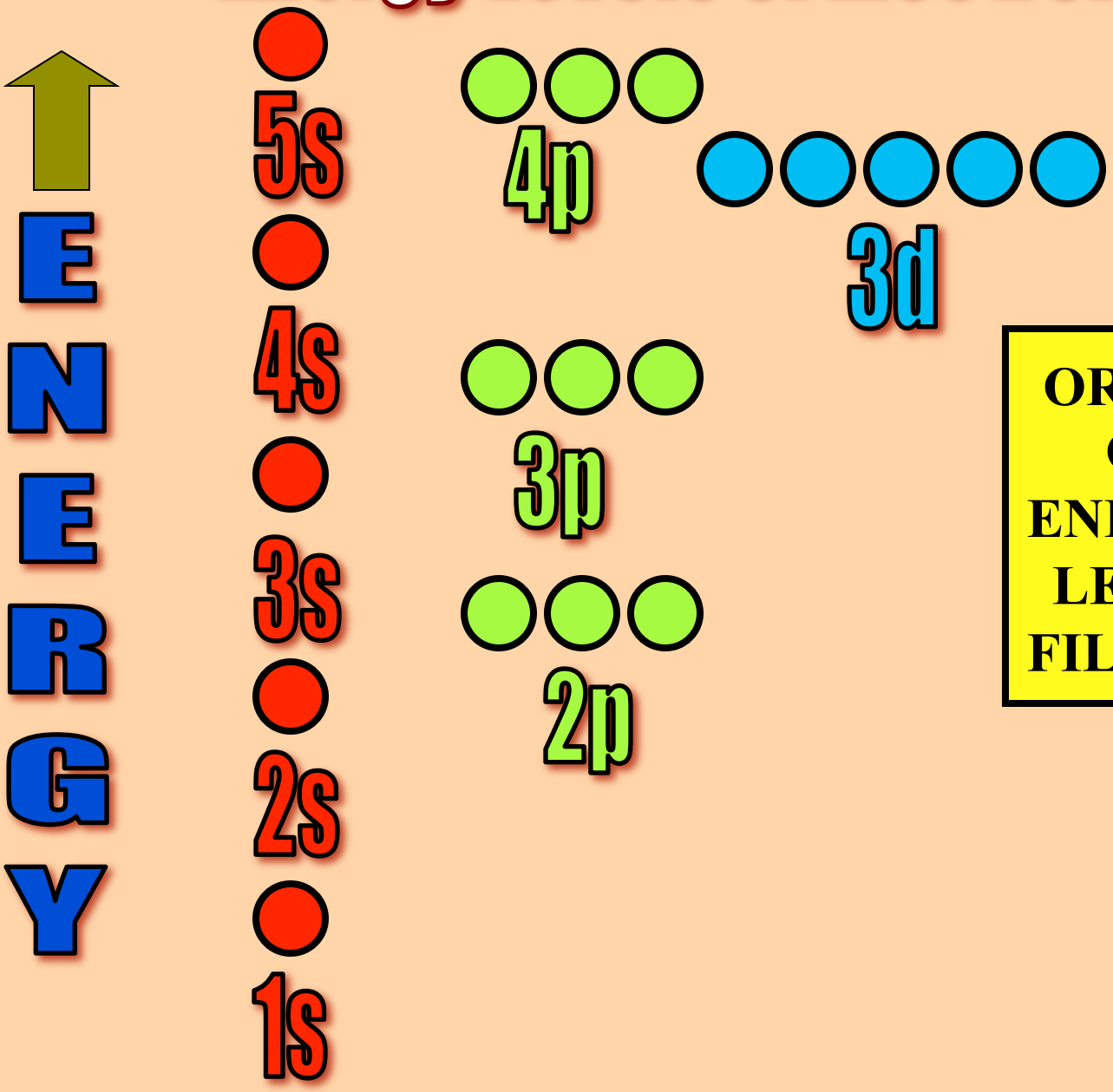
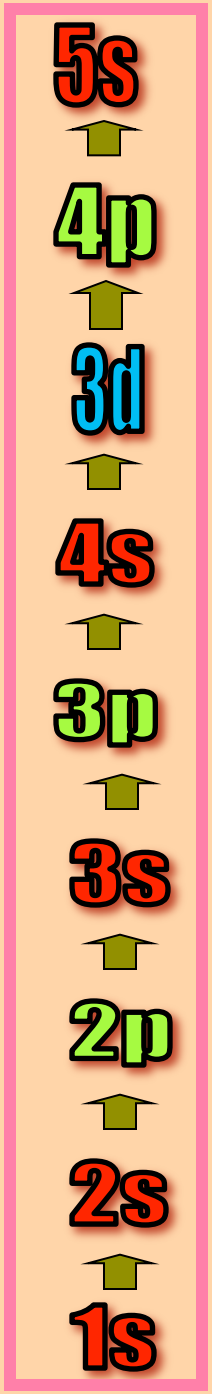
Isoelectronic Configurations

Unit 2 – Ch 5.2-5.3

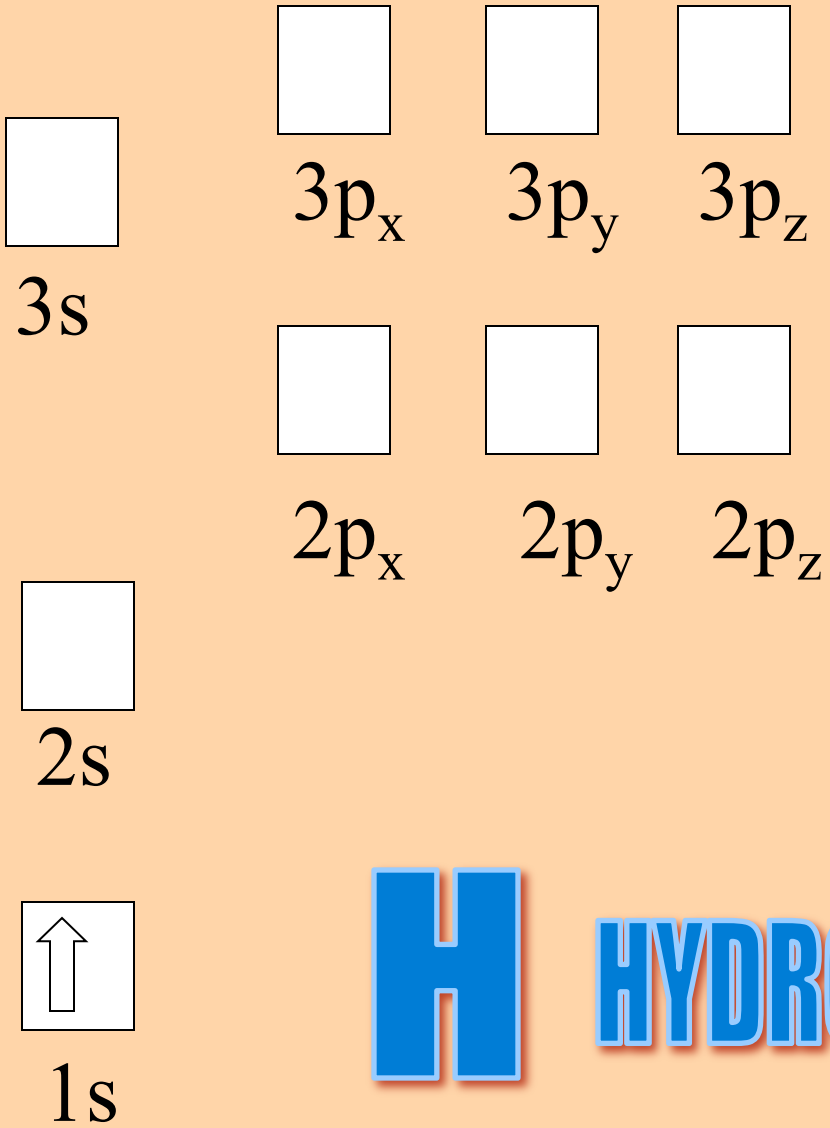
Energy Levels of Electrons



ORDER OF ENERGY LEVEL FILLING



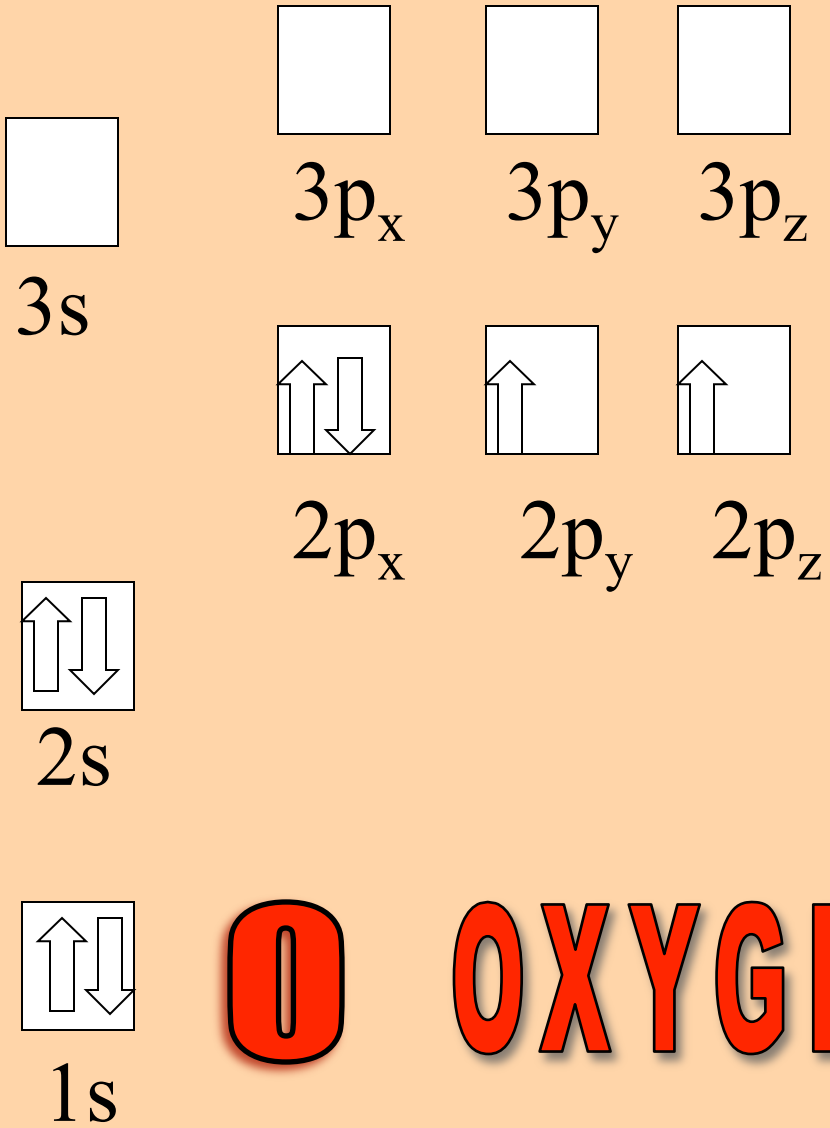
Orbital (Diagram) Notation



1 ELECTRON

H HYDROGEN $1s^1$

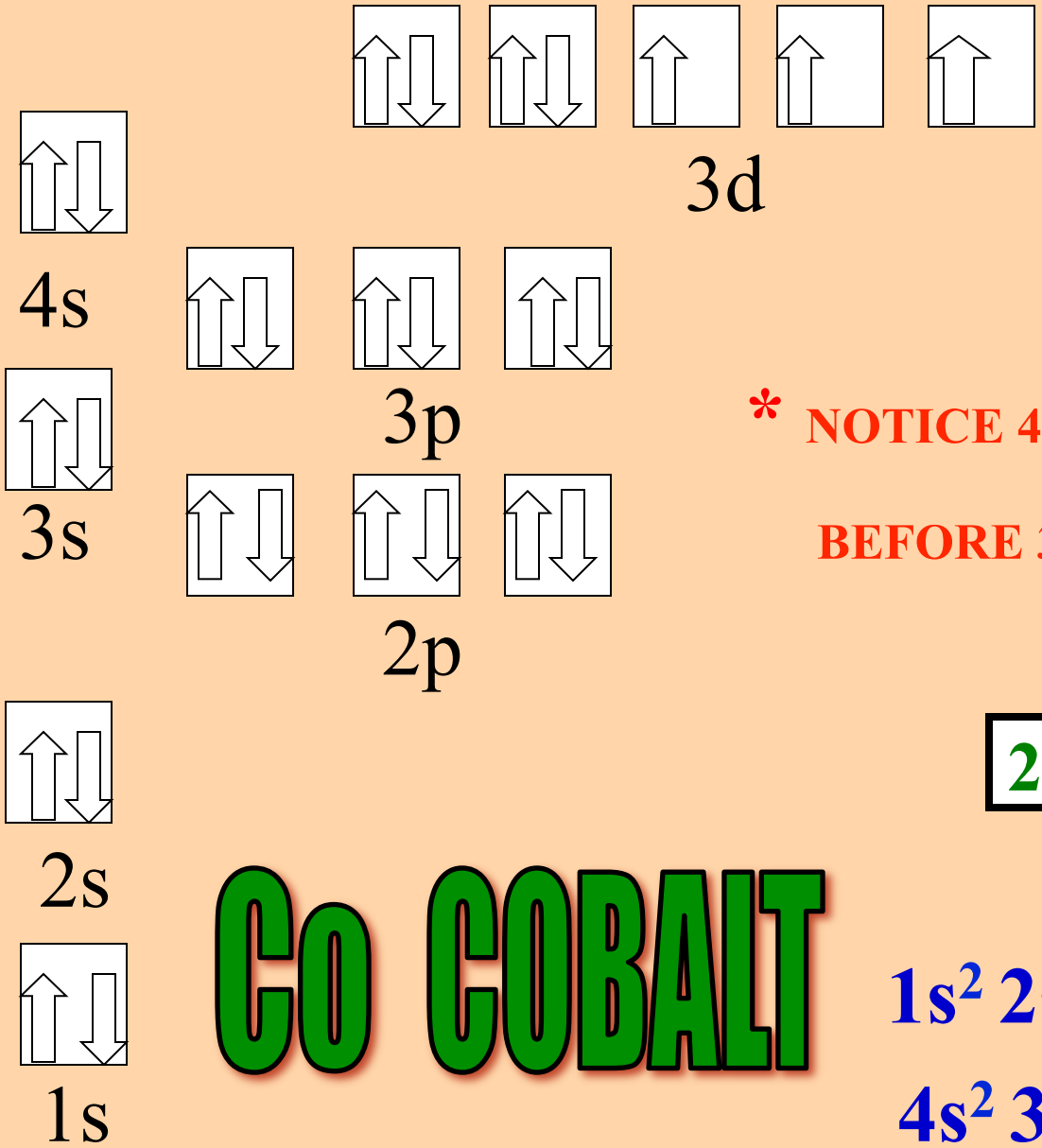
Orbital (Diagram) Notation



8 ELECTRONS

O OXYGEN $1s^2\ 2s^2\ 2p^4$

Orbital (Diagram) Notation



* NOTICE 4s ORBITALS FILL BEFORE 3d ORBITALS !! *

27 ELECTRONS

Co COBALT

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

$4s^2\ 3d^7$

THE BIG PICTURE

Energy Level	Max # e^- *per energy level* ($2n^2$)	Sublevels (Subshells)	Max # e^- *per sublevel*	# of Orbitals *per sublevel*	Max # e^- *per orbital*
n = 1	2 e^-	"1s"	2 *= 2 e^-*	1 (pair)	2 e^-
n = 2	8 e^-	"2s" "2p"	2 6 *= 8 e^-*	1 (pair) 3 (pairs)	2 e^-
n = 3	18 e^-	"3s" "3p" "3d"	2 6 10 *= 18 e^-*	1 (pair) 3 (pairs) 5 (pairs)	2 e^-
n = 4	32 e^-	"4s" "4p" "4d" "4f"	2 6 10 14 *= 32 e^-*	1 (pair) 3 (pairs) 5 (pairs) 7 (pairs)	2 e^-

ELECTRON CONFIGURATIONS OF *IONS*

- **WHAT IS AN *ION*?**
  - **CHARGED** particle (Atom)
- **HOW ARE IONS *FORMED*?**
  - ***GAINING*** OR ***LOSING*** electrons
- **WHAT ARE THE TWO *TYPES* OF IONS?**
  - **CATIONS (+)**
  - **ANIONS (-)**
- **HOW ARE CATIONS AND ANIONS *FORMED*?**
  - **CATIONS (+) → *LOSE*** electrons
  - **ANIONS (-) → *GAIN*** electrons

ELECTRON CONFIGURATIONS OF *IONS*

❖ **WHAT *TYPES* OF ATOMS GENERALLY FORM CATIONS AND ANIONS ?**

- **CATIONS (+)** formed by ***METALS***
  - Found in **"s" "p" "d" "f"** blocks
- **ANIONS (-)** formed by ***NONMETALS***
  - Found in **"p"** block **ABOVE** ***Metalloid Staircase***

+1	+2											+3		-3	-2	-1	
1 1A												13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1 H	2 2A																2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg	3	4	5	6	7	8	9	10	11	12	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La*	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac†	104 Unq	105 Unp	106 Unh	107 Uns	108 Uno	109 Une	110 Uun	111 Uuu							

*Lanthanides	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
†Actinides	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

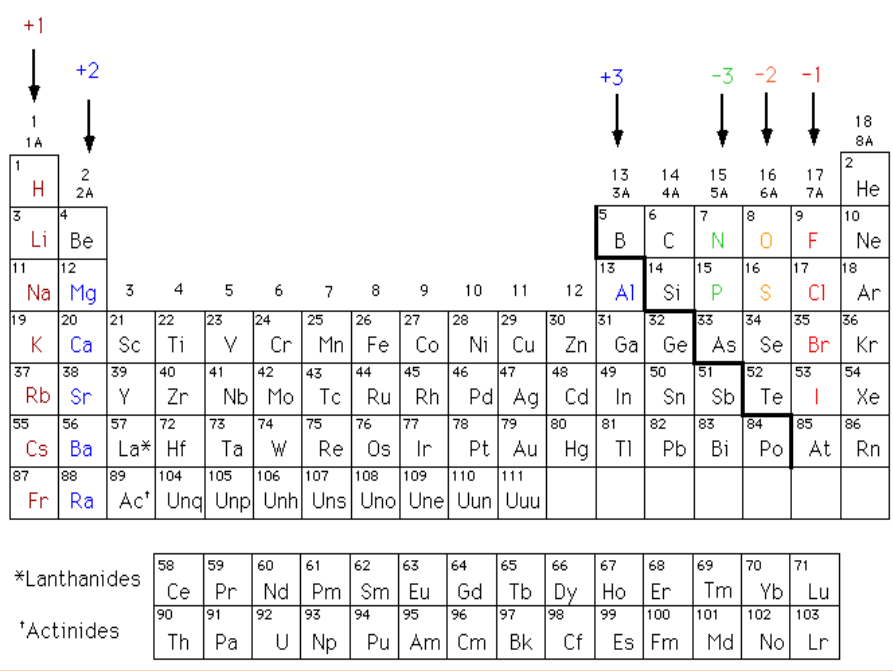
ISOELECTRONIC **CONFIGURATIONS**

- **DEFINITION:** ***Atoms*** or ***ions*** with ***SAME*** number of ***ELECTRONS***
  - Therefore, ***SAME*** electron **configuration**
- **EX: (Mg^{2+})** & **(N^{3-})** have same # of **ELECTRONS**
  - ***Isoelectronic*** with ***NOBLE GAS*** → **NEON** (Atomic #10)
- In doing this, atoms achieve a ***FULL OCTET*** **:** ***(8 Valence e^-)***
  - Results in ***CHEMICAL STABILITY*** **!**

ISOELECTRONIC **CONFIGURATIONS**

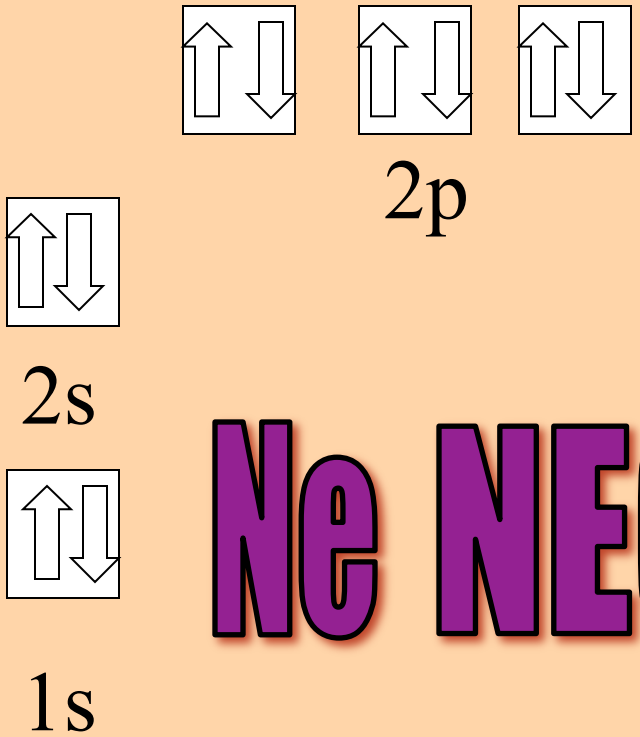
- **EX:** Name ***IONS*** that are ***isoelectronic*** with ***NEON (Ne)***:

  — **N^{-3}, O^{-2}, F^{-1}, Na^{+1}, Mg^{+2}, Al^{+3}**



ISOELECTRONIC WITH *NEON*

N^{-3}, O^{-2}, F^{-1}, Na^{+1}, Mg^{+2}, Al^{+3}



SECOND
ENERGY LEVEL IS COMPLETED

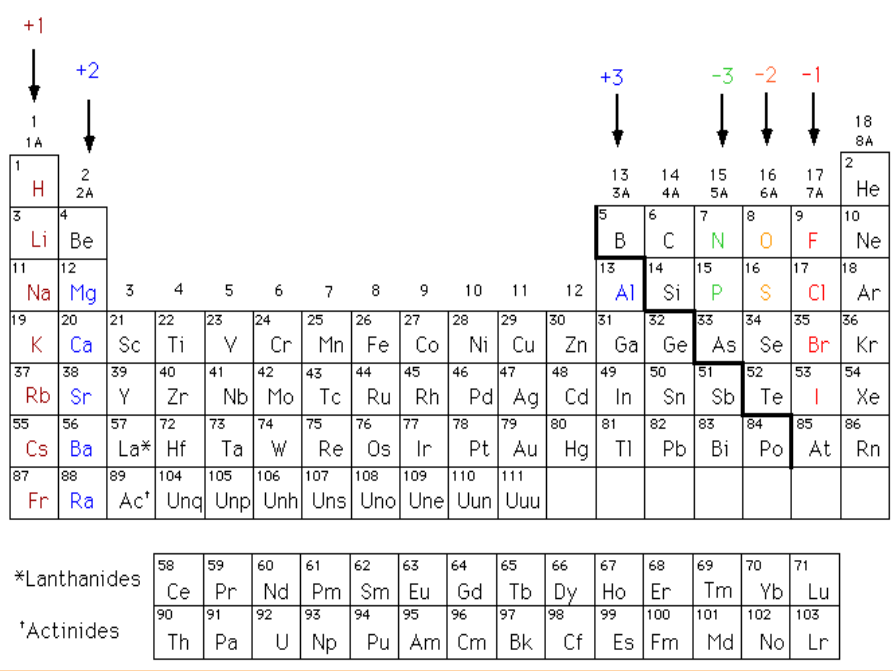
Ne NEON

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

ISOELECTRONIC **CONFIGURATIONS**

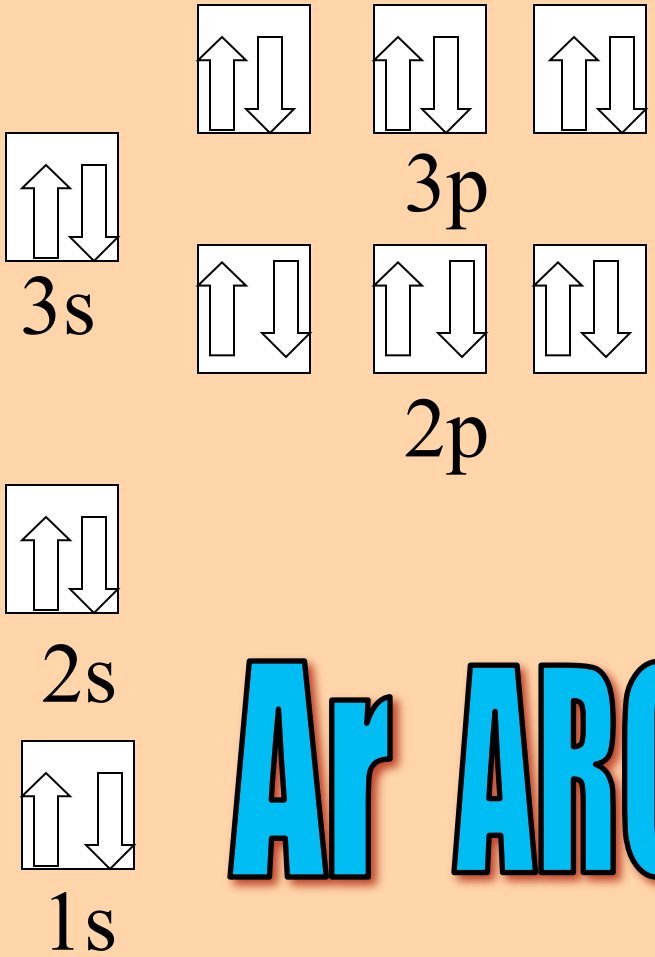
- **EX:** Name ***IONS*** that are ***isoelectronic*** with ***ARGON (Ar)***:

  — P^{-3}, S^{-2}, Cl^{-1}, K^{+1}, Ca^{+2}



ISOELECTRONIC WITH *ARGON*

P^{-3}, S^{-2}, Cl^{-1}, K^{+1}, Ca^{+2}



THIRD
ENERGY LEVEL IS COMPLETED

Ar ARGON

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