(1) **Today**

Attendance

Review Syllabus

Sections 1.1 – 1.3
atomic structure
electrons, valence vs core electrons

Reviewing Periodic Trends

Next Class (2)

Section 1.4
Introduction to Chemical Bonding Theories
octet rule etc

Sections 1.5-1.10
Valence Bond Theory

(3) **Second Class from Today**

Sections 1.5-1.10
Valence Bond Theory

Skipping Section 1.11 for now
An introduction to Molecular Orbital Theory

Sections 1.12
Drawing Chemical Structures

Third Class from Today (4)

Sections 1.12
Drawing Chemical Structures

Lab starts on Monday, September 8

Goggles and lab coats will be required starting Monday, September 22.

Appropriate Problems from McMurry Chap 1

Section 1.3 Problems 1-1 and 1-3

Section 1.4 Problems 1-4 through 1-7, 1-24 through 1-28 1-33

Section 1.5 - 1.10 Problems 1-8, 1-9, 1-10, 1-11, 1-12, 1-13, 1-14, 1-34 – 1-40, 1-48, 1-49, 1-50 (part a is asking how are they similar electronically), 1-56

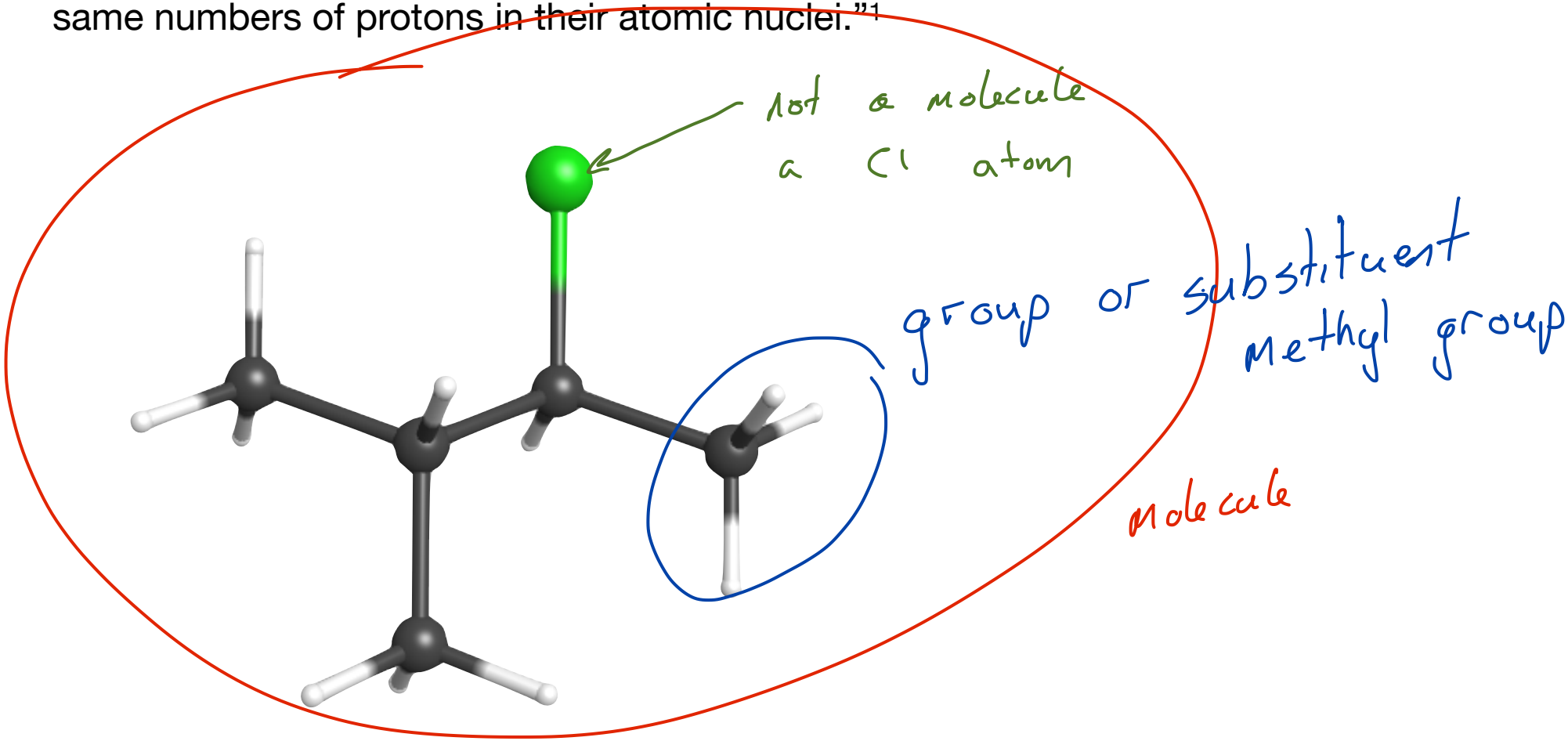
Section 1.12 Problems 1-15 through 1-21, 1-41 through 1-44, 1-52, 1-53, 1-54, 1-55

Challenging Problems 1-45, 1-46, 1-47, 1-51

Atoms, Elements, Molecules, and Substituents or Groups

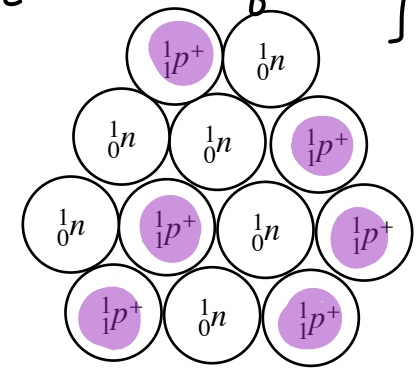
A diversion into the language of chemistry…

"In chemistry, an element is a pure substance consisting only of atoms that all have the same numbers of protons in their atomic nuclei."[1]



[1] https://en.wikipedia.org/wiki/Chemical_element accessed September 3, 2021

reacts more quickly

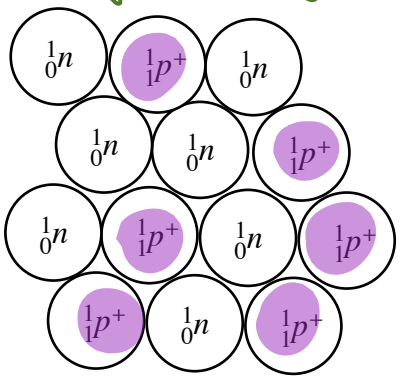


6 protons
6 neutrons

^{12}C

~ 99 %

magnetically active

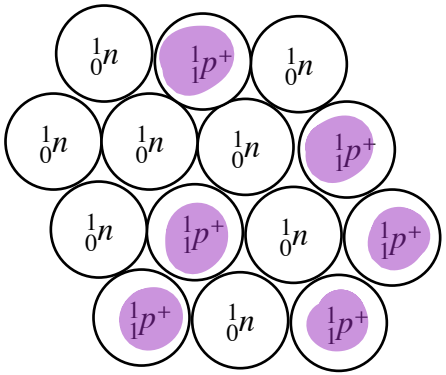


6 protons
7 neutrons

^{13}C

~ 1 %

reacts more slowly



6 protons
8 neutrons

^{14}C

radioactive
< 0.001 %

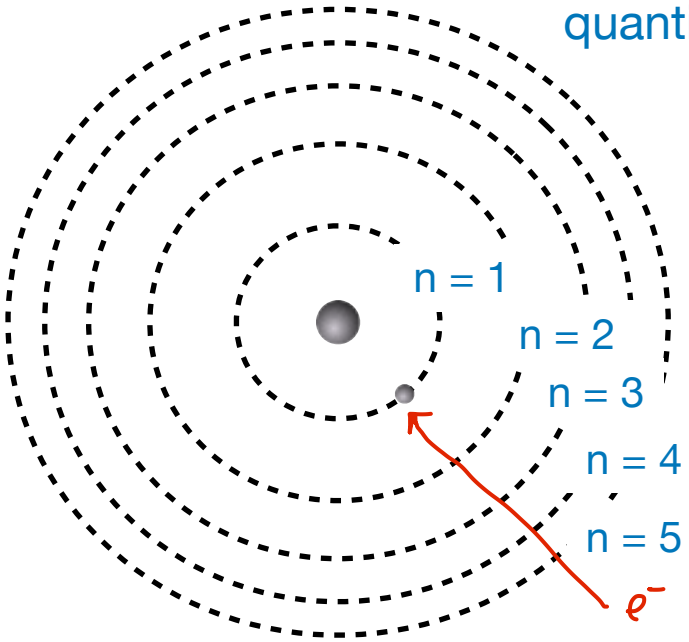
C atoms have 6 protons in their nuclei

all C atoms are equally attractive to e^-'s so they all do the same kinds of reactions make the same kinds of molecules

React at different rates + have different nuclear properties

Remember the structure of an atom

Line spectra produced by excited atoms revealed that electrons can only exist in specific energy levels and any model that attempts to describe the atom must have quantized energy levels.



Bohr successfully modeled the Hydrogen atom like a planetary system using particle physics; e.g.,

e^- orbited the atom in defined energy levels

e^- was held in its orbit by electrostatic attraction

$E = KE + PE$ which is $E = 1/2\ mv^2 + Ze^2/r$

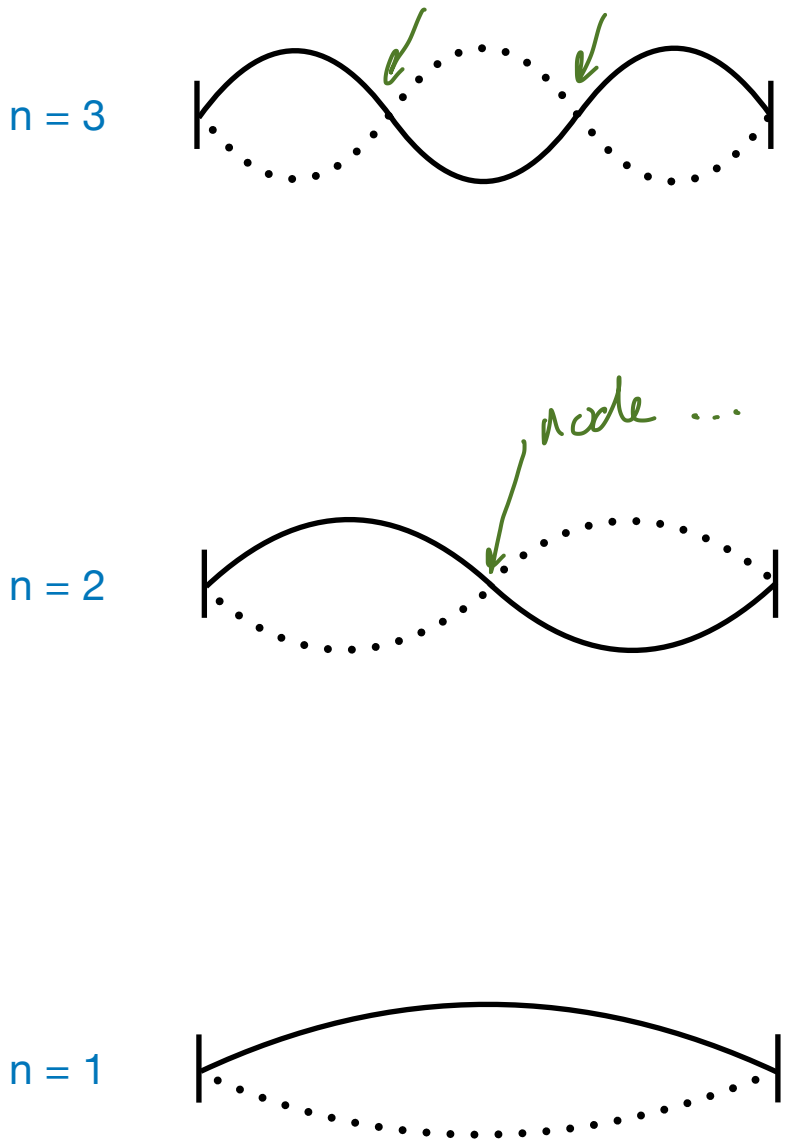
e^- can only exist in specific shells/energy levels

The model only worked for atoms with one electron.

Also it is physically impossible for electrons to orbit a nucleus like the Moon orbits the Earth…. The electrons would radiate energy and crash into the nucleus.

Another branch of Physics also researched systems that had quantized energy levels…

Wave Mechanics



more nodes
higher frequency ...
higher energy

node ... a point were there is zero deflection/ amplitude in the wave

instead of a string tied down at two ends we have an e^- wave confined to an atom

Wave/Quantum Mechanical Model

1 Å = 100 pm

Bohr had 1 quantum number.

the electron is in the n = 1 or 2 or 3 or 4… shell

Quantum Mechanics requires four quantum numbers to describe an electron: n, l, m_l, and m_s.

n is the principal energy level
l describes the shape of the orbital
$\mathbf{m}_l$ describes the orientation of the orbital and
$\mathbf{m}_s$ indicated the spin of the electron.

Further, as ***n*** gets larger more orbital shapes (***l***'s) become available and as more shapes become available, those shapes have more possible orientations ($\mathbf{m}_l$'s).

Image derived from 1https://en.wikipedia.org/wiki/Atom#/media/File:Helium_atom_QM.svg

And Where Are the Electrons Again? The Quantum Mechanical Model

The H atom's only electron:

$1s^1$ n = 1, $l = 0$, $m_l = 0$, and $m_s = +1/2$

spin $+\frac{1}{2}$ or $-\frac{1}{2}$

He's two e⁻'s:

$1s^2$ n = 1, $l = 0$, $m_l = 0$, and $m_s = +1/2$
n = 1, $l = 0$, $m_l = 0$, and $m_s = -1/2$

electron configuration

B's five e⁻'s:

$1s^2\,2s^2\,2p^1$ n = 1, $l = 0$, $m_l = 0$, and $m_s = +1/2$
n = 1, $l = 0$, $m_l = 0$, and $m_s = -1/2$
n = 2, $l = 0$, $m_l = 0$, and $m_s = +1/2$
n = 2, $l = 0$, $m_l = 0$, and $m_s = -1/2$
n = 2, $l = 1$, $m_l = 1$, and $m_s = +1/2$