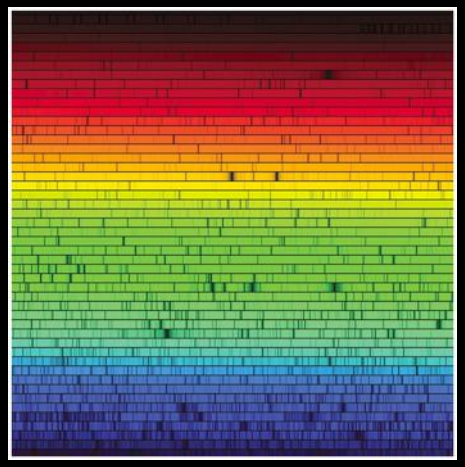
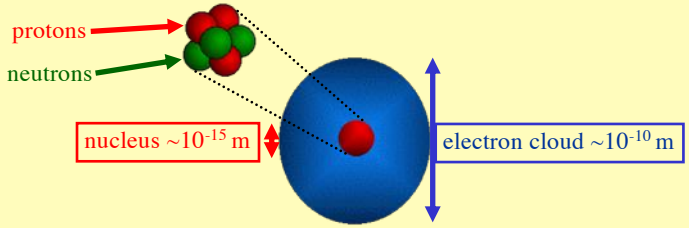
Atoms & Spectra



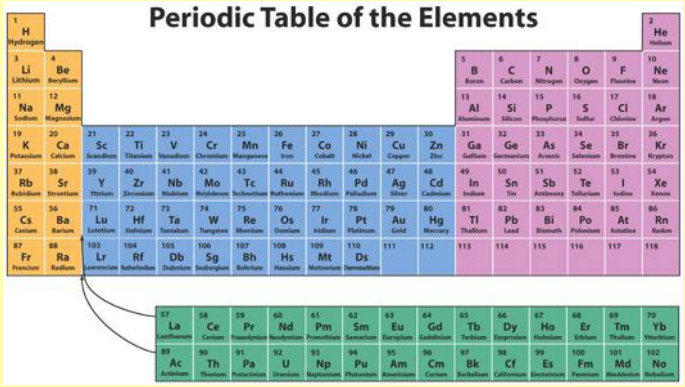
Atoms

- matter is composed of *atoms*
- contain a *nucleus* of positive *protons* & neutral *neutrons* surrounded by negative *electron* "cloud"



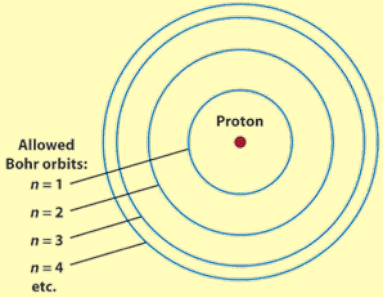
- number of *protons* determines *physical properties* (***ie***) *determines which element we have*

- ***H*** and ***He*** make up ~*99% of all matter*



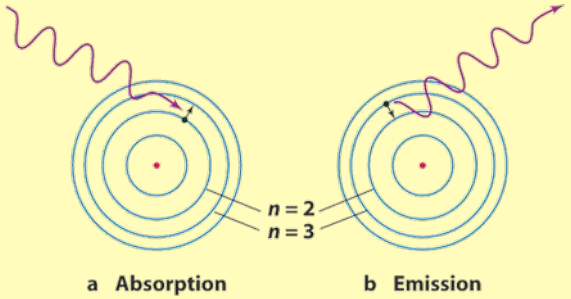
- ***molecules*** have two or more atoms (***eg***) O_2, H_2O
- ***molecules'*** properties can *differ* from constituents

The H Atom



- ***electrons*** *only* occupy certain "orbits" (*"rungs"*)
- their orbits *equate* to *specific energies*
- *want* to be *closest* to ***nucleus*** (*lowest* energy orbit)

- ***transitions***: *electron* movement **between** *orbits*
- atom ***absorbs*** energy: *electron* moves *outward*
- atom ***emits*** energy: *electron* moves *inward*
- ***absorption/emission*** only at ***specific wavelengths***

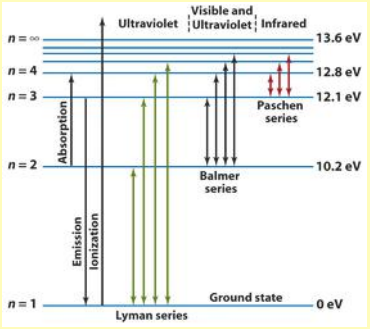


- atoms typically ***neutral*** (# protons **=** # electrons)
- if an atom *gains/loses electron(s)* becomes an ***ion***

Q: *electron in H atom absorbs >13.6 eV & escapes, resulting in… ?*

Q: *Which* ***Balmer*** *transition is most likely to emit UV? Why?*

CLICKER: electrons moving from n=3 to n=2 …



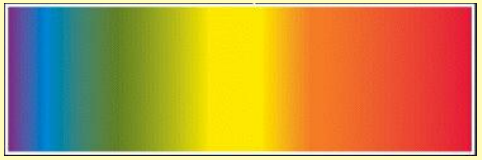
(a) absorb UV (b) absorb visible (c) absorb infrared
(d) emit UV (e) emit visible (f) emit infrared (g) are ionized

Types of Spectra

- ***emission line***, ***continuous***, ***absorption line***
- ***emission line****:* from a *hot, low density gas*
- source ***emits*** light only at *certain wavelengths*

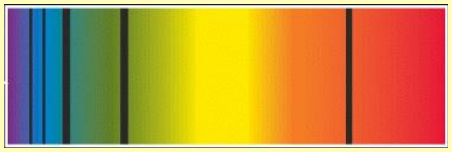
(eg) neon signs, sodium street lamps, aurora

- ***continuous****: from a hot, high density gas OR a glowing solid*
- *source emits at all wavelengths (but* ***not*** *equally!)*

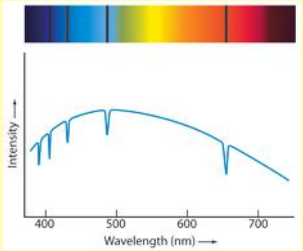


(eg) light bulb filaments, heated metal

• ***absorption line****:* from a *hot, high density gas surrounded by a cooler, low density gas*

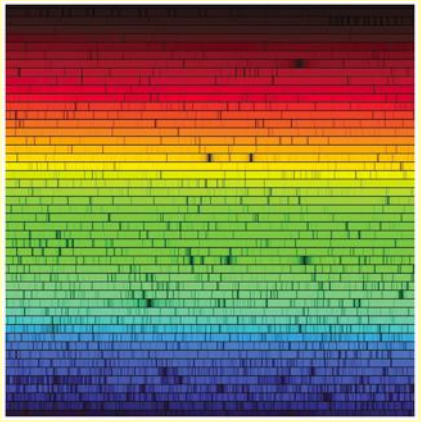


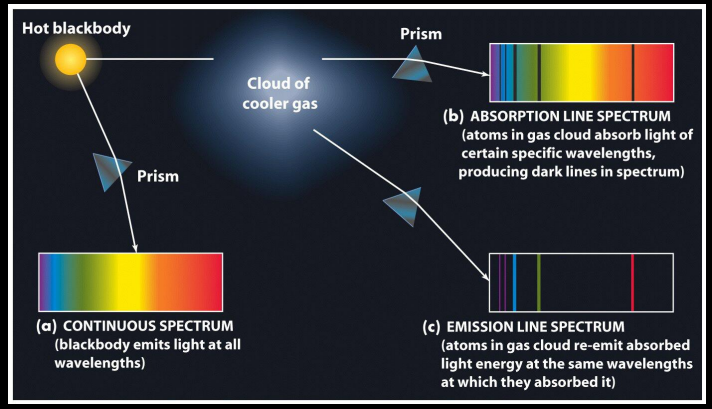
• *high density gas emits at all wavelengths;* cooler low density gas between source & observer absorbs *some* light at ***specific*** energies



(eg) stars

Solar Spectrum





• *absorption & emission* lines ***come from electron transitions*** within ***atoms and molecules***

• ***every atom or molecule*** has a ***unique*** spectral signature