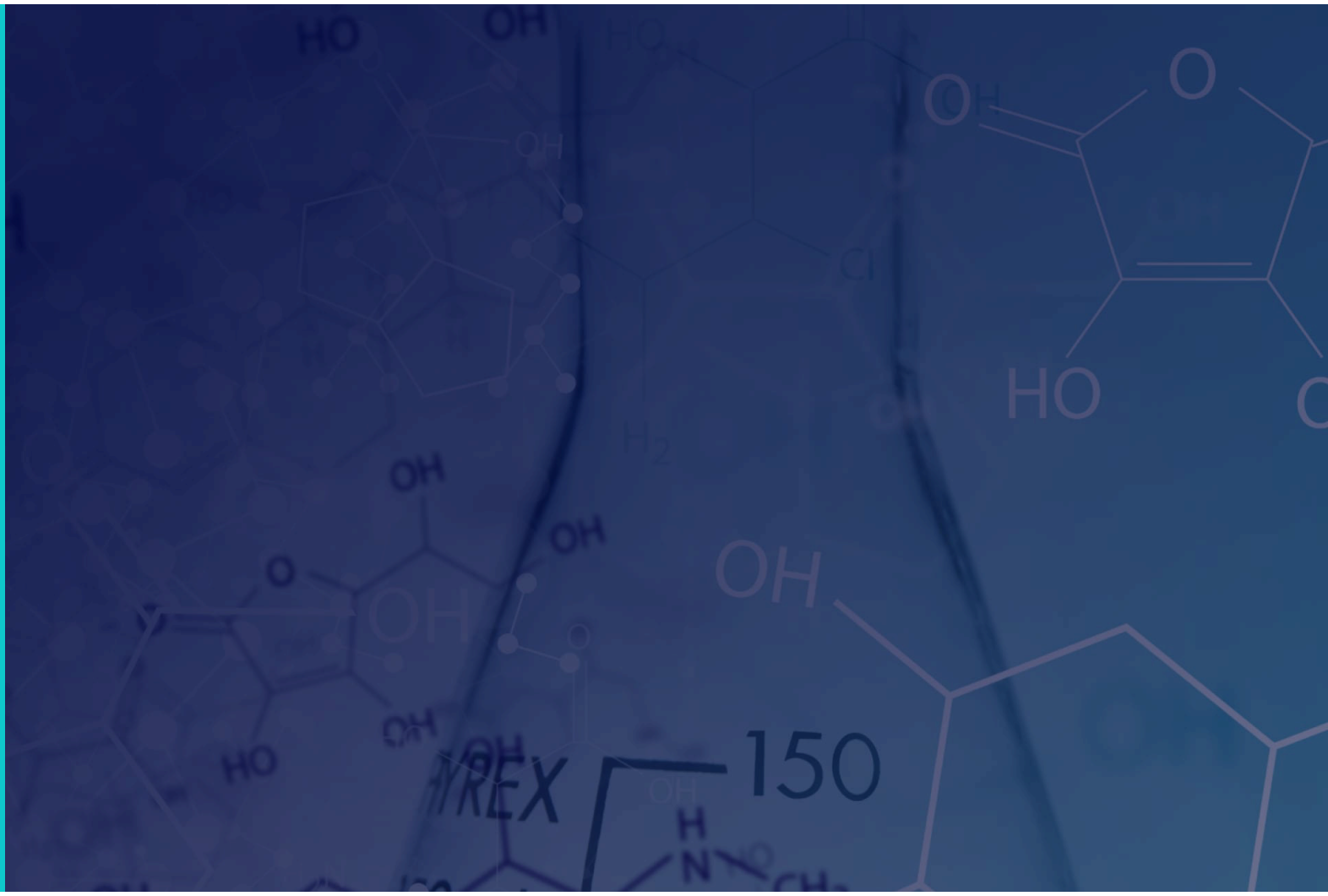

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CHM151Y

Summer 2025, Chapter 1 Notes

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1. Atoms, Ions, & Isotopes

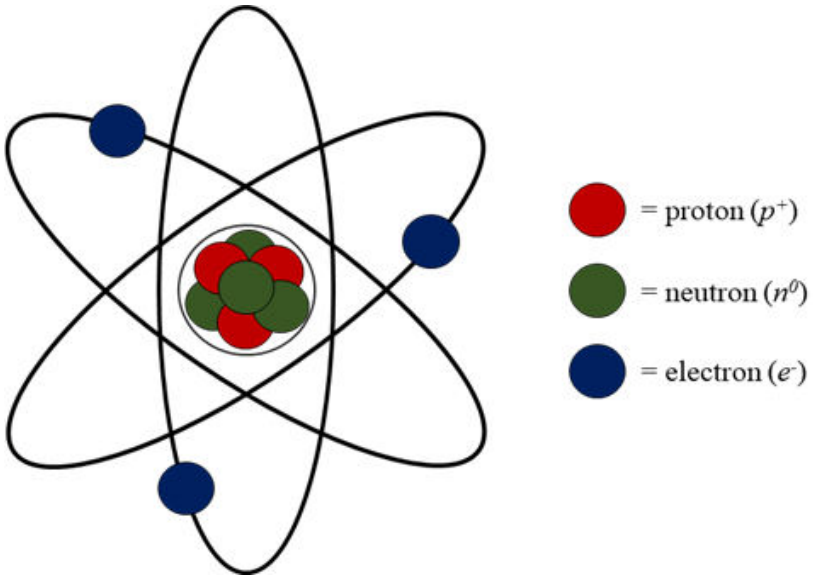
1.1 Atomic Structure

1.1.1

The Atom and its Subatomic Particles

Atoms are the building blocks of chemistry (and life!). They make up everything from the screen of your computer, to components in your eyes! They are all around us. Since atoms are such a key concept in chemistry, let's take a closer look at their structure.

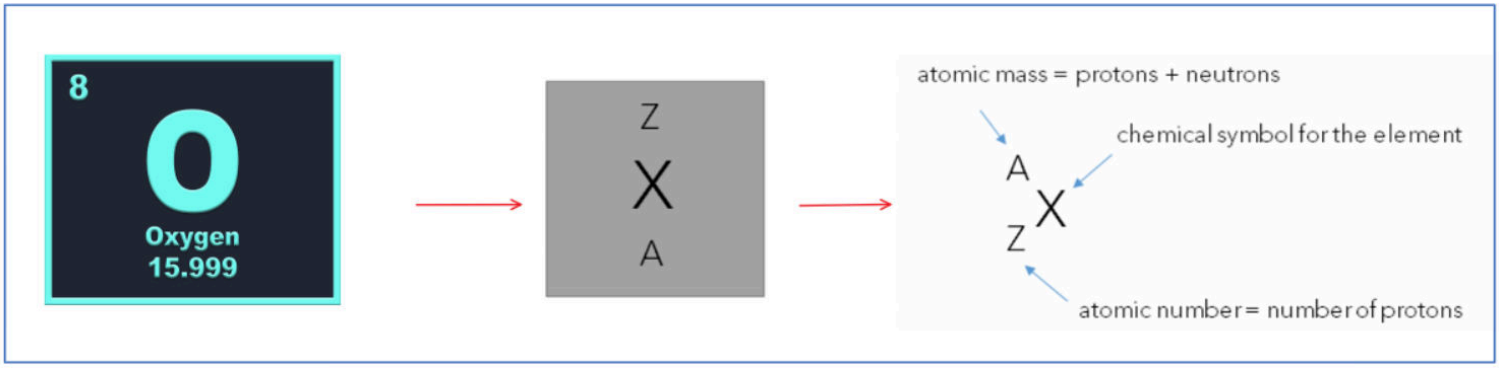
Atomic Structure



Subatomic Particles

Particle	Mass (g)	Mass (amu or $g \cdot mol^{-1}$)	Relative Charge
Proton	1.673×10^{-24}	1.007	+1
Neutron	1.675×10^{-24}	1.009	0
Electron	9.109×10^{-28}	5.485×10^{-4}	-1

Chemical Symbols and Notation



Example: Nuclear Notation

Ex1) $^{12}_{6}C$

# of protons: _____

# of neutrons: _____

# of electrons: _____

WIZE CONCEPT

Atomic Mass = # of protons + # of neutrons
# of neutrons = Atomic mass - # of protons

Ex2) $^{19}_{9}F^{-}$

# of protons: _____

# of neutrons: _____

# of electrons: _____

WIZE TIP

When **electrons are added** to an element we call it an **anion**, and it would have a **negative charge.**
When **electrons are removed** from an element we call it a **cation**, and it would have a **positive charge**

1.1.3

Practice: Nuclear Notation

How many protons, neutrons and electrons are there in $^{75}As^{3-}$?

Number of protons

Number of neutrons

Number of electrons

1.2 Isotopes and Atomic Weight

1.2.1 Isotopes and Atomic Mass

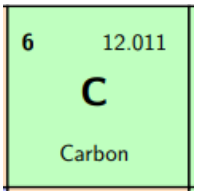
Isotopes and Atomic Mass

Isotopes

- When two atoms have the **same number of protons and electrons**, but a **different number of neutrons**, we call these **isotopes.**
- Isotopes have the **same atomic number**, but a **different mass number.**

^{12}C	^{13}C	^{14}C
protons	protons	protons
neutrons	neutrons	neutrons
98 %	1.07 %	Trace

How is the Atomic Mass in the Periodic Table Calculated?



- The atomic mass is written as 12amu for C for example, but this does not mean that each C atom weighs exactly 12amu!
- **The atomic mass # is actually a weighted average** based on the **relative abundance of isotopes**
  - Isotopes have similar reactivity to one another, that's why we can form C bonds with either C-12 or 13 etc

To determine the average mass of an element, use this equation:

$$A.W. = \sum_{i=1}^{n} (mass\ of\ each\ isotope_i)(abundance\ of\ each\ isotope_i)$$

WATCH OUT!

Plug in the **mass of each isotope in amu** and plug in the **relative abundance of each isotope in the form of a decimal** not percentage!

For example, above we are told the relative abundance of C-12 is 98%. You would want to plug in 0.98 for this isotope's relative abundance.

1.2.2

Example: Solving for the Atomic Weight

Chlorine can be found in nature as $^{35}\mathrm{Cl}$ (mass 34.969u, 75.78% abundance) and $^{37}\mathrm{Cl}$ (mass 36.966u, 24.22% abundance). What is the average atomic mass of Cl?

1.2.3

Practice: Solving for the Weight of an Isotope

Naturally occurring potassium contains two stable isotopes. The lighter isotope, ^{39}K (38.9637 amu) is the more abundant isotope, accounting for 93.26% of the nuclei. What is the weight of the heavier isotope, ^{41}K?

- 41.00 amu
- 40.96 amu
- 39.09 amu
- 41.08 amu

1.2.4

Bromine is a noxious fuming red liquid in its elemental form. Naturally occurring bromine has two stable isotopes ^{79}Br (78.918*u*) and ^{81}Br (80.916*u*). What are the relative abundances of these two isotopes?

Enter your answer as a percentage (ex. If the answer is 16.26%, enter 16.26 as the answer)

Relative Abundance of Br-79

Relative Abundance of Br-81

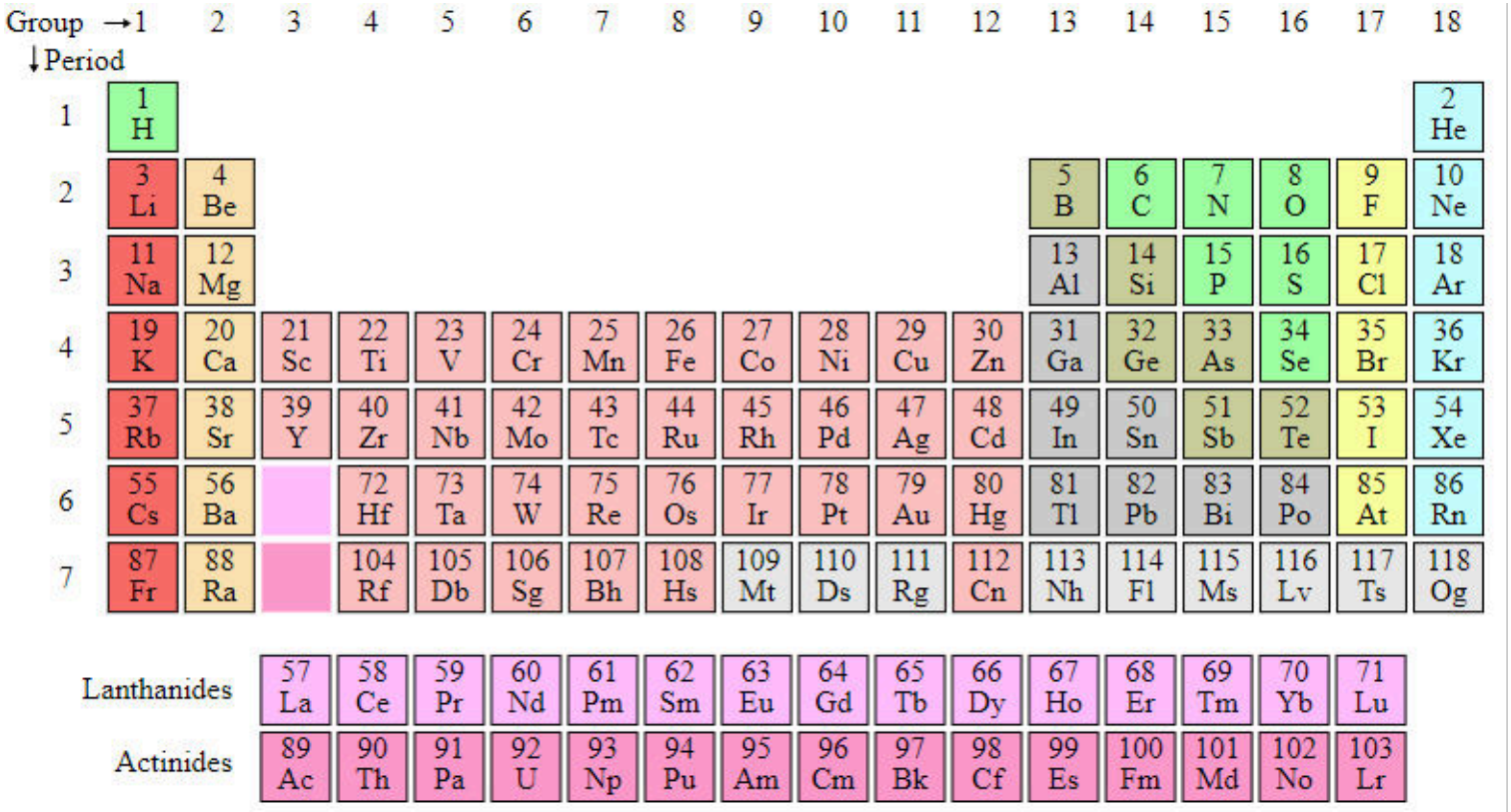
1.3 The Periodic Table & Properties

1.3.1

The Periodic Table of Elements

The **periodic table** is something we are going to see a lot of in chemistry! It organizes the elements by their **atomic number (Z)** and is organized into **groups (columns)** and **periods (rows)**.

Elements in the **same group have very similar reactivity** which we will talk about more when we learn about things like valence electrons, bonding, and Lewis structures.



You should be familiar with each of the following labels:

- Groups
- Periods
- Alkali Metals
- Alkaline Earth Metals
- Transition Metals
- Nitrogen group (aka Pnictogens)
- Oxygen group (aka Chalcogens)
- Halogens
- Noble (Inert) Gases
- Metals
- Non-metals
- Metalloids
- Lanthanides and Actinides (aka Rare Earth Metals)

1.3.2

Practice: Understanding Noble Gases

Which of the following statements is true?

- Noble gases are highly reactive since they want to obtain a full octet.
- Noble gases are highly reactive since they want to gain more electrons.
- Noble gases are unreactive since they already have a full octet.
- Noble gases are very stable because they want to gain more electrons