

UNIT THREE: CHAPTER 4

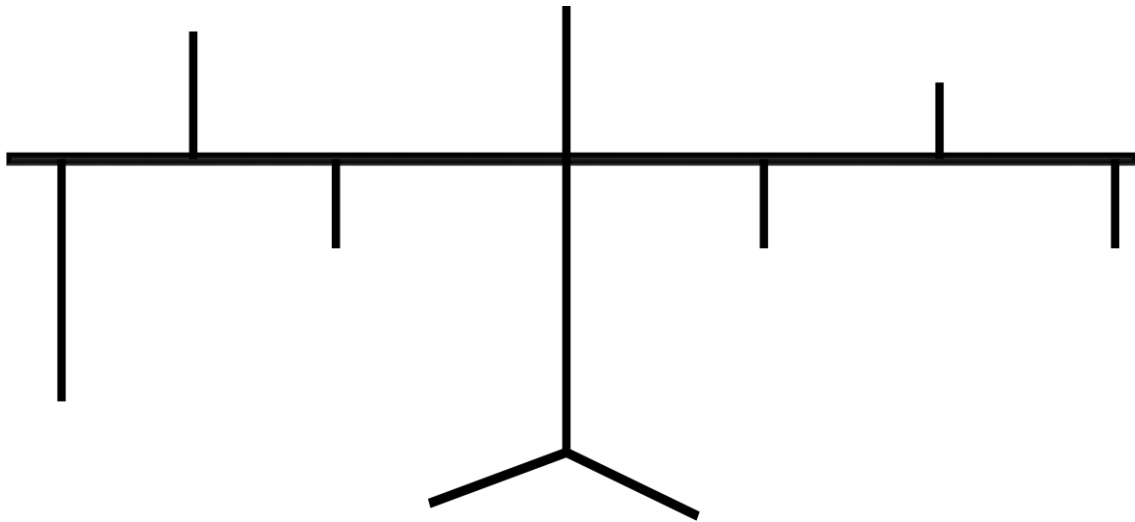
ELECTROMAGNETIC RADIATION

What is Electromagnetic Radiation?

- _____
- _____
 - Travels in _____!

Types of Electromagnetic Radiation

- _____

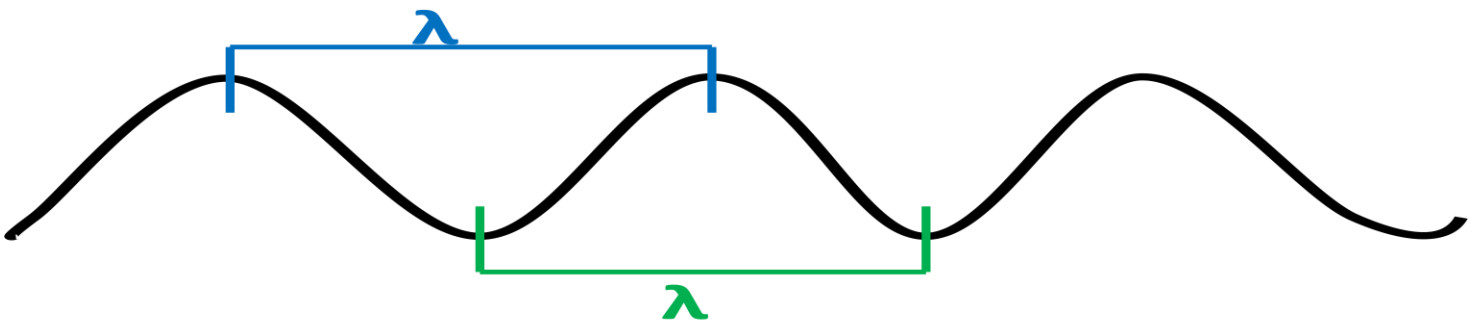


_____ wavelengths
_____ frequency
_____ energy

_____ wavelengths
_____ frequency
_____ energy

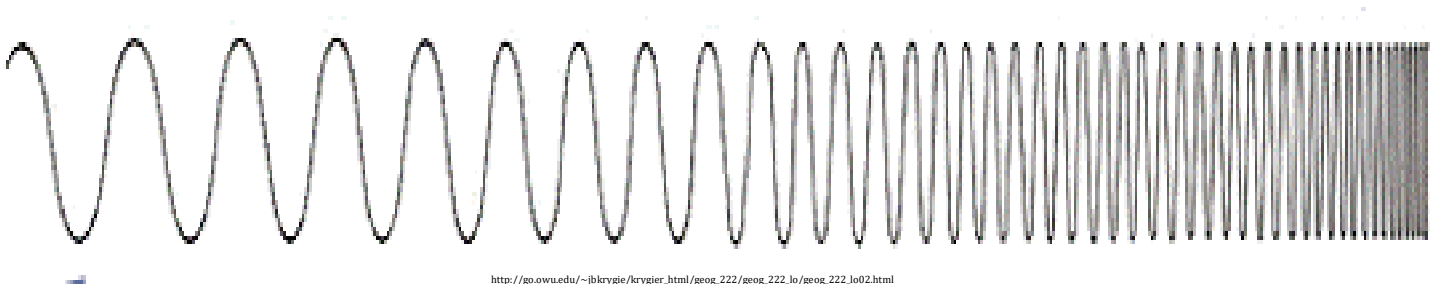
Wavelength

- Distance between _____
_____.
- Symbol: _____
- Units: _____



Frequency

- The number of waves that _____
 - Usually _____
- Symbol: _____
- Units: _____
 - _____



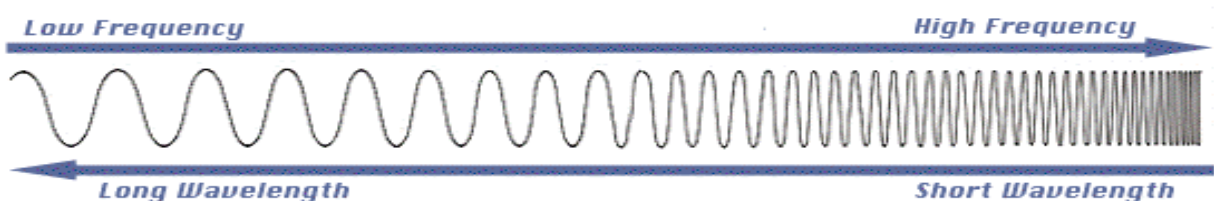
http://go.owu.edu/~jbkrygie/krygier_html/geog_222/geog_222_lo/geog_222_lo02.html

Speed

- How _____
- Symbol: _____
- Units: _____
- All forms of light travel at the _____ speed
 - _____

Frequency and Wavelength

- Mathematically related: _____
- The relationship between _____ (λ) and _____ (ν) is _____ proportional, so as...
 - ... λ _____ (_____) then ν _____ (_____ #waves/sec)
 - ... λ _____ (_____) then ν _____ (_____ #waves/sec)
- BUT, the _____ (c) is _____ the same
 - $c =$ _____



Quantum

- The minimum quantity of energy that _____
_____.

- Small packet of _____ that is _____

- Identified by _____ in 1900

- German physicist

- Proposed the relationship between a _____
_____.



http://upload.wikimedia.org/wikipedia/commons/d/d7/Max_planck.jpg

Photon

- “_____” of _____ released

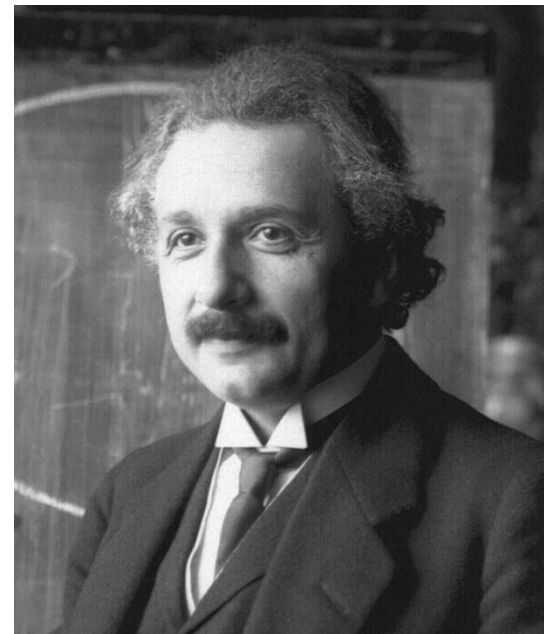
- Particle of _____

- (_____)

- Has _____ mass

- Carries a _____ of energy

- Identified by _____



<http://www.hdwallpapersinn.com/wp-content/uploads/2013/01/Albert-Einstein4.jpg>

Quanta & Photons

- ... are _____!
- Both indicate that energy is _____

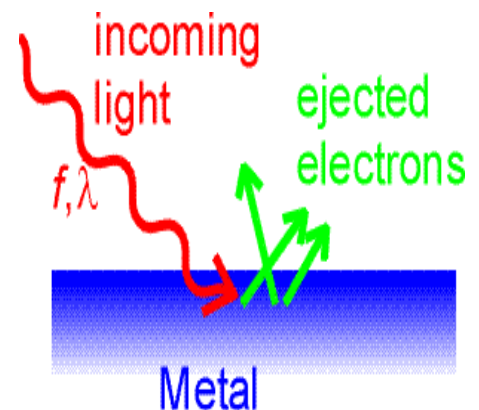
_____.
- ...but do not have a _____ or _____

Dual Wave-Particle Nature

- Proposed by _____ in 1905
 - _____ (_____)
 - _____
 - Energy travelling in _____
 - _____ with mass and volume
 - Like _____ in small packets
 - Like _____, their movement (_____)
 - is _____

Photoelectric Effect

- When _____ (electromagnetic radiation) is put into _____ there is a _____ in the _____ (they _____ and can be _____).



<http://www.pa.msu.edu/courses/1997spring/phy232/lectures/quantum/photoelectric.html>

- Occurs at a specific _____ and _____ of energy (_____)

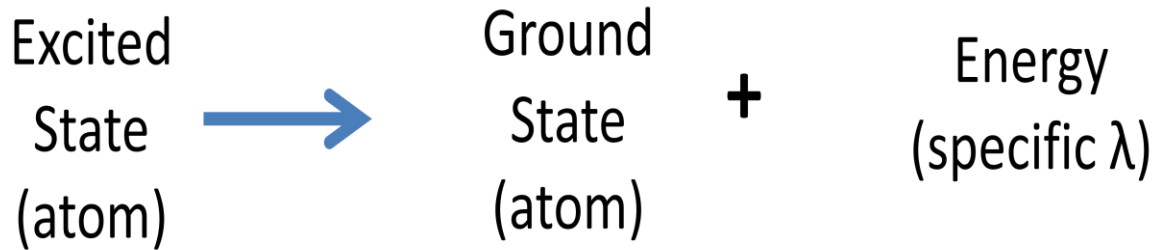
Energy

- $E =$ _____
 - $E =$ _____
 - $h =$ _____ $= 6.626 \times 10^{-34} \text{ J}\cdot\text{s}$
 - $\nu =$ _____
- _____ relationship, so...
 - ... as _____ increases then _____ increases
 - ... as _____ decreases then _____ decreases

States of an Atom

- | | |
|---|--|
| ▪ _____ STATE | ▪ _____ STATE |
| ▪ _____ energy state of an
atom (how it occurs normally) | ▪ _____ state of an atom |
| ▪ Electrons in _____
_____ | ▪ _____ of energy
_____ so electrons are at
_____ energy positions |
- Adding _____ (light) to an _____ in a set amount (_____) causes electrons to _____ from _____ state to _____ state.

- When electrons _____ to the _____ state, atoms _____ the _____ (electromagnetic radiation) and part of it is visible as _____.



Spectrum

- _____
- Produced by a _____:
 - an instrument with a _____ or _____ that can _____ electromagnetic radiation by _____ wavelengths

Types of Spectrum

- _____ spectrum
- _____ spectrum
 - (_____ spectrum or _____ spectrum)
- _____ spectrum
 - (_____ spectrum)

Continuous Spectrum

- _____
for the wavelengths in _____ part of
electromagnetic radiation
- No _____ between colors
 - One color _____ into the next
 - Like a _____
- From light energy sources like:
 - _____



<http://3.bp.blogspot.com/-BZqvUeGrU/TtbcGXqSpQI/AAAAAAAAAE/DQP9DioxXeo/s1600/Rainbow.jpg>



http://astro.unl.edu/naap/hr/graphics/Spectral_lines_en.png

Emission Spectrum

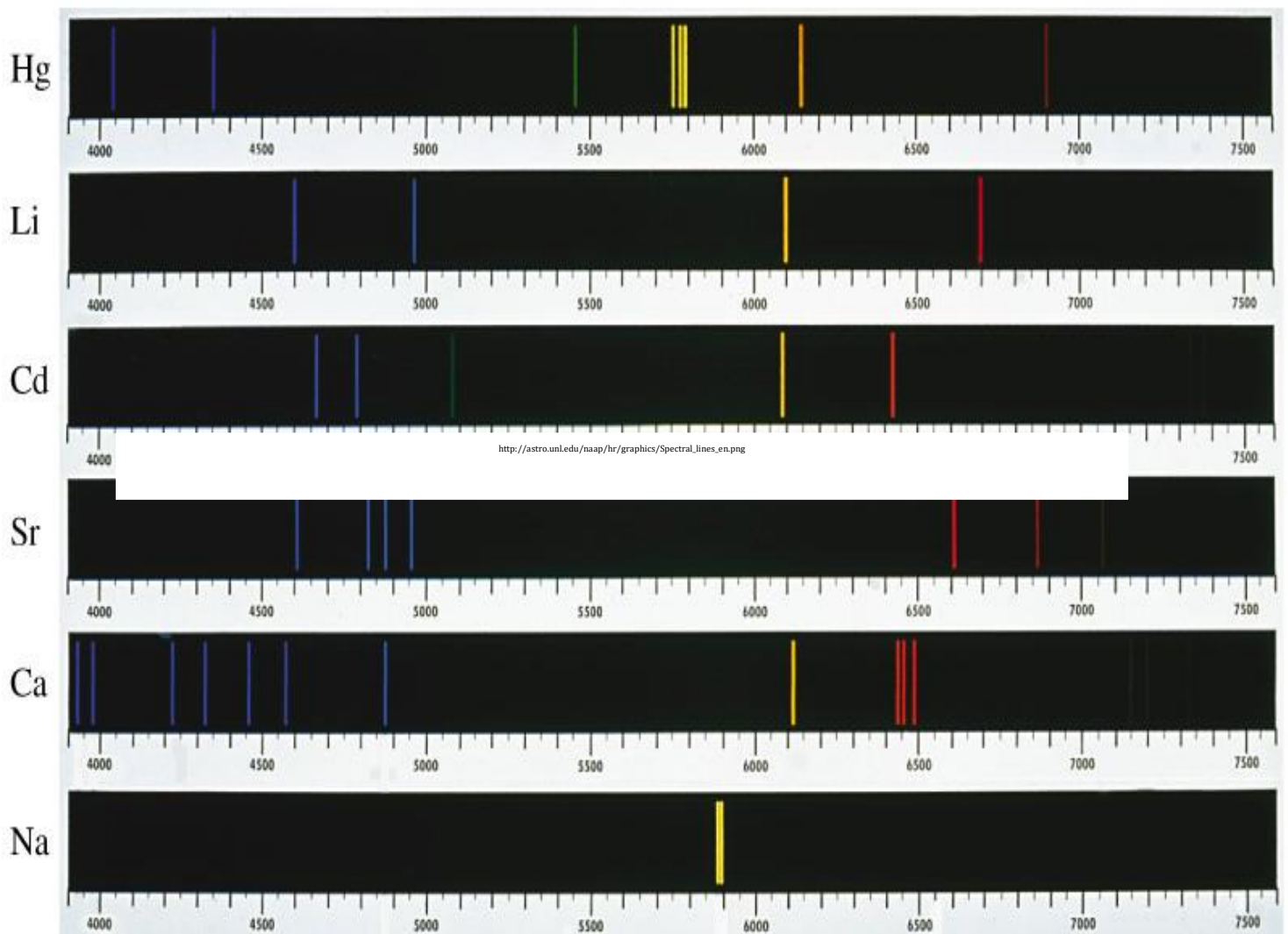
- _____
_____.
- _____ for each element
 - “ _____ ” for each element
 - No _____

○ Used to _____

- One of the _____ in the spectrum is _____ (with our _____ / all are seen by _____)



http://astro.unl.edu/naap/hr/graphics/Spectral_lines_en.png



http://www.amazingrust.com/Experiments/background_knowledge/Images/line_spectrum.jpg

Absorption Spectrum

- Band of colors with _____
_____.
- Dark lines are _____ to bright-line spectra (emission spectra) of
elements to _____.
 - Dark lines _____ bright line

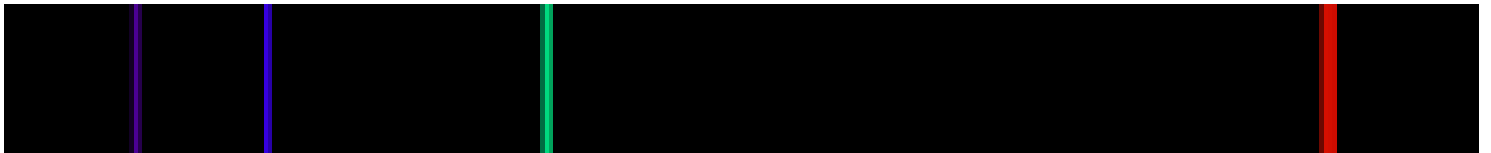


http://astro.unl.edu/naap/hr/graphics/Spectral_lines_en.png

Continuous Spectrum



Emission Lines



Absorption Lines

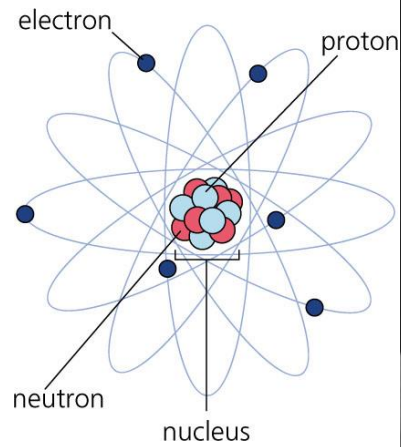


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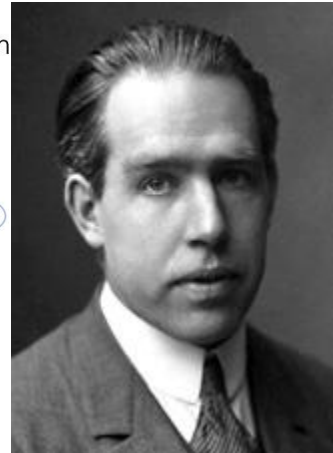
QUANTUM NUMBERS

Bohr

- Developed a model of the _____
- Called it a
“ _____ ”
- His model worked only for _____
- Does **not** apply to _____



<http://oldeloohuis.com/nuclearfusion.html>

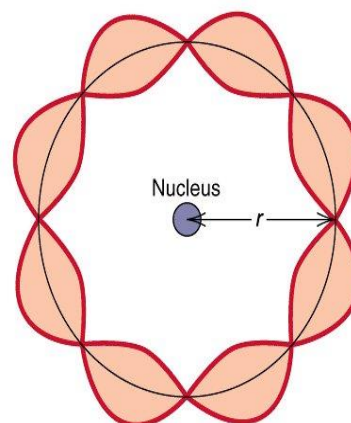


http://www.nobelprize.org/nobel_prizes/physics/laureates/1922/bohr.jpg

De Broglie

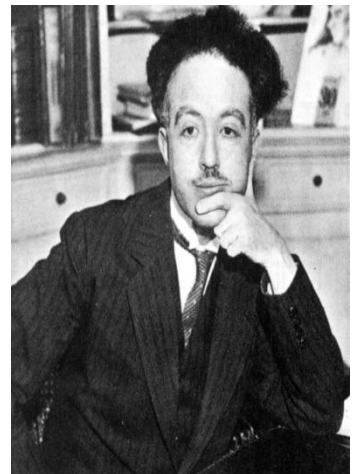
- Determined electrons have

- Found _____ exist at
specific _____
(like _____)



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<http://web.sbu.edu/chemistry/wier/electrons/bohrstandingwave.jpg>



http://3.bp.blogspot.com/_7y8-ee6viii/TSTdeSNS2I/AAAAAAAAAFKw/RdM6p0eqZbc/s1600/Louis_de_Broglie10.jpg

Heisenberg Uncertainty Principle

- Not possible to determine _____

_____.



<http://www.nndb.com/people/488/000071275/heisenberg3-sized.jpg>

Schrödinger

- Calculated probable _____ using:
 - Electrons acting _____
 - _____
- Determined _____



http://www.nobelprize.org/nobel_prizes/physics/laureates/1933/schrodinger_postcard.jpg

Orbital

- _____
_____.
- Different _____ and _____ in the _____.
 - **But**, they can _____ hold _____ electrons

Quantum Numbers

- Specify _____ (_____) of _____
and _____ (_____) of _____.
- 4 different quantum numbers
 - _____
 - _____
 - _____
 - _____

Principal Quantum Number

- Indicates _____ (distance from _____)
- Symbol: _____
- Can be whole numbers from _____
- Corresponds to the _____ (_____)
 - # of electrons in an energy level: _____

▪ $n=1$: _____e-

▪ $n=2$: _____e-

▪ $n=3$: _____e-

▪ $n=4$: _____e-

Angular Momentum Quantum Number

▪ Indicates _____

▪ Symbol: _____

▪ Can be whole numbers from _____

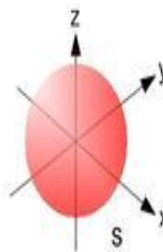
▪ Represents the _____ within an _____

▪ Sublevels: _____

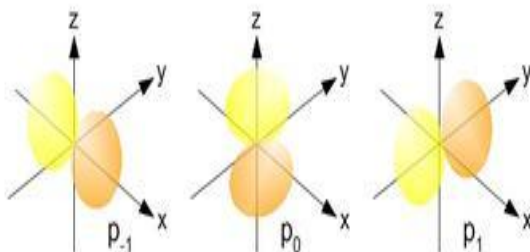
Angular Momentum Quantum Number	Sublevel	Electron Capacity	Shape (pg. 102-103)

Sublevels & Orbitals

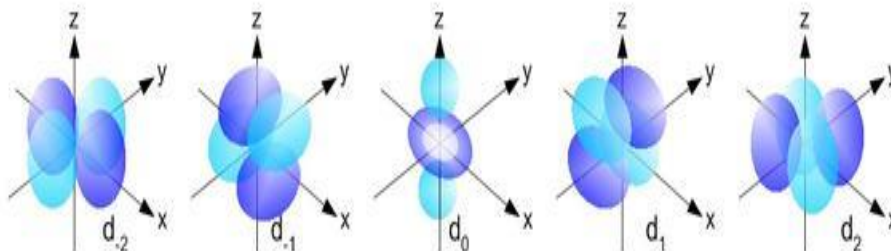
s sublevel = 1 orbital



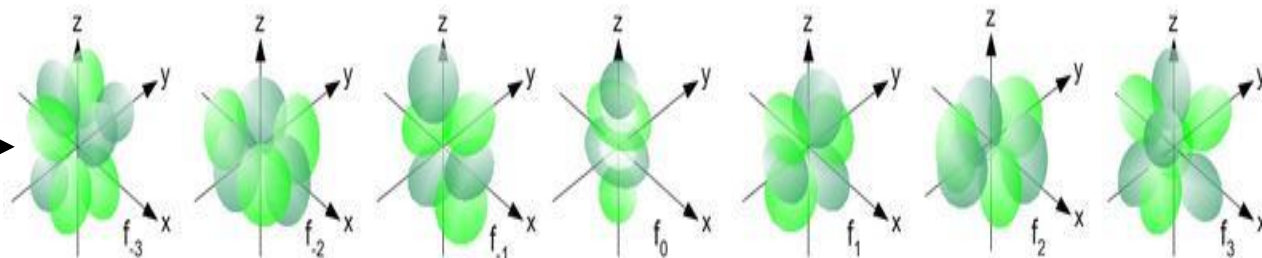
p sublevel = 3 orbitals



**d sublevel =
5 orbitals**



**f sublevel =
7 orbitals**



http://jahschem.wikispaces.com/file/view/Single_electron_orbitals.jpg/188326873/800x469/Single_electron_orbitals.jpg

Magnetic Quantum Number

- Indicates _____ of _____ around _____
(around _____)
- Symbol: _____
- Can be whole numbers from _____

- Represents the number of _____
- Remember, orbitals hold up to _____ electrons

Sublevels & Orbitals

Sublevels	Magnetic Quantum Number Range	Number of Orbitals

Spin Quantum Number

- Indicates _____
- Symbol: _____ (_____)
- Can be _____
- Spin must be in _____

ARRANGEMENT OF ELECTRONS

Electron Arrangements

- Show how electrons occur _____
- _____ for each element
 - Since each element has a _____
- Show the _____ for electrons

Aufbau Principle

- Electrons must fill _____
- Orbital filling:

1s

2s

2p

3s

3p

3d

4s

4p

4d

4f

5s

5p

5d

5f

6s

6p

6d

6f

7s

7p

7d

7f

- Exceptions:
 - Groups with _____ (lowest energy will be the _____ not the _____)
 - Occurs with elements in the same _____ below them on the periodic table

Pauli Exclusion Principle

- No _____ in an element will have the _____ set of _____.
- So, this means that there can only be _____ electrons per _____ and they **must** have _____.
- Ex.

Hund's Rule

- Electrons are distributed among the _____ (with the same _____) in order to give a _____ number of _____.
- Ex.

Types of Electron Arrangements

- _____
- _____
- _____

Orbital Notation

- Uses:
 - Line to represent _____
 - Label under line:
 - _____
 - Sublevel letter for _____
 - _____
- _____ showing _____
 - Maximum _____
 - _____ directions

- Ex.

Electron Configuration Notation

- Uses:

- _____
- Sublevel letter for _____
- _____

- Ex.

Noble Gas Notation

- Uses:

- _____ of noble gas in brackets [] for _____

- Use noble gas in _____

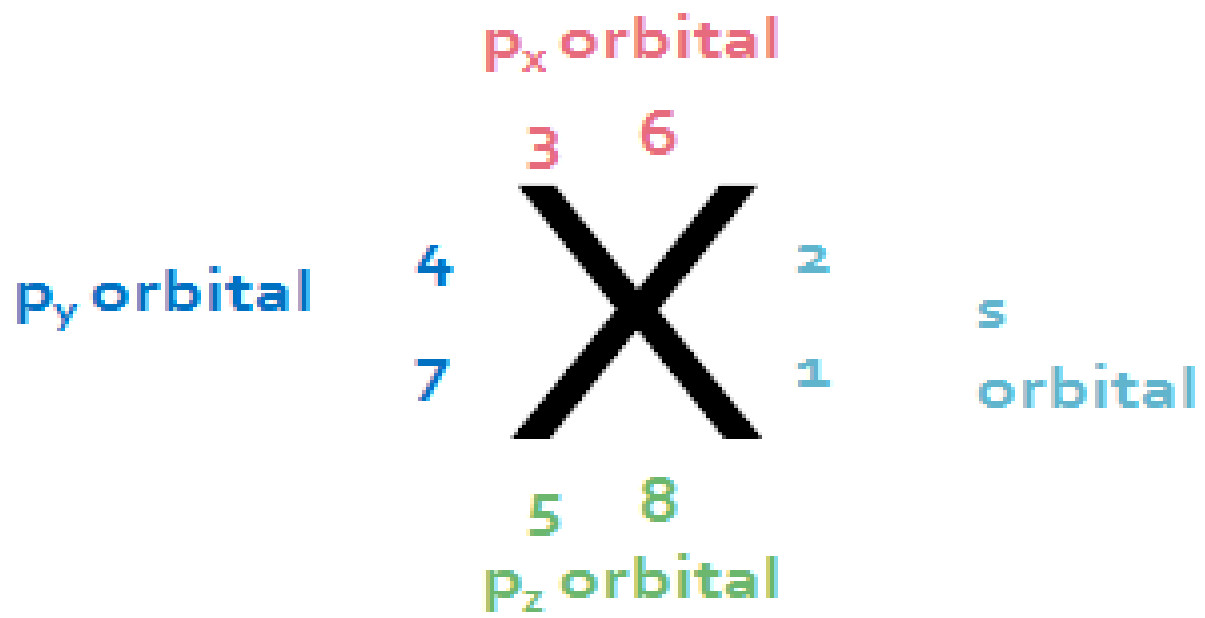
- Continue with _____ and
_____ for _____.
- _____ for number of _____
- Ex.

Why Use Electron Dot Diagrams?

- These diagrams show the _____ that an atom has.
- Most atoms _____ hold and _____ to hold _____ electrons in their
_____ shell in order to be chemically _____.
- _____.
- This corresponds to full _____ and _____ orbitals.

Filling Electron Dot Diagrams

- First, determine the _____.
- Fill the _____ as _____ around the element symbol as follows:



- Ex.

Electron Arrangements

- Ex. 1:

- Ex. 2:

- Ex. 3:

- Ex. 4:

- Ex. 5:

- Ex. 6:

Exam Date: _____

- **Arrangement of Electrons in Atoms (Chapter 4)**

- ✓ Electromagnetic radiation / types / wavelength / frequency / speed / energy / units
- ✓ Quantum / photon
- ✓ Ground state / excited state
- ✓ Spectrum / continuous / emission / absorption
- ✓ Bohr / De Broglie / Heisenberg / Schrödinger
- ✓ Quantum numbers (each type) / energy level / sublevel / orbital
- ✓ Aufbau / Pauli Exclusion / Hund's Rule
- ✓ Orbital notation / electron configuration notation / noble gas notation / electron dot diagrams