Light/ Quantum #s

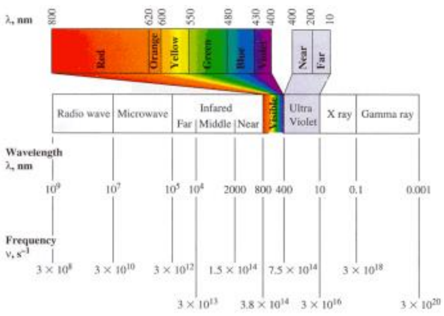
Tuesday, October 20, 2020 11:30 PM

Light

- ***v λ = c***
- λ: wavelength; distance between peaks
- v: frequency; number of peaks during set amount of time
- c = $2.99 * 10^{8}$ m/s

Wavelength

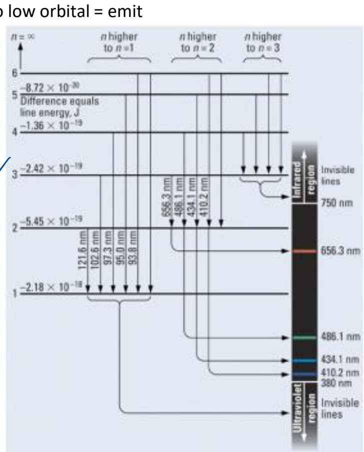
- Relationship between wavelength and frequency: Inverse
- As wavelength increases, the frequency decreases



Energy

- *E = h v*
- *E:* energy
- *H* : Planck's constant; $6.626 * 10^{-34}\ J * s$
- *v:* frequency
- Energy Emission
- Emitted in the visible light part of the spectrum
- As we go to higher energy orbitals, energy decreases by ten fold
- The higher the orbital level the less space/ energy
- Low to high orbital = absorb
- High to low orbital = emit

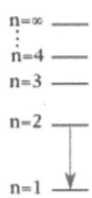
abs em



Practice Problem

Which of the following would emit the most amount of energy?

a. n=4 to n=3
b. n=5 to n=2
c. n=3 to n=1
d. n=3 to n=5



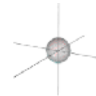
Answer: C
A - 4 is a small orbital and doesn't have lots of energy
B - 5 is a very small orbital, so it would not release a lot of energy
C - 1 is a large orbital and would release a lot of energy
D - Since it goes from low to high, it absorbs instead of emitting

Equations

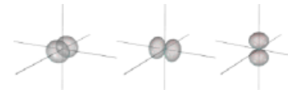
Light: $v\lambda = c$ $\quad v\lambda = c \quad E = hv$

Quantum Numbers

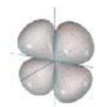
- n
- Principle level
- Relative size/ energy
- l
- Subsidiary level
- Related to orbital shape
- Uses letter designations
    - l=0 s orbital
    - l=1 p orbital
    - l=2 d orbital
    - l=3 f orbital
- m (l/ s)
- Magnetic and spin levels
- ml
    - Indicates orientation
    - l or -l
- ms
    - Indicates spin
    - +1/2 or -1/2



size



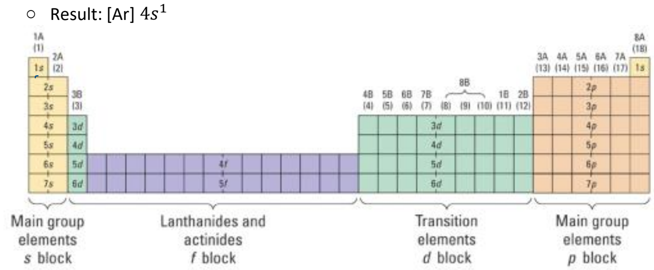
shape



Orientation

Electron Configurations

- Electron Configurations
- Fill lowest orbitals first
- Pauli Exclusion Principle: no two electrons may have identical sets of four quantum #s (Simple definition: no more than two electrons can occupy the same orbital and electrons must have opposite spins)
- Noble Gas Notation
- Take noble gas quantum number and add respective quantum numbers
- Ex: Potassium
    - 19 electrons
    - Argon (noble gas) has 18 electrons (just one less than potassium)
    - Take argon's configuration and add one orbital
    - Result: [Ar] $4s^{1}$



Practice Problem

1) What is the correct electron configuration for aluminum?
    a. $1s^{2}2s^{1}$
    b. $1s^{2}2s^{2}2p^{2}3s^{2}3p^{2}3d^{2}4s^{1}$
    c. $1s^{2}2s^{2}2p^{4}3s^{2}3p^{1}$
    d. $1s^{2}2s^{2}2p^{6}3s^{2}3p^{1}$

2) Which of the following sets of quantum numbers refers to a 2s orbital?
    a. n=2, l=0, ml = 0, ms=+1/2
    b. n=1, l=2, ml = 2, ms=+1/2
    c. n=1, l=2, ml = 0, ms=+1/2
    d. n=2, l=1, ml = -1, ms=+1/2

1) Answer: D - Aluminum has 13 electrons and so the sum of the superscripts in D is 13 and has the correct orbital numbers
2) Answer: A - if l = 1, then we would have p orbitals, so l=0

Equations

Light: $\nu \lambda = c$

Energy: $E = h\nu$

$\nu \lambda = c$

$\downarrow$

$\frac{\nu \lambda = c}{\lambda}$

$\downarrow$

$\nu = \frac{c}{\lambda}$

$E = h\nu$

$\downarrow$

$\frac{E = h\nu}{h}$

$\downarrow$

$\nu = \frac{E}{h}$

$$\boxed{\frac{c}{\lambda} = \frac{E}{h}}$$