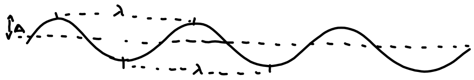
Tuesday 1/21/20

Start of Ch 4 "Electrons in atoms" (Arrangement of...)

Electrons exhibit wave-particle duality

electrons as particles → Television (compact, rare)

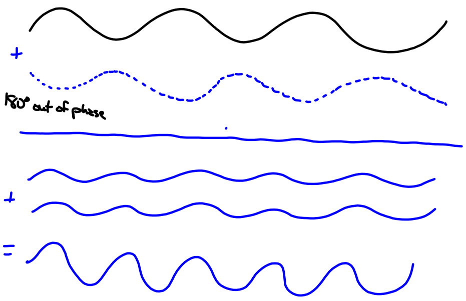
as waves → constructive & destructive interference patterns in double-slit experiment



wave speed = wave length × frequency

For light (& other electromagnetic radiation the speed is fixed. → $c = 3.00 \times 10^8$ m/s

outside noise



constructive interference

photons (light) also exhibit wave-particle duality

photon - a mass-less wave-packet of energy

acting as a wave → mirage effect on a hot road
rainbow effect through a prism
or off of a CD surface.

acting as a particle → LASER cutting of materials
the photo-electric effect.

shorter wavelengths are diffracted through large angles

longer wavelengths are diffracte through much smaller angles

Releigh scattering

For light waves

$c = \lambda \nu$

v = "vee"

ν = "nu" fancy "vee"

c = S.O.L. = 3.00×10^8 m/s

λ = wavelength (m)

ν = the frequency (nu)

Energy of an photon $E = h\nu$

Energy (Joules)

h = Planck's Constant 6.626×10^{-34} J·s

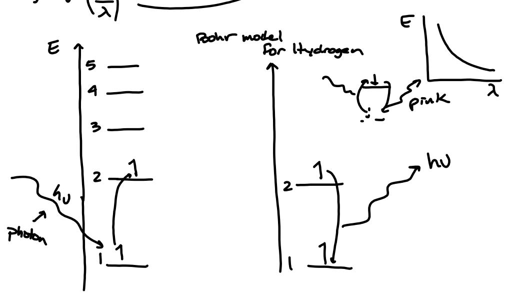
ν = frequency $\frac{1}{s}$ (s^{-1}) Hz

i) $c = \lambda \nu$

ii) $\nu = \left(\frac{c}{\lambda}\right)$

$E = h\nu$

$\boxed{E = \frac{hc}{\lambda}}$



Read: ~

DO: 15-22 p. 126

Quantum #s (there are four in total)

① The principal Q.N. n can take integer values (from $1 \to \infty$)

n tells us i) relative energy of the orbital

ii) relative average distance from nucleus the orbital projects.

② Angular momentum quantum number ℓ can take integer values from 0 to $(n-1)$

ℓ tells us i) the type of sublevel the orbital is in

ii) the shape of the orbitals in that sublevel.

If $\ell = 0$ then s-sublevel

$\ell = 1$ then p-sublevel

$\ell = 2$ then d-sublevel

$\ell = 3$ then f-sublevel

③ The magnetic quantum number m_ℓ can take integer values from $(-\ell$ to $+\ell)$

m_ℓ tells us i) how the orbitals project into space

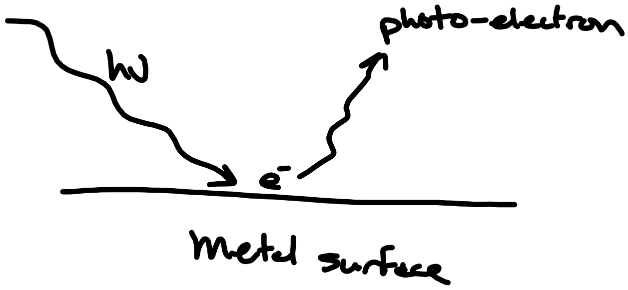
i) really, how many different orbitals are in the sublevel

So: when $\ell =$

	ℓ	m_ℓ	# of orbitals	Shape
s	0	0	1	
p	1	-1, 0, +1	3	 p_x p_y p_z
d	2	-2, -1, 0, 1, 2	5	
f	3	-3, -2, -1, 0, 1, 2, 3	7	right

④ The electron spin quantum # m_s $[-1/2, +1/2]$

this qn tells us i) the maximum occupancy of any orbital is $2e^-$.



ϕ = work function = the amount of energy required to release 1 electron from surf.

Wed. 1/22/20

from the homework #22

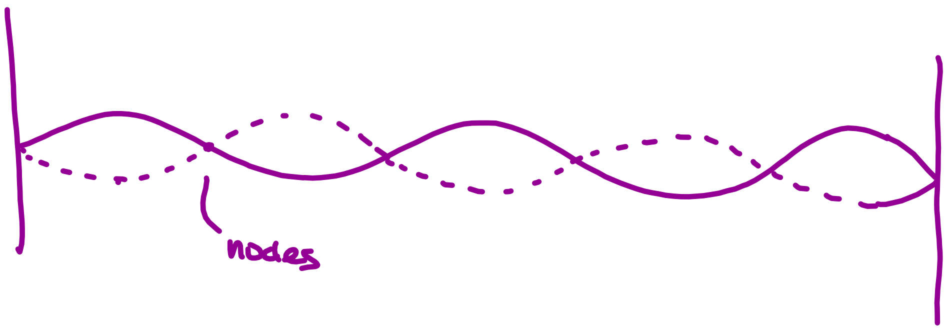
How many e^- in the following main energy levels?

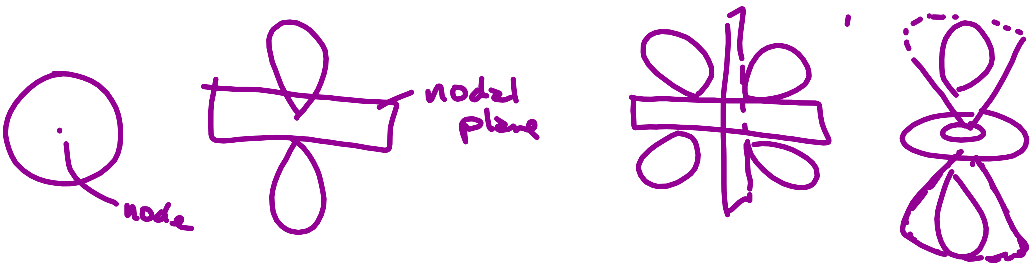
		n $(1 \to \infty)$	ℓ $[0 \to (n-1)]$	m_ℓ $(-\ell \to +\ell)$	m_s $-1/2; +1/2$	# e^-
22)	a) $n=1$	1	0 - s	0	$-1/2, +1/2$	2
	b) $n=3$	3	0 - s	0	$-1/2 / +1/2$	2
			1 - p	$-1, 0, +1$		6
			2 - d	$-2, -1, 0, 1, 2$		10
						$18e^-$
	c) $n=4$	4	0 - s	0 (1)		2
			1 - p	$-1, 0, +1$ (3)		6
			2 - d	$-2, -1, 0, +1, +2$ (5)		10
			3 - f	$-3, -2, -1, 0, +1, +2, +3$ (7)		14
						$32e^-$

d) $n=6$ $\quad$ $\#e^- = 2n^2 = 72e^-$

$$\left.\begin{array}{ll} 1 & 1\text{-orb} \\ 2 & 3\text{-orbs} \\ 3 & 5\text{-orbs} \\ 4 & 7\text{-orbs} \\ 5 & 9\text{-orbs} \\ 6 & 11\text{-orbs!} \end{array}\right\} 36 \text{ orbitals} \times 2 = 72e^-$$

Chem 1 A
Homework Due 1/23/20
Read: 4.3
DO: 1-6 p.122


nodes


node
nodal plane

Thurs 1/23/20

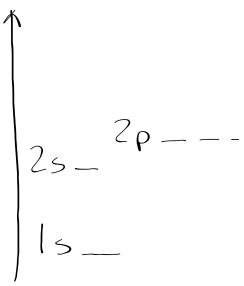
Ground State Electron Configurations in atoms

3 rules for assigning electrons to orbitals for atoms in the ground state.

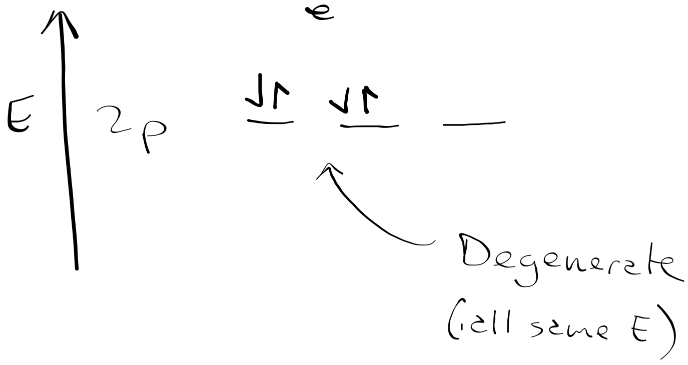
n	ℓ	m_ℓ	m_s
2	1	0	

① Aufbau rule
→ "Building up"
→ Lowest energy orbitals fill 1st

② Pauli Exclusion Principle
→ 1 set of quantum numbers (4) can describe only 1 e^-
→ Orbitals can hold up to 2 e^- each



③ Hund's Rule
→ When e^- fill orbitals that are degenerate they fill each orbital singly before pairing up. e^-
→ Ski Trip



Write complete electron configurations for the following

a) $_{6}C$

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

b) $_{34}Se$

$\boxed{1s^2 2s^2 2p^6 3s^2 3p^6} 4s^2 3d^{10} 4p^4$

$[Ar]\ 4s^2 3d^{10} 4p^4$

$[Ar]\ 3d^{10} \underline{4}s^2 \underline{4}p^4$

E

$2p$ $\underline{\downarrow}$ $\underline{\downarrow}$ $\underline{\ \ }$

$2s$ $\underline{\downarrow\uparrow}$

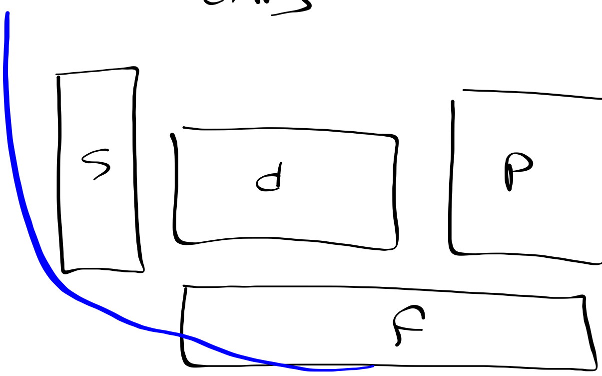
$1s$ $\underline{\downarrow\uparrow}$

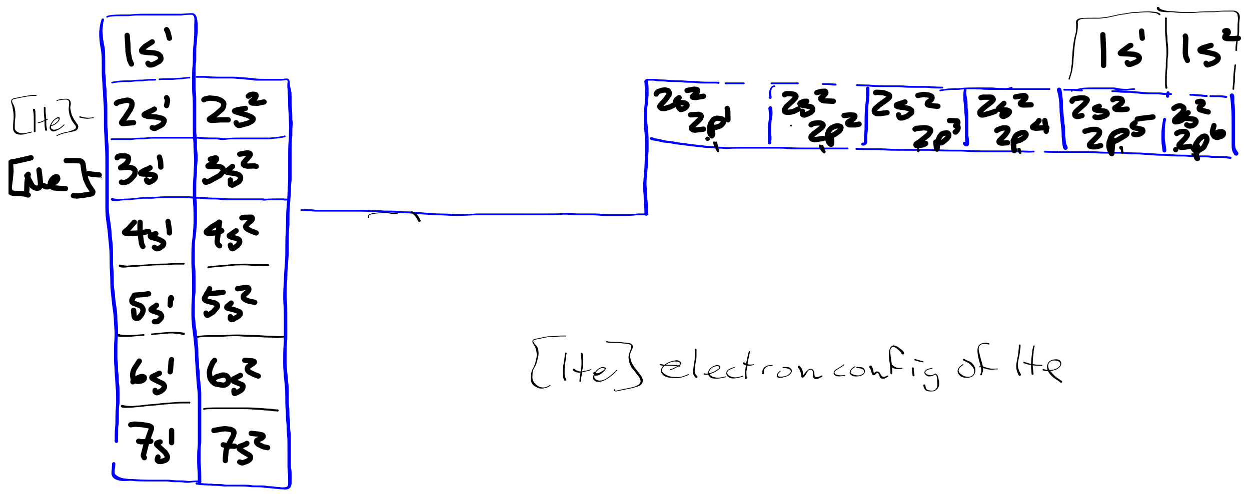
c) Cl

$1s^2 2s^2 2p^6 3s^2 3p^5$

d) Ca^{2+} $1s^2 2s^2 2p^6 3s^2 3p^6$

[Ar]





[He] electron config of He

#e=4

2p ↓ ↓ ↓ ← HUND'S RULE

3 unpaired e^-

2s ↓↑

1s ↓↑

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

"Orbital Notation"

for

$$C \rightarrow \underset{1s}{\underline{\downarrow\uparrow}}\quad \underset{2s}{\underline{\downarrow\uparrow}}\quad \underset{2p}{\underline{\downarrow}\ \underline{\downarrow}\ \underline{\quad}}$$

regular ol' electron config notation

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

Equations useful for FLAME TEST LAB ANAYSIS

speed of electromagnetic radiation

$$C = \lambda \nu$$

$c = 3.00 \times 10^{8}$ m/s

nm 405 nm = 405×10^{-9} m

n

energy of a photon (in terms of frequency (ν))

$$E = h\nu$$

$h = 6.626 \times 10^{-34}$ J·s

energy of a photon (in terms of wavelength)

$$E = \frac{hc}{\lambda}$$

λ = wavelength (in m)

$h = 6.626 \times 10^{-34}$ J·s

$c = 3.00 \times 10^{8}$ m/s

2 d) Calculate frequency, in Hz of highest energy light in (c)

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

$$\nu = \frac{c}{\lambda} = \frac{3.00\times10^{8}\ \text{m/s}}{405\times10^{-9}\ \text{m}} = s^{-1}$$

$E = h\nu$

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

$E = \frac{hc}{\lambda}$ (const)

$$E = \frac{(6.626\times10^{-34}\ \text{J}\cdot\text{s})(3.00\times10^{8}\ \text{m/s})}{405\times10^{-9}\ \text{m}}$$

$$\nu = \frac{E}{h} = \frac{E}{6.626\times10^{-34}\ \text{J}\cdot\text{s}}$$

Ans: Just use

"n"

$405\,nm \rightarrow 405 \times 10^{-9}\,m$

nano $\times 10^{-9}$

$405\,nm \times \frac{1\,m}{1 \times 10^{9}\,nm} =$

R O Y G B I V

$\leftarrow$ λ increasing

ν increasing $\rightarrow$

E increasing $\rightarrow$

$\rightarrow s^{-1}$

405nm $\qquad 3.00\times10^{8}\,m/s$

$405\times10^{-9}\,m$

$$\frac{3.00\times10^{8}\,\cancel{m}}{1s}\times\frac{1}{405\times10^{-9}\,\cancel{m}}=$$

$$\frac{3.00\times10^{8}\,m/s}{405\times10^{-9}\,m}=$$

$$E=\frac{hc}{\lambda}$$

$$\lambda=\frac{hc}{E}$$

n	l	sublevels	# of orbitals	# of e⁻ per main en. level
1	0			2
2		s p		
3			9	
4	0 1 2 3			32