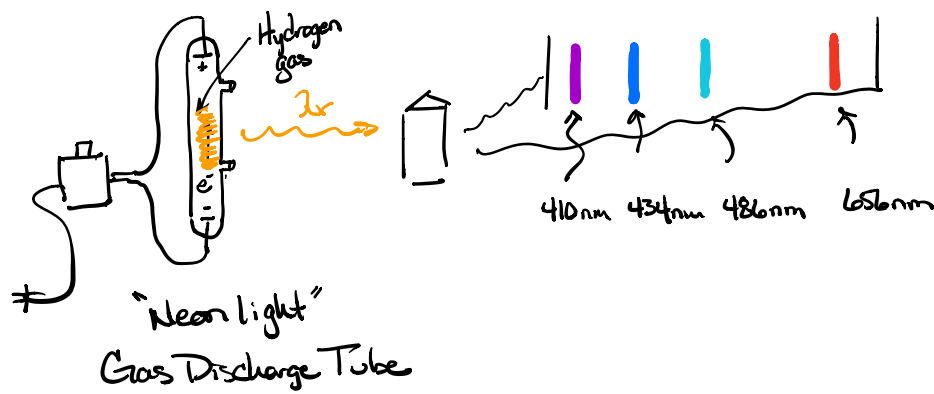
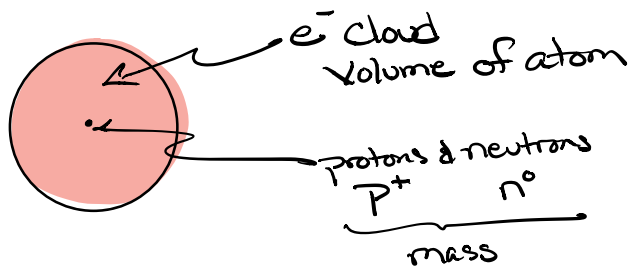


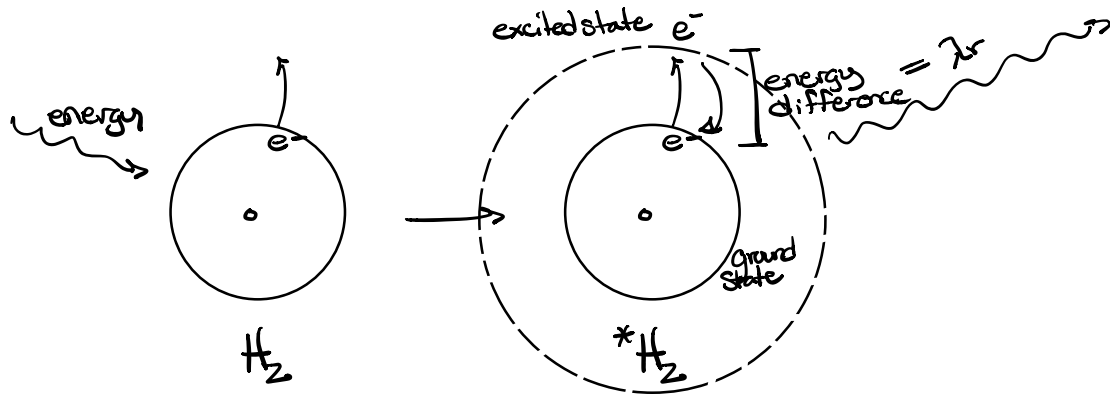
Electronic Configurations

Lab Activity # 26

Carbon atomic #6

${}^{12}_{6}\text{C}$ protons neutrons electrons
 6 6 6





Because the electron has only specific locations it can travel to (excited states) \Rightarrow There is structure in the electron cloud.

\Rightarrow Element Electronic Structure
Electron Configurations

(old terms)

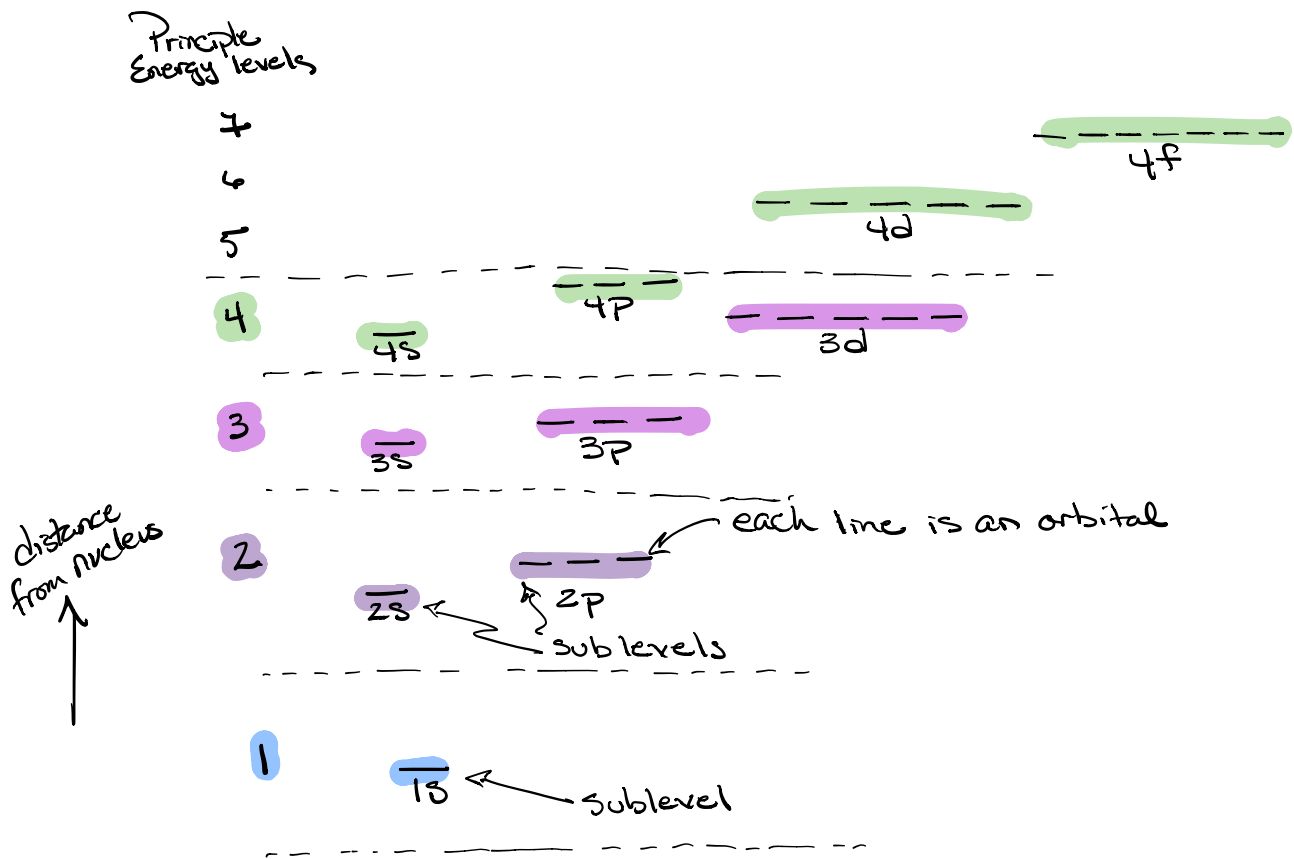
Principle Energy levels (shells)

- Sub level (sub shells)

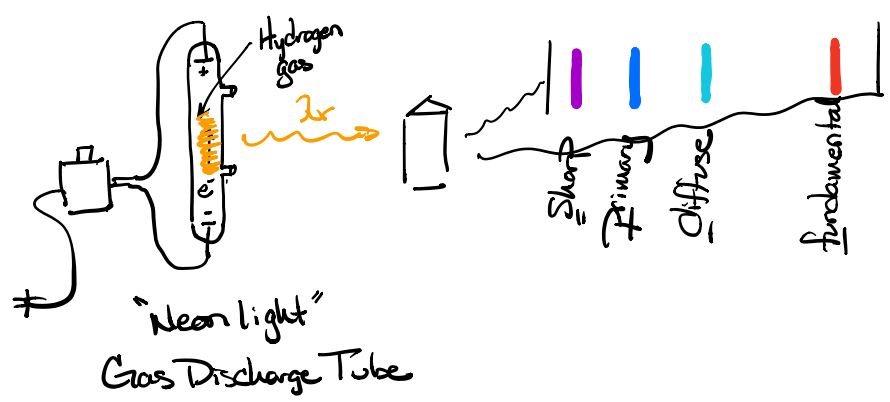
- orbital

- Spin

No two electrons may have the same value for all four quantum numbers
 \Rightarrow every electron is unique



nucleus • Sublevels named s, p, d, f, g, h...



- Principle energy level starts at 1 and increases by 1 each time

1, 2, 3, 4, ...

- Sublevel

The number of sublevel in a principle energy level is equal to the value of the principle energy level

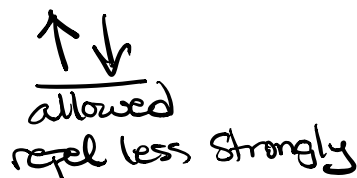
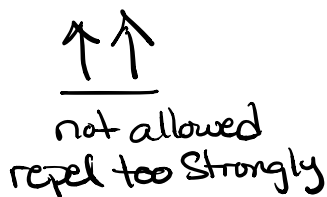
| <u>Principle energy level</u> | <u># of Sub levels</u> |
|-------------------------------|------------------------|
| 1 | 1 (s) |
| 2 | 2 (s, p) |
| 3 | 3 (s, p, d) |
| 4 | 4 (s, p, d, f) |
| 5 | 5 (s, p, d, f, g) |
| ... | |

The number of orbitals within a sub level increases by 2 each time

| | | | | | | | | |
|---|---|---|---|---|---|---|---|-----------------|
| | ⋮ | | | | | | | #e ⁻ |
| - | - | - | - | f | - | - | - | 9 orbitals 18 |
| | - | - | - | d | - | - | - | 7 orbitals 14 |
| | | - | - | p | - | - | | 5 orbitals 10 |
| | | | - | s | - | | | 3 orbital 6 |
| | | | | s | | | | 1 orbital 2 |

- Each orbital can hold a total of 2 electrons.

e⁻ represented by an arrow (either up or down) that indicates spin.



Energy diagram

| | | | |
|---|------------------------|--|----------------------------|
| 2 | $\frac{1\uparrow}{2s}$ | $\frac{1\uparrow 1\uparrow 1\uparrow}{2p}$ | $\uparrow = 1$ Spin up |
| 1 | $\frac{1\uparrow}{1s}$ | | $\downarrow = 1$ Spin down |

Electronic Configuration - short hand notation for the energy diagram

$1s^2 2s^2 2p^6$
 \swarrow #e⁻ in Sublevel

\uparrow principle energy level \uparrow Sublevel

Principle energy levels
 1A
 2A
 3A
 4A
 5A
 6A
 7A
 8A
 18
 8A

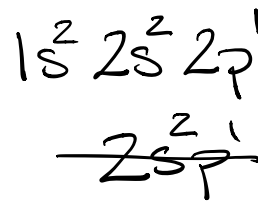
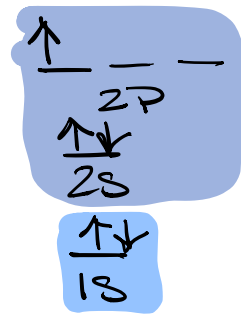
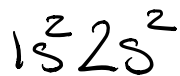
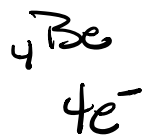
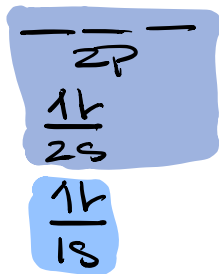
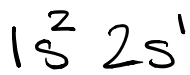
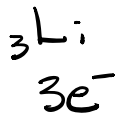
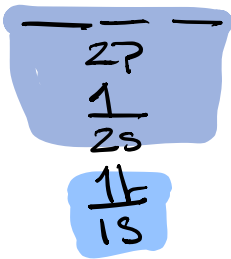
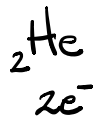
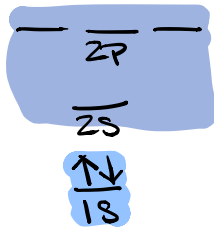
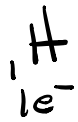
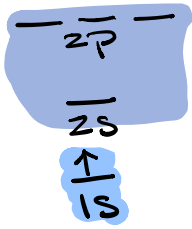
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|-------------------------------|--------------------------------|--------------------------------|-----------------------------------|-----------------------------------|---------------------------------|---------------------------------|--------------------------------|--------------------------------|----------------------------------|---------------------------------|---------------------------------|--------------------------------|--------------------------------|---------------------------------|---------------------------------|--------------------------------|-------------------------------|--|--|----------------------------|---------------------------|-----------------------------|---------------------------|-----------------------------|---------------------------|--|--|
| 1 | 1 H Hydrogen 1.008 | 2 2A | | | | | | | | | | | | | | | | | | | 2 He Helium 4.003 | | | | | | | |
| 2 | 3 Li Lithium 6.941 | 4 Be Beryllium 9.012 | | | | | | | | | | | | | | | | | | | 5 B Boron 10.81 | 6 C Carbon 12.01 | 7 N Nitrogen 14.01 | 8 O Oxygen 16.00 | 9 F Fluorine 19.00 | 10 Ne Neon 20.18 | | |
| 3 | 11 Na Sodium 22.99 | 12 Mg Magnesium 24.30 | 3 3B | 4 4B | 5 5B | 6 6B | 7 7B | 8 8B | 9 8B | 10 8B | 11 1B | 12 2B | 13 Al Aluminum 26.98 | 14 Si Silicon 28.09 | 15 P Phosphorus 30.97 | 16 S Sulfur 32.07 | 17 Cl Chlorine 35.45 | 18 Ar Argon 39.95 | | | | | | | | | | |
| 4 | 19 K Potassium 39.10 | 20 Ca Calcium 40.08 | 21 Sc Scandium 44.96 | 22 Ti Titanium 47.87 | 23 V Vanadium 50.94 | 24 Cr Chromium 52.00 | 25 Mn Manganese 54.94 | 26 Fe Iron 55.84 | 27 Co Cobalt 58.93 | 28 Ni Nickel 58.69 | 29 Cu Copper 63.55 | 30 Zn Zinc 65.39 | 31 Ga Gallium 69.72 | 32 Ge Germanium 72.61 | 33 As Arsenic 74.92 | 34 Se Selenium 78.96 | 35 Br Bromine 79.90 | 36 Kr Krypton 83.80 | | | | | | | | | | |
| 5 | 37 Rb Rubidium 85.47 | 38 Sr Strontium 87.62 | 39 Y Yttrium 88.91 | 40 Zr Zirconium 91.22 | 41 Nb Niobium 92.91 | 42 Mo Molybdenum 95.95 | 43 Tc Technetium 97.91 | 44 Ru Ruthenium 101.1 | 45 Rh Rhodium 102.9 | 46 Pd Palladium 106.4 | 47 Ag Silver 107.9 | 48 Cd Cadmium 112.4 | 49 In Indium 114.8 | 50 Sn Tin 118.7 | 51 Sb Antimony 121.8 | 52 Te Tellurium 127.6 | 53 I Iodine 126.9 | 54 Xe Xenon 131.3 | | | | | | | | | | |
| 6 | 55 Cs Cesium 132.9 | 56 Ba Barium 137.3 | 57 La Lanthanum 138.9 | 72 Hf Hafnium 178.5 | 73 Ta Tantalum 180.9 | 74 W Tungsten 183.8 | 75 Re Rhenium 186.2 | 76 Os Osmium 190.2 | 77 Ir Iridium 192.2 | 78 Pt Platinum 195.1 | 79 Au Gold 197.0 | 80 Hg Mercury 200.6 | 81 Tl Thallium 204.4 | 82 Pb Lead 207.2 | 83 Bi Bismuth 209.0 | 84 Po Polonium 209 | 85 At Astatine 210 | 86 Rn Radon 222 | | | | | | | | | | |
| 7 | 87 Fr Francium 223 | 88 Ra Radium 226 | 89 Ac Actinium 227 | 104 Rf Rutherfordium 261 | 105 Db Dubnium 262 | 106 Sg Seaborgium 263 | 107 Bh Bohrium 262 | 108 Hs Hassium 265 | 109 Mt Meitnerium 266 | 110 Ds Darmstadtium 269 | 111 Rg Roentgenium 272 | 112 Cn Copernicium 277 | 113 Nh Nihonium 289 | 114 Fl Flerovium 289 | 115 Mc Moscovium 289 | 116 Lv Livermorium 289 | 117 Ts Tennessine 289 | 118 Og Oganesson 289 | | | | | | | | | | |
| | | | Lanthanides | 58 La Lanthanum 138.9 | 59 Pr Praseodymium 140.9 | 60 Nd Neodymium 144.2 | 61 Pm Promethium 145 | 62 Sm Samarium 150.4 | 63 Eu Europium 152.0 | 64 Gd Gadolinium 157.2 | 65 Tb Terbium 158.9 | 66 Dy Dysprosium 162.5 | 67 Ho Holmium 164.9 | 68 Er Erbium 167.3 | 69 Tm Thulium 168.9 | 70 Yb Ytterbium 173.0 | 71 Lu Lutetium 175.0 | | | | | | | | | | | |
| | | | Actinides | 90 Th Thorium 232.0 | 91 Pa Protactinium 231.0 | 92 U Uranium 238.0 | 93 Np Neptunium 237 | 94 Pu Plutonium 244 | 95 Am Americium 243 | 96 Cm Curium 247 | 97 Bk Berkelium 247 | 98 Cf Californium 251 | 99 Es Einsteinium 252 | 100 Fm Fermium 257 | 101 Md Mendelevium 258 | 102 No Nobelium 259 | 103 Lr Lawrencium 262 | | | | | | | | | | | |

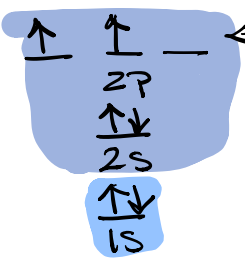
d-block

f-block

filling order

1s 2s 2p 3s 3p 4s 3d 4p 5s 4d 5p 6s

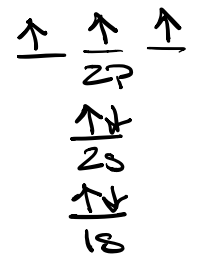




${}_6\text{C}$
 $6e^-$

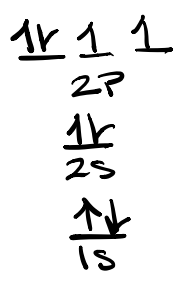
$$1s^2 2s^2 2p^2$$

Half fill each
Sublevel all same
Spin \rightarrow only pair
when all orbitals
are half filled
 \Rightarrow don't pair unless
you have to



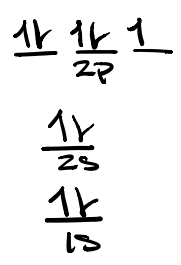
${}_7\text{N}$
 $7e^-$

$$1s^2 2s^2 2p^3$$



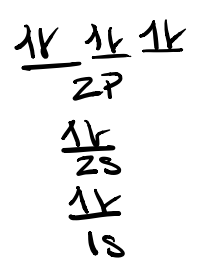
${}_8\text{O}$
 $8e^-$

$$1s^2 2s^2 2p^4$$



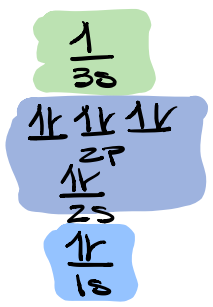
${}_9\text{F}$
 $9e^-$

$$1s^2 2s^2 2p^5$$



${}_{10}\text{Ne}$
 $10e^-$

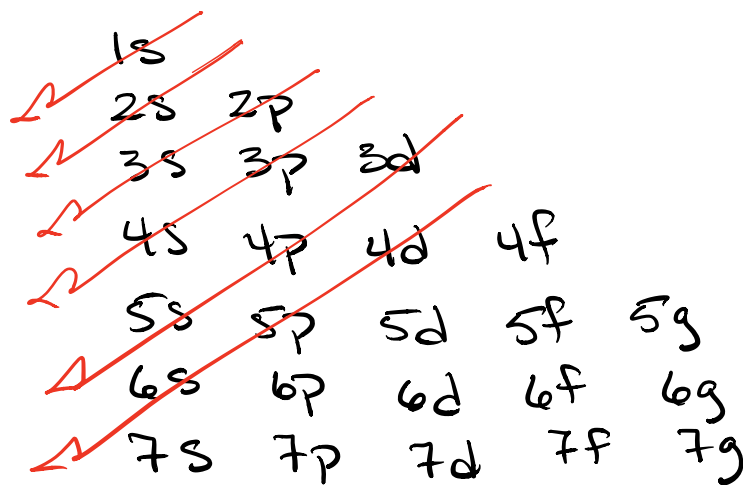
$$1s^2 2s^2 2p^6$$



"Na
 $11e^-$
 $1s^2 2s^2 2p^6 3s^1$

Filling order for orbitals

- Learn the layout of the PT
- Memorization tool



1s 2s 2p 3s 3p 4s 3d 4p 5s 4d 5p 6s
filling order of the energy diagram