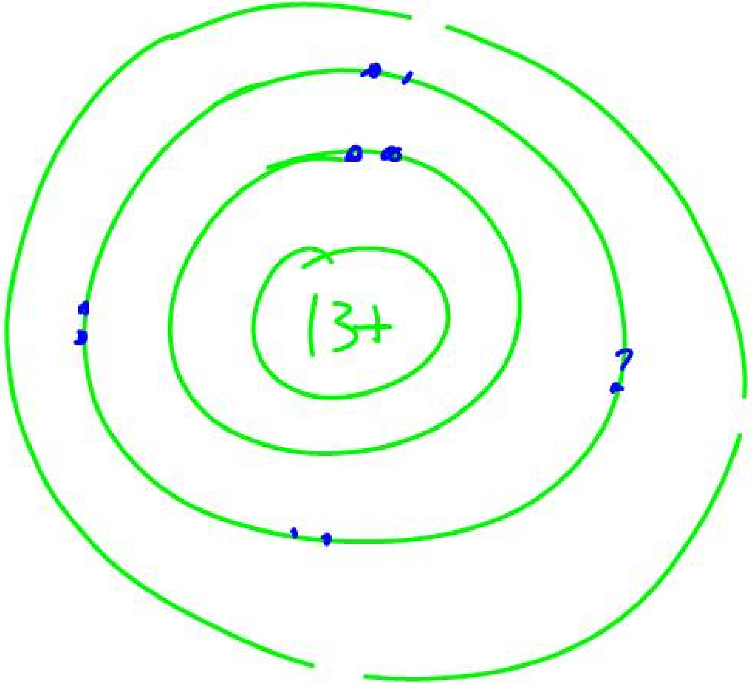
The Atom

Online Book Intro Atom

$_{13}Al$



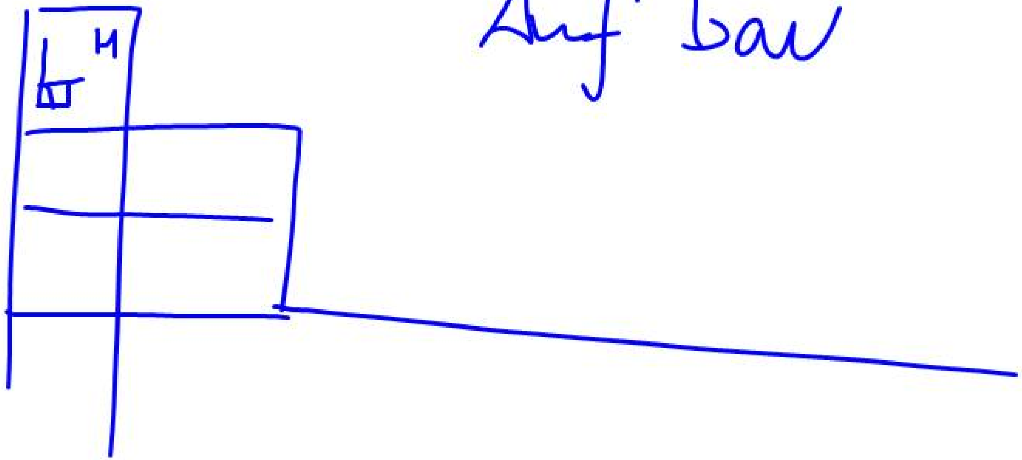
$10e^-$

$13\ p^+$

$+3$

Al^{3+}

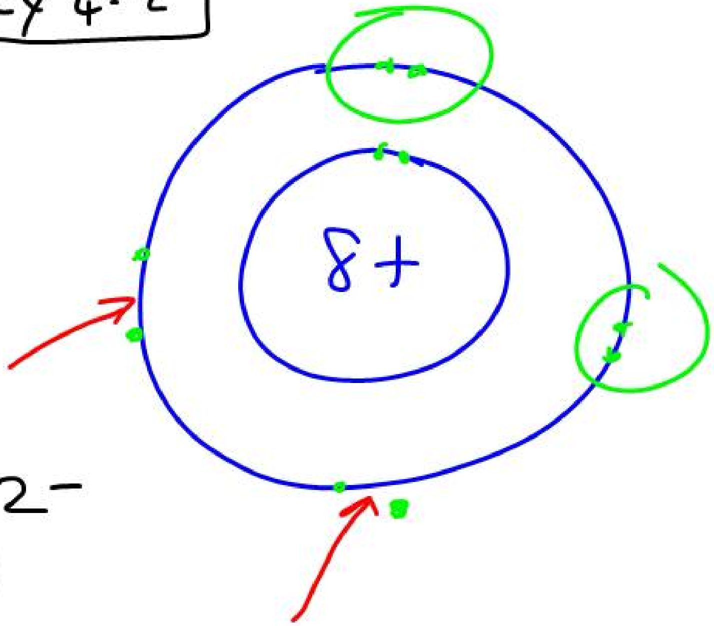
Aufbau



Ex 4.2

Lone pairs

$^{16}_{8}O$



O^{2-}

$10e^-$

$_{16}S$

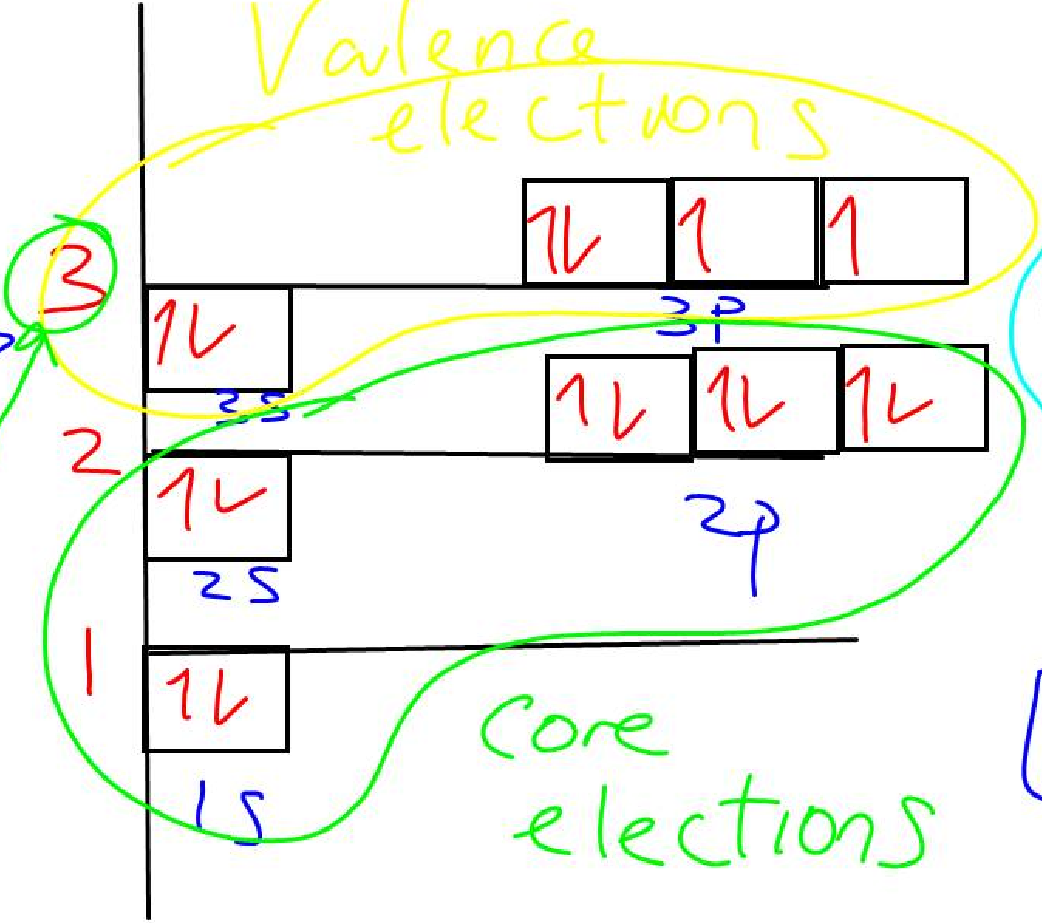
Aufbau

electron configuration

$16e^-$

Group 6

Period 3



$1s^2 2s^2 2p^6 3s^2 3p^4$

Group

Period

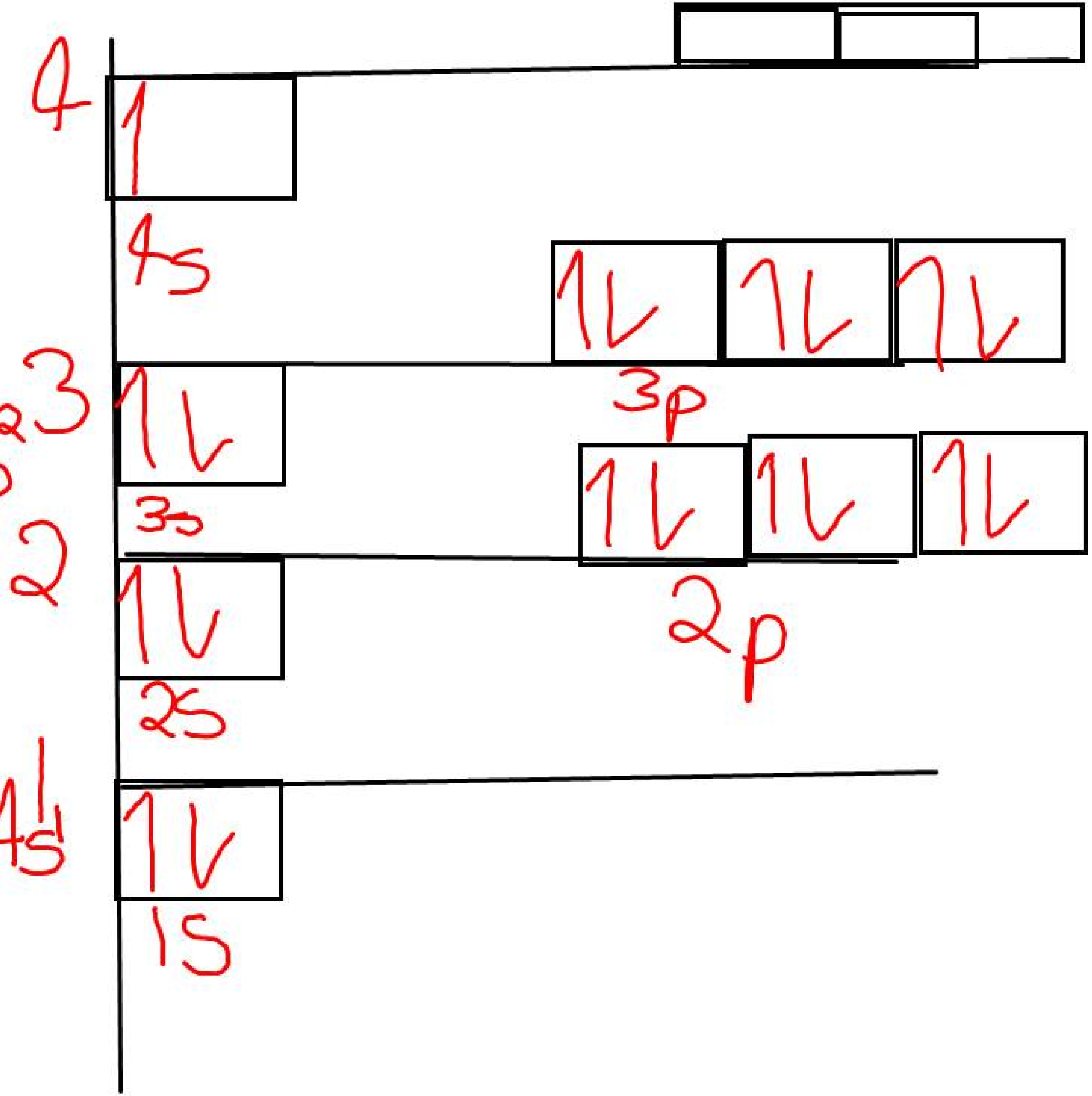
Core e^-

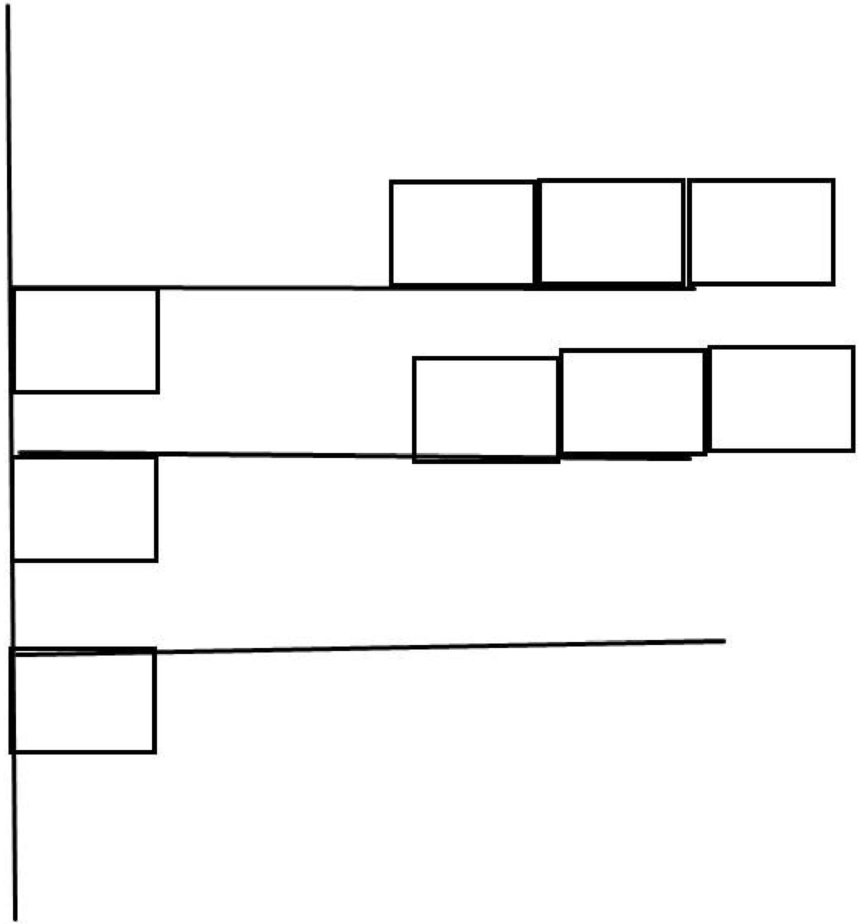
$[Ne]3s^2 3p^4$

$_{19}K$

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$.

$[Ar]4s^1$

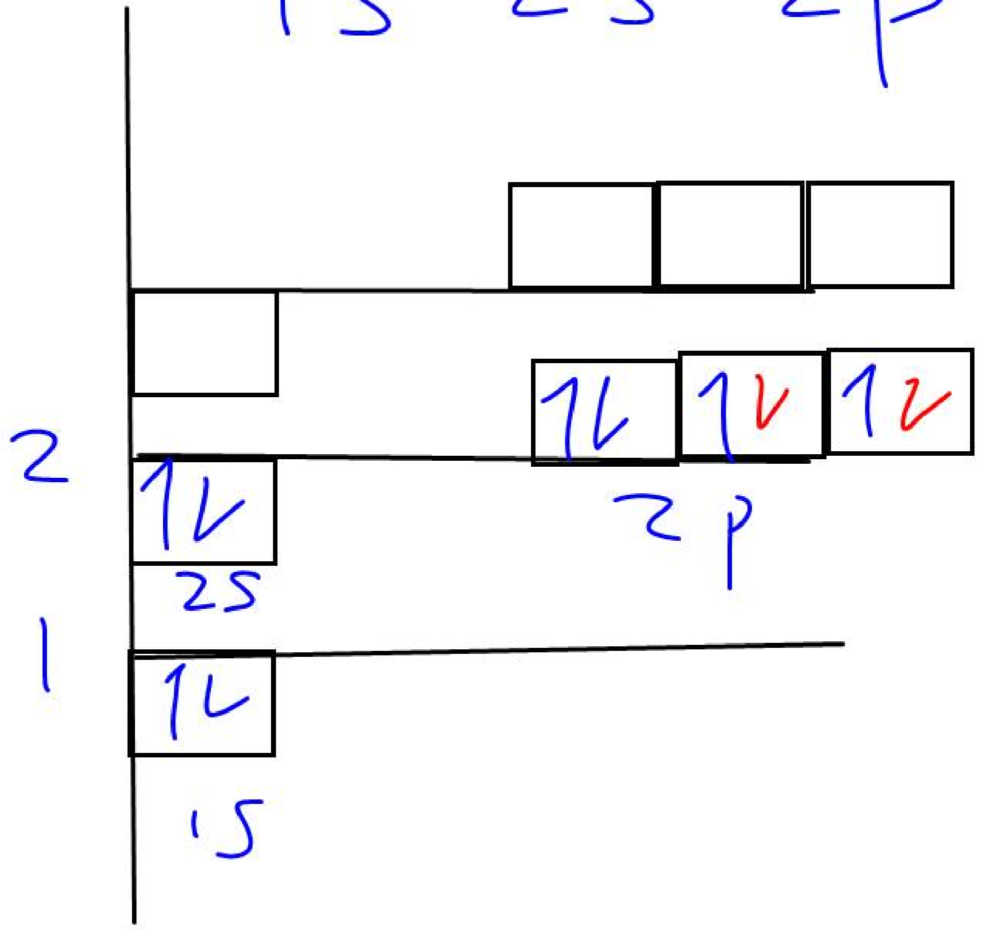


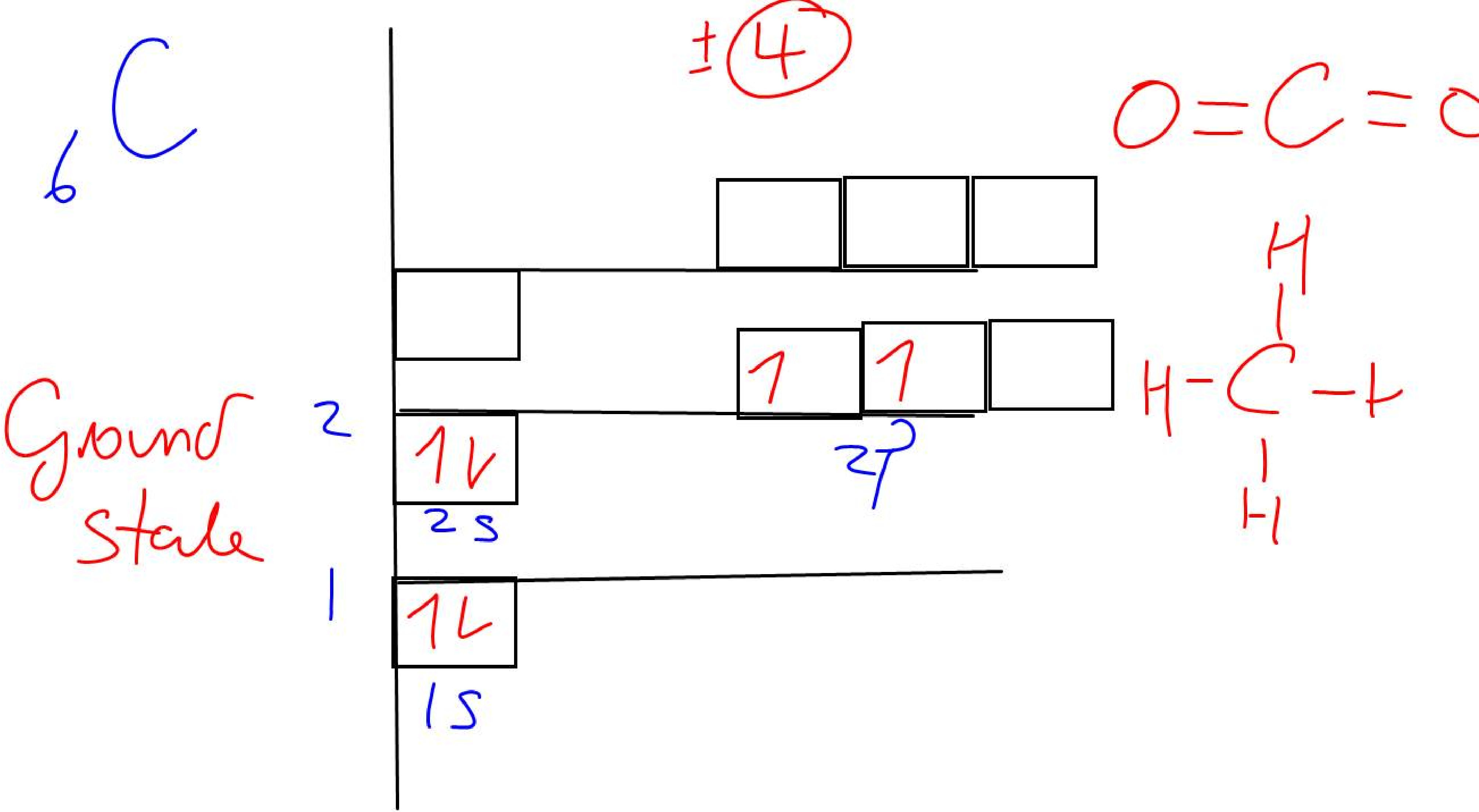


$_{8}O^{0}$

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

O^{2-}




6C
±4
O=C=O
H
H-C-H
H
Ground state
2
1
1↓↓
1↓↓
↑
↑
2s
1s
2p

3) (a) $^{39}_{19}K$

(b) $^{64}_{29}Cu$

(c) $^{35}_{17}Cl$

4 (a) 17

(b) 18

(c) 17

5) (d) $^{15}_{7}N$

6) (a) Ar

(b) 40

(c) 15

(7)

A mass No.

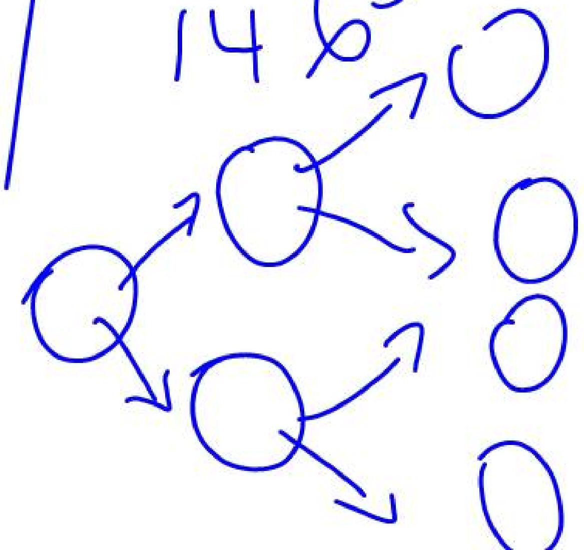
Z Atomic No.

N neutron

$^{A}_{Z}X$

	Mass No. A (+ and n°)	Atomic No. Z (+)	N (n°)
$^{235}_{92}U$	235	92	143
$^{238}_{92}U$	238	92	146

Isotopes



8

16

(6) 19,9% B – 10 R.A.M.

80,1% B – 11

$$19{,}9\% \times 10 = 1{,}99$$

$$+ \quad 80{,}1\% \times 11 = + \ 8{,}81$$

$$10{,}80 \ u$$

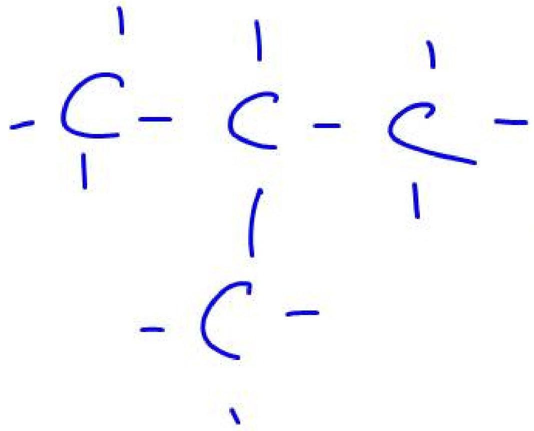
7)

79% Mg-24 = 18,96

10% Mg-25 = + 2,5

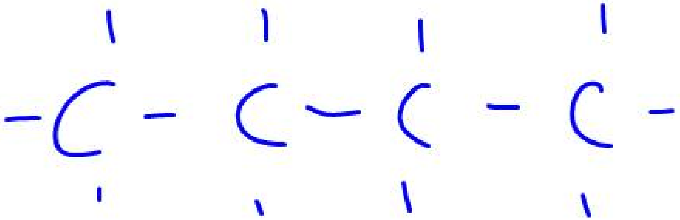
11% Mg-26 = + 2,86

24,32 u



C_4H_{10}

ISOMER



C_4H_{10}

8) $^{A}_{Z}X$ - STD Notation

$^{234}_{92}U$

(a) $^{232}_{92}U$

(b) $^{238}_{92}U$

9 (b)

10

(a) 16

(b) 33

(c) 16

(d) 17

DEMOCRITUS'S ATOMIC THEORY

This is the Greek philosopher Democritus who began the search for a description of matter more than 2400 years ago. He asked: Could matter be divided into smaller and smaller pieces forever, or was there a limit to the number of times a piece of matter could be divided?

His theory: Matter could not be divided into smaller and smaller pieces forever, eventually the smallest possible piece would be obtained. This piece would be indivisible. He named the smallest piece of matter “atomos,” meaning “not to be cut.”

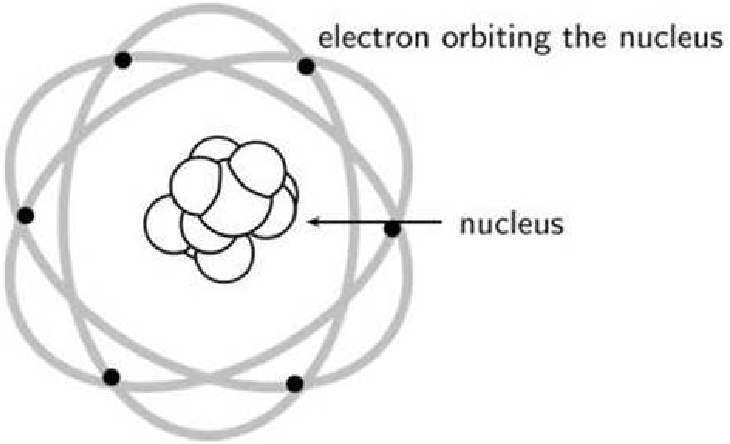
To Democritus, atoms were small, hard particles that were all made of the same material but were different shapes and sizes. Atoms were infinite in number, always moving and capable of joining together.

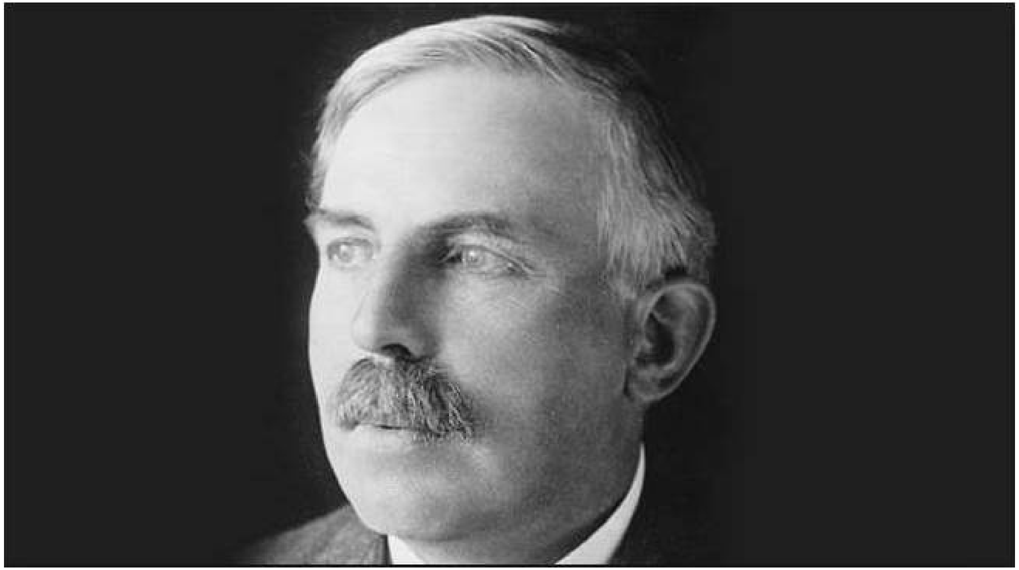
The Billiard Ball

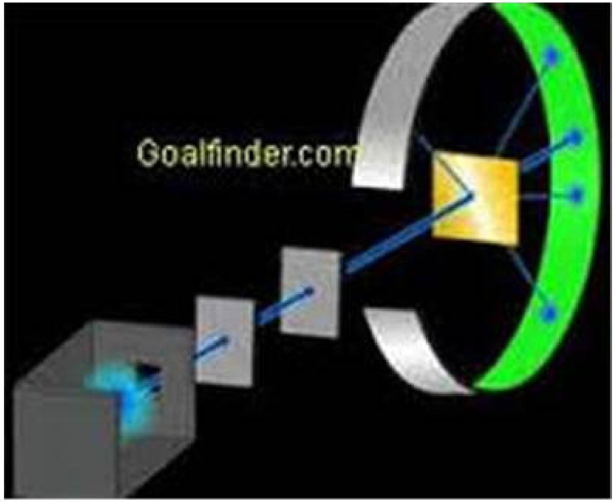
John Dalton

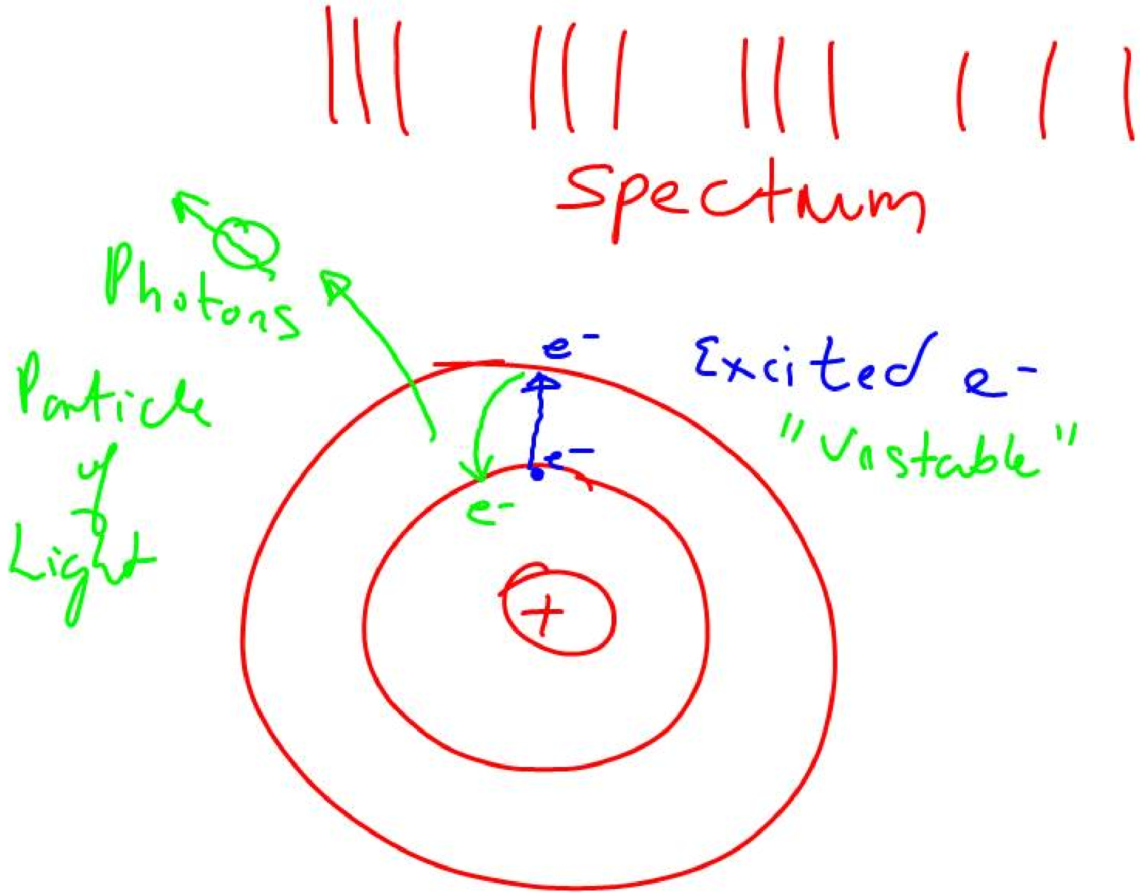
J. J. Thomson

Ernest Rutherford









Niels Bohr

e⁻s in fixed energy levels

QUANTUM MECHANICS 1925 - 1927

THE UNCERTAINTY PRINCIPLE

> The more precisely the position is determined, the less precisely the momentum is known in this instant, and vice versa.
>
> --Heisenberg, uncertainty paper, 1927

This is a succinct statement of the "uncertainty relation" between the position and the momentum (mass times velocity) of a subatomic particle, such as an electron. This relation has profound implications for such fundamental notions as causality and the determination of the future behavior of an atomic particle.

Werner Heisenberg

$^{A}_{Z}X$ — Symbol of Element

A – Mass No. — Amount of $p^+ + N^0$ → Nucleons

Z – Atomic No. – Amount of p^+

If the atom is Neutral then $p^+ = e^-$

Mass of an atom :

- → p^+ → a.m.u or u (atomic mass unit)
- → N^0

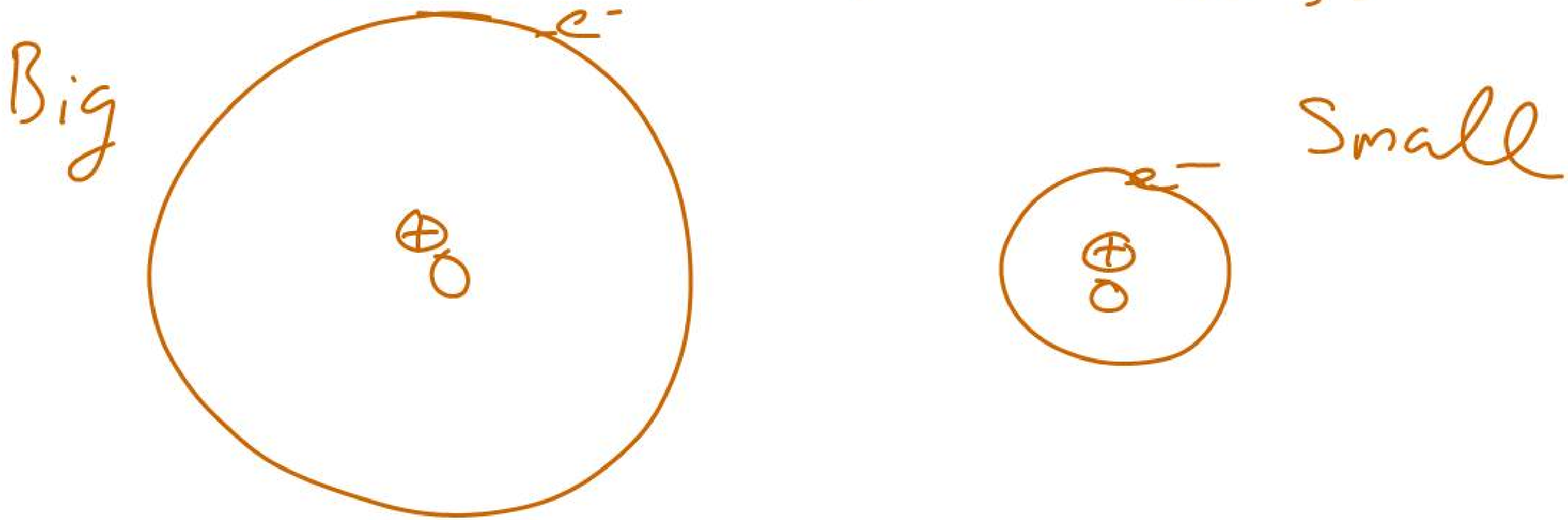
C → assign 12 amu

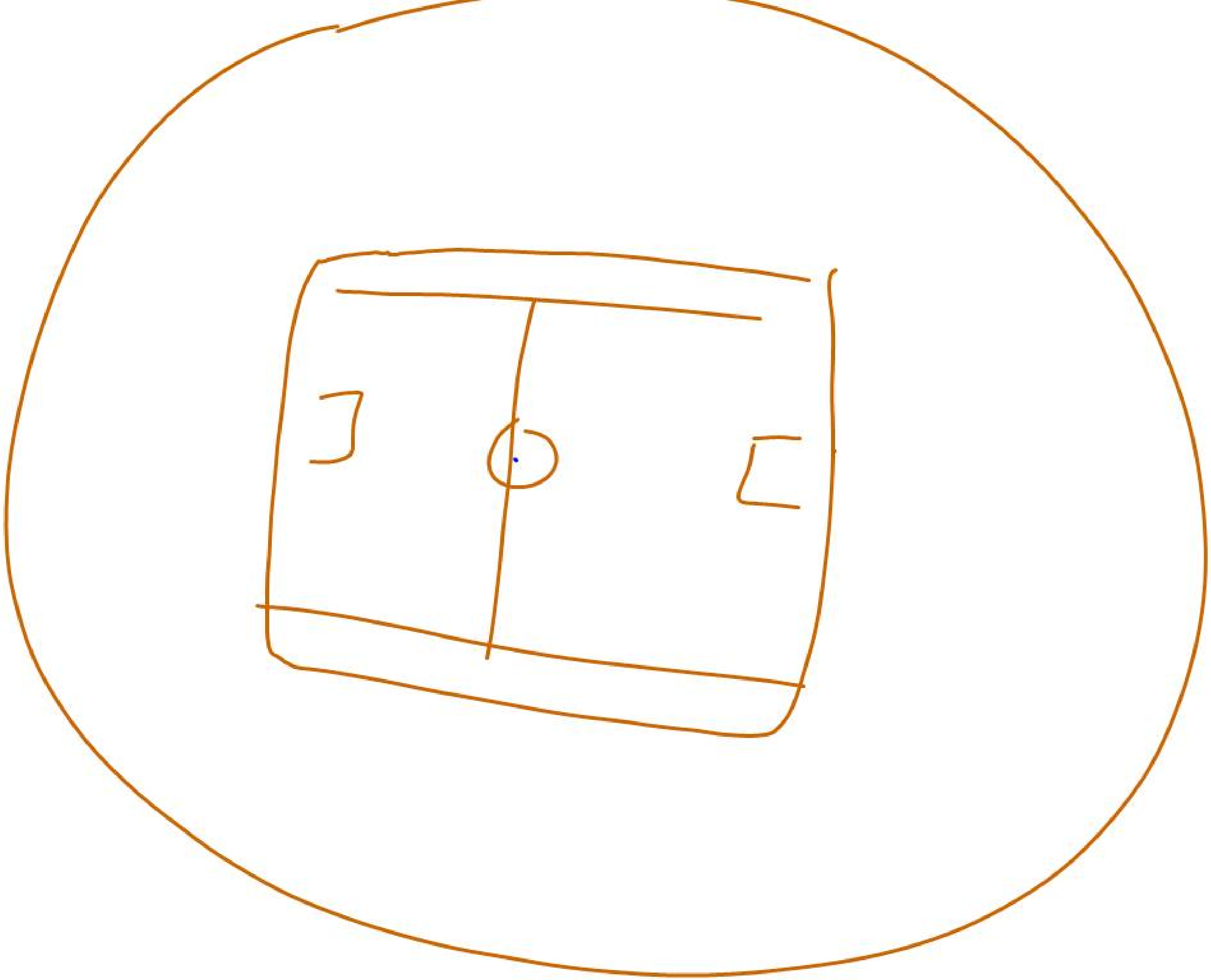
∴ H is $\frac{1}{12}$ the mass of C ∴ H = 1 amu

He = 2 amu
= 2 u

Volume of an Atom:

Comes from the spatial arrangement of the e^-s that orbit the nucleus.





Cl < } TWO ISOTOPES

$^{35}_{17}Cl$ 75% Cl - 35 ⇒ 35 - 17 = ∴ 18 N°

$^{37}_{17}Cl$ 25% Cl - 37 ⇒ 37 - 17 = ∴ 20 N°

$$\frac{75}{100} \times 35 = 26{,}25\ u$$

$$\frac{25}{100} \times 37 = +9{,}25\ u$$

$$35{,}5\ u$$

Nuclear Notation

$$^{A}_{Z}X$$

Mass No: A

No. of Nucleons

$p^+ + N^0$

Atomic No: Z — No of p^+

X — Symbol of your element

No of Neutrons = A − Z

$^{35}_{17}Cl$ $^{36}_{17}Cl$

Same Atomic No.

∴ Same Element.

Amount of Neutrons different.

∴ Isotope

[Make sure it's the same element

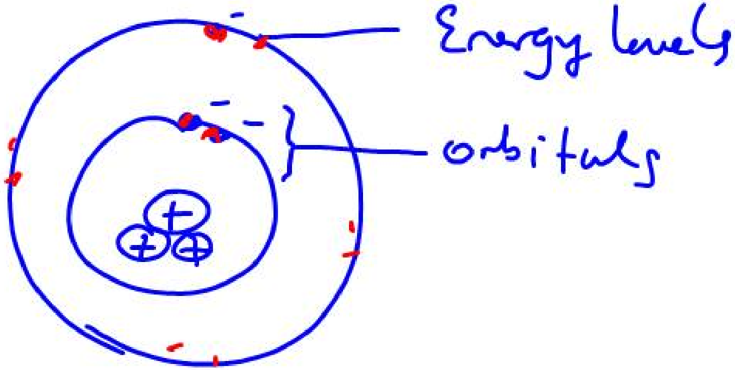
∴ same Atomic No.]

Electron structure

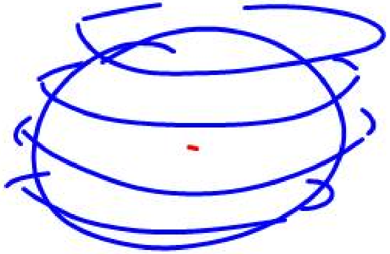
$_1H$

$_2He$

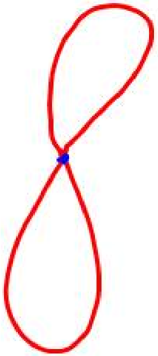
$_3Li$



S-orbital



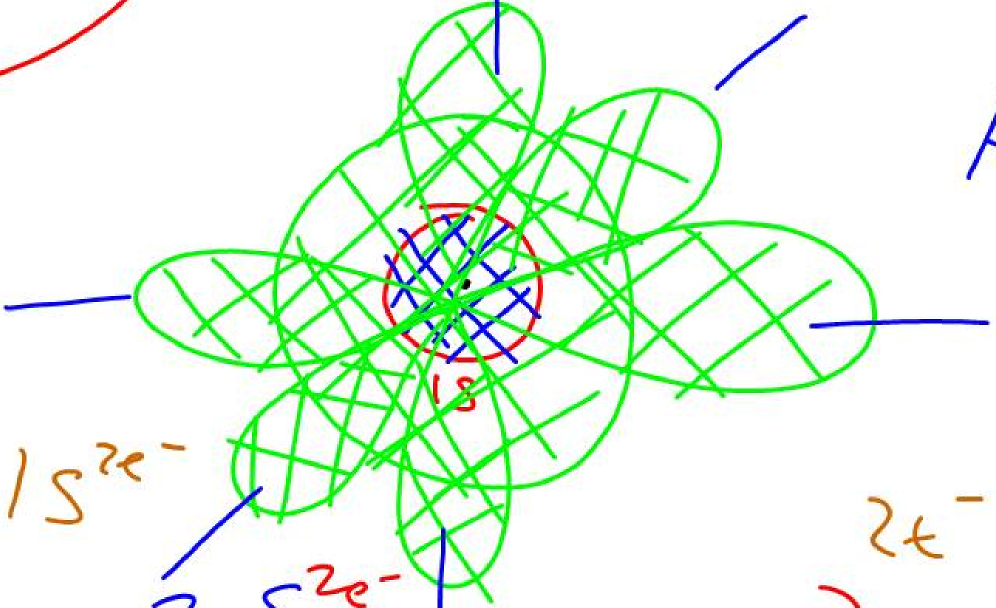
P-orbital

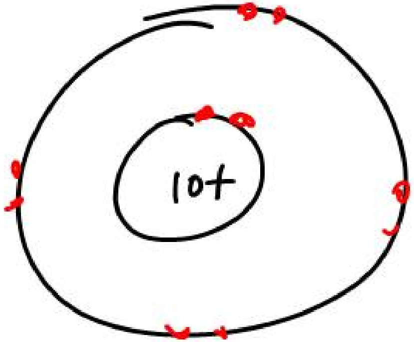


$_{10}Ne$

$10p^+$

$\therefore 10e^-$





Auf Bau Diagram

$1s^{2e^-}$

$2s^{2e^-}$

$2P_x^{2e^-}$ $2P_y^{2e^-}$ $2P_z^{2e^-}$

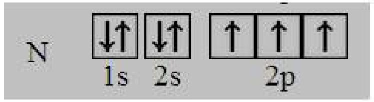
$2e^-$ } $10e^-$

$8e^-$

Hund's Rule

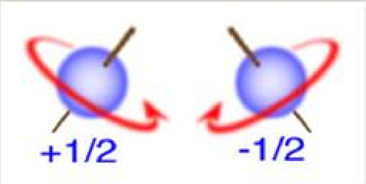
When filling sublevels other than s, electrons are placed in individual orbitals before they are paired up.

Electrons fill like people do on a bus. You would never sit right next to someone you did not know if there are free seats available, unless of course all the seats are taken then you must pair up.



Pauli Exclusion Principle

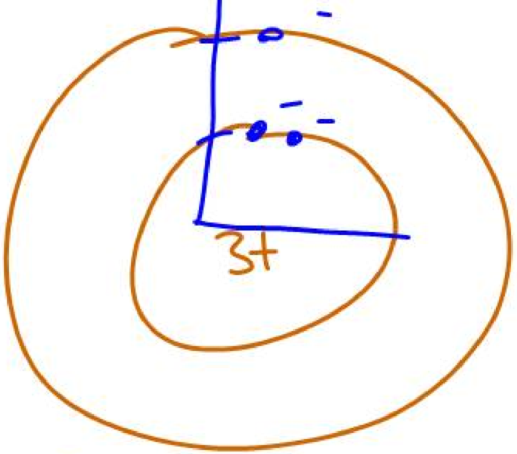
An orbital can hold 0, 1, or 2 electrons only, and if there are two electrons in the orbital, they must have opposite (paired) spins.



When we draw electrons, we use up and down arrows. So, if an electron is paired up in a box, one arrow is up and the second must be down.

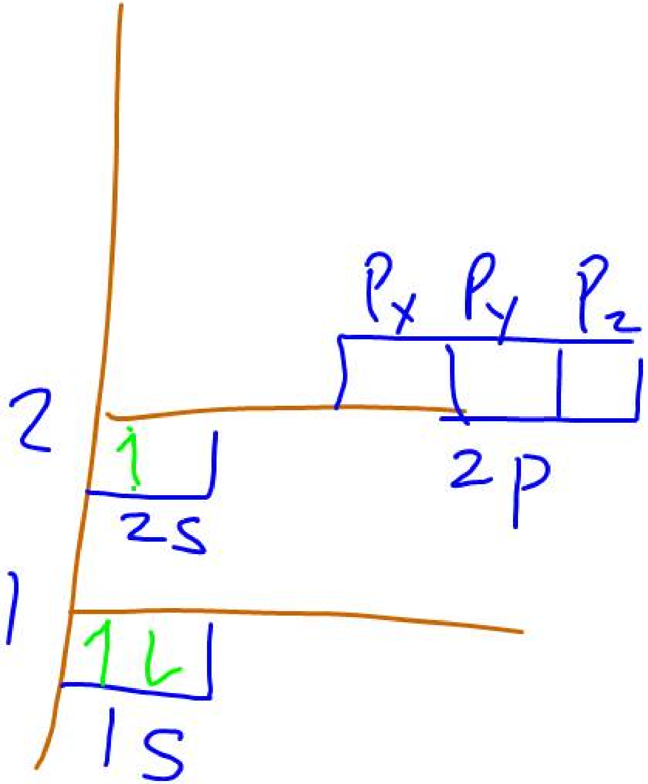
$_3Li$

∴ $3e^-$



Bohr

Auf Bau



$_3Li$ electron configuration

$2e^-$

$1s^2$

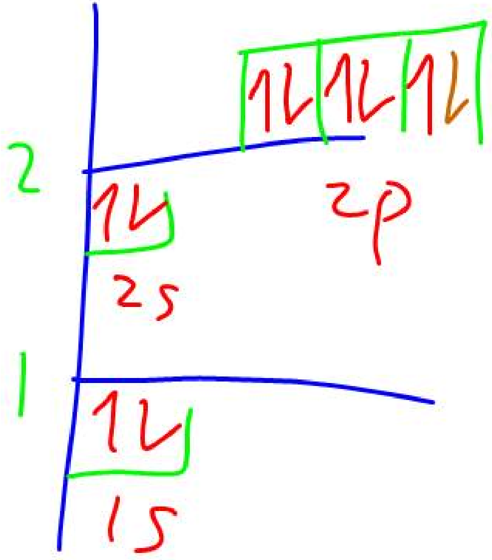
3+

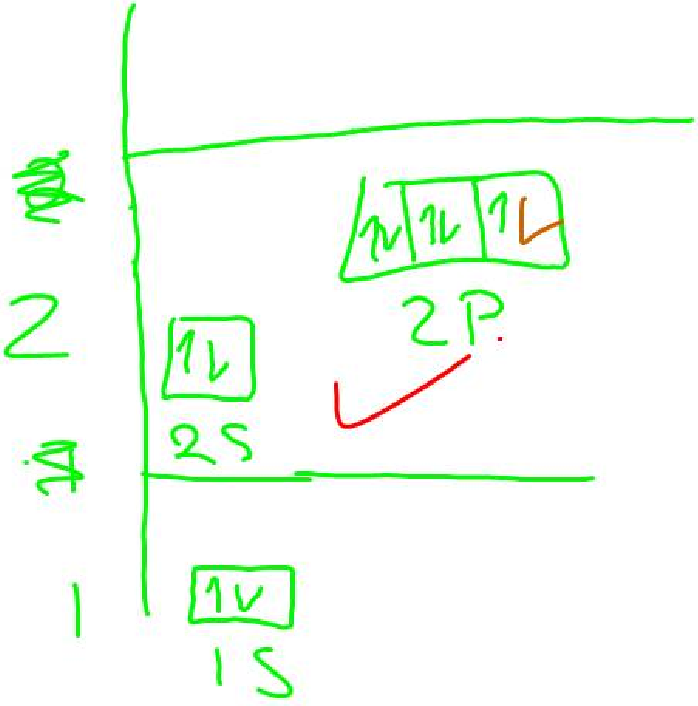
F

9

$F^- \rightarrow 10e^-$

Auf Bau Electron Configuration





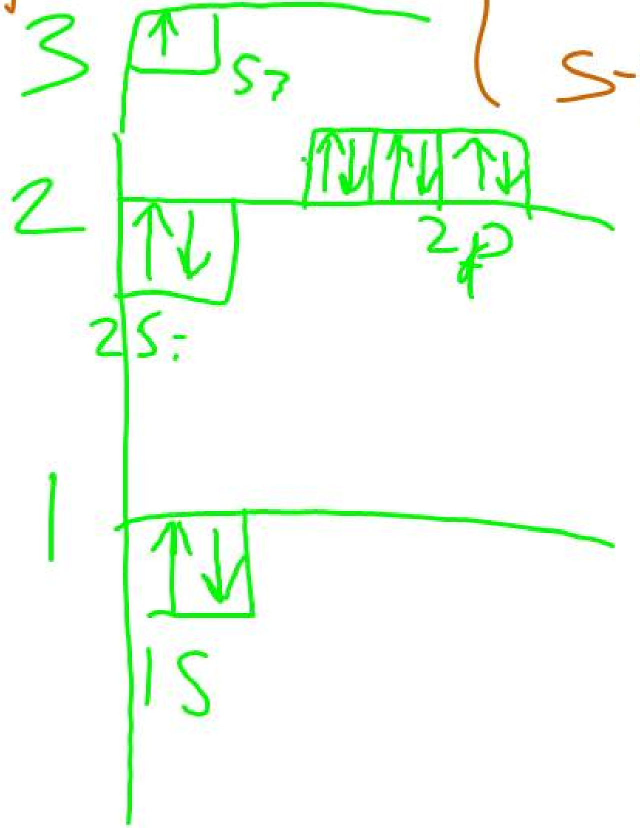
$1S^2 : 2S^2 : 2P^5$

$_{11}Na$

Aufbau

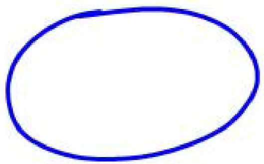
{ e^- - configuration
s-p notation

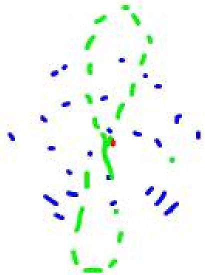
$11e^-$



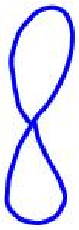
$1s^2\ 2s^2\ 2p^6\ 3s^1$

S – orbital

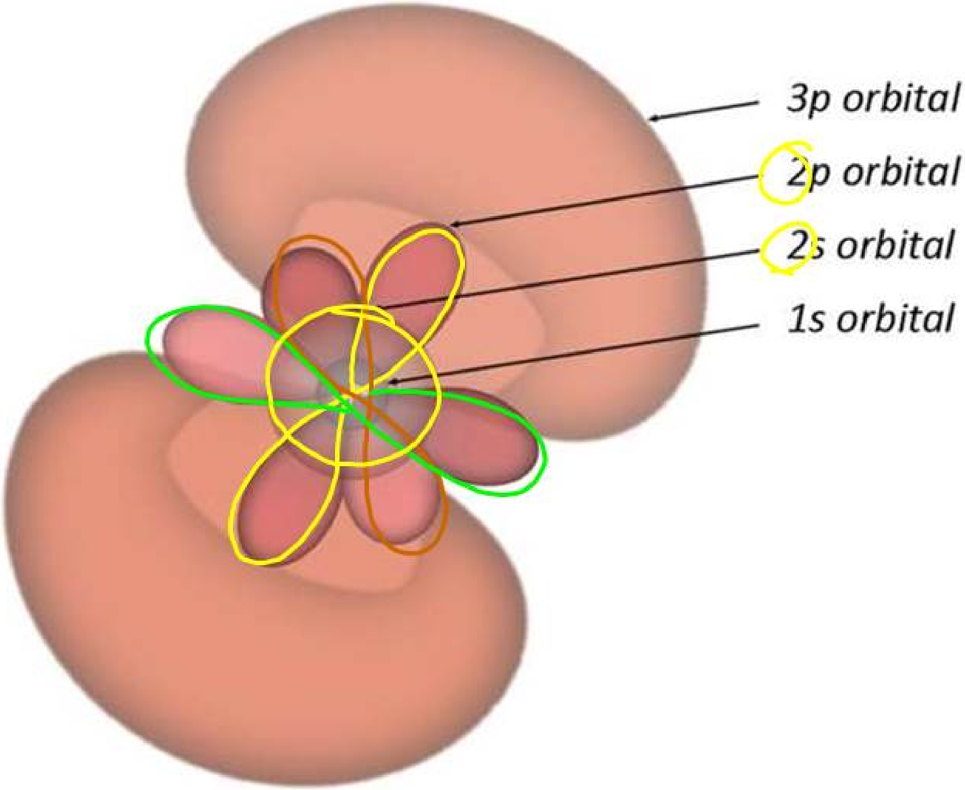


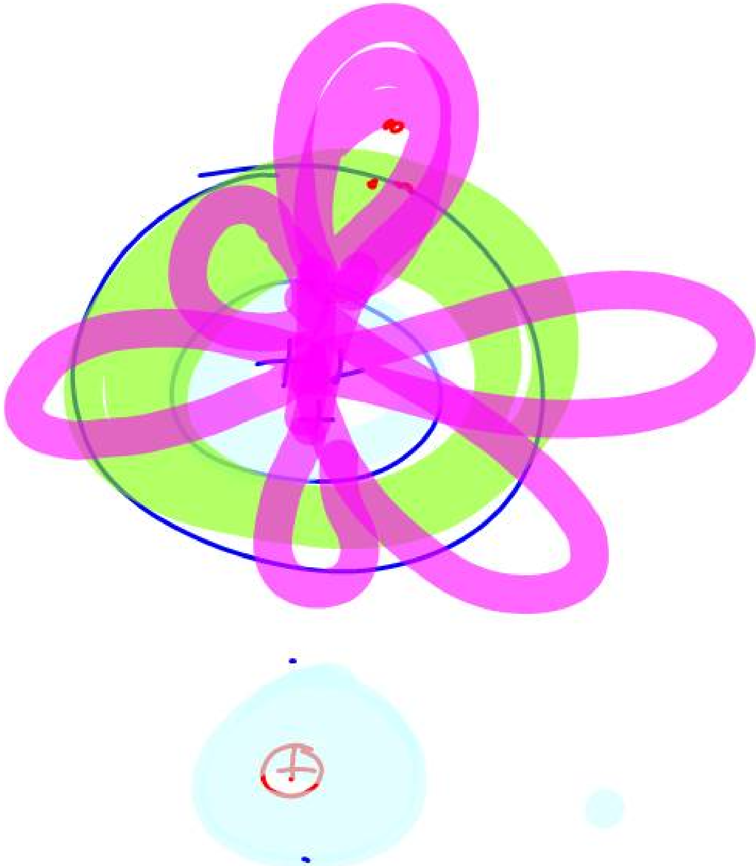


p – orbital



d – orbital

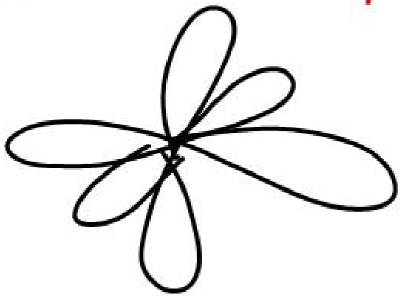

3p orbital
2p orbital
2s orbital
1s orbital

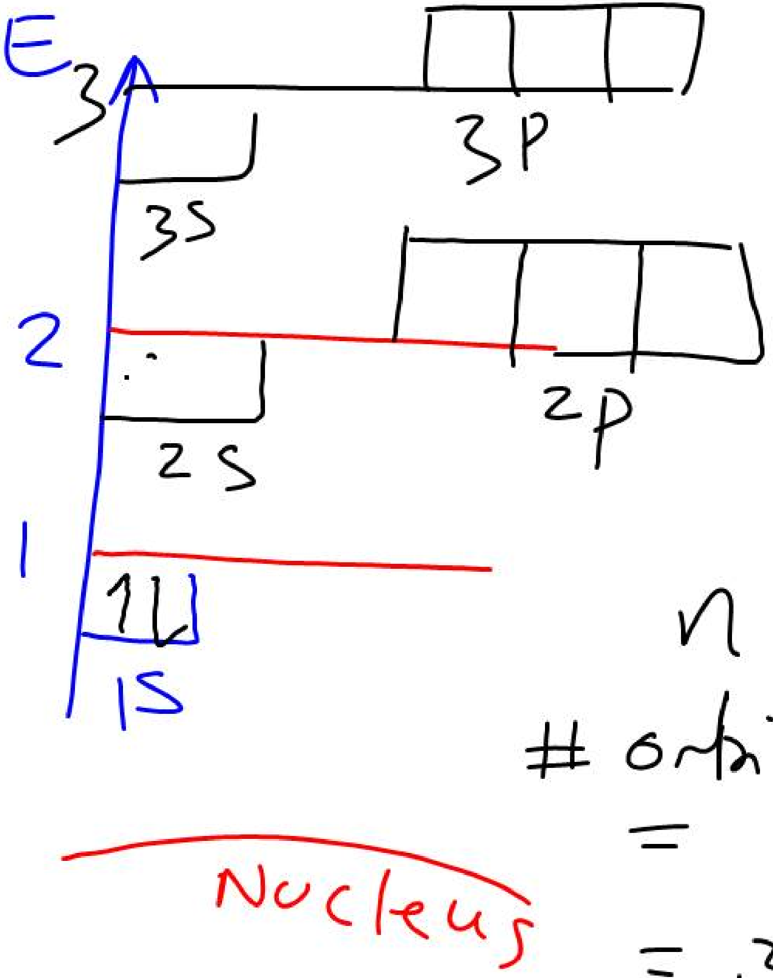


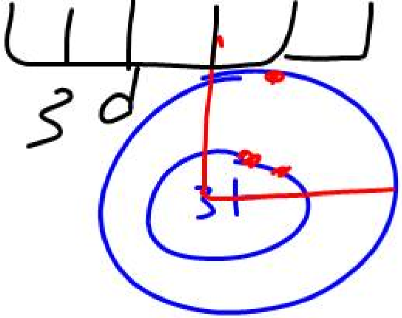
Auf-Bau

Li^{+}

$_{3}Li$







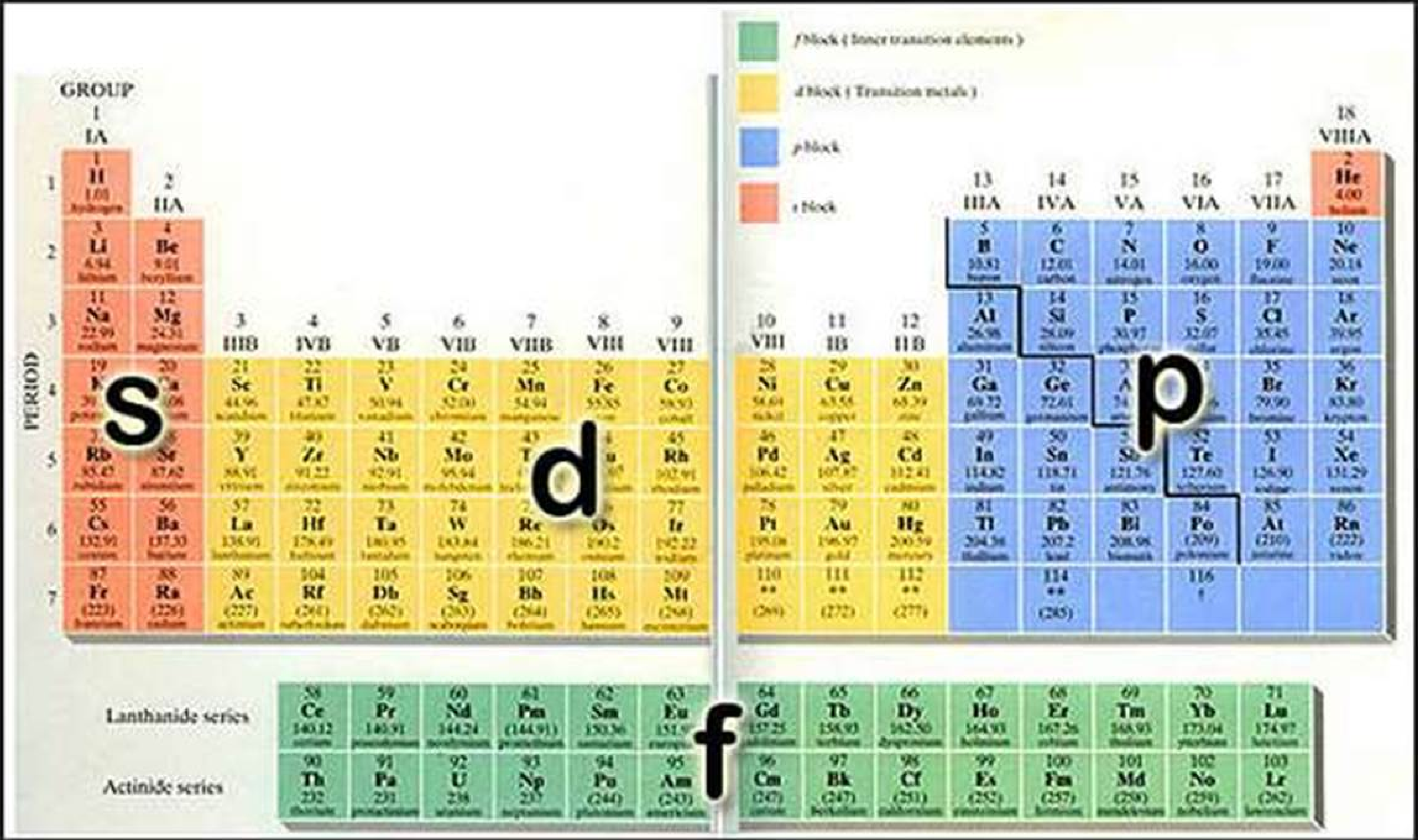
$3^2 = 9$

n = Energy level

orbitals

$= n^2 \quad 2^2 = 4$

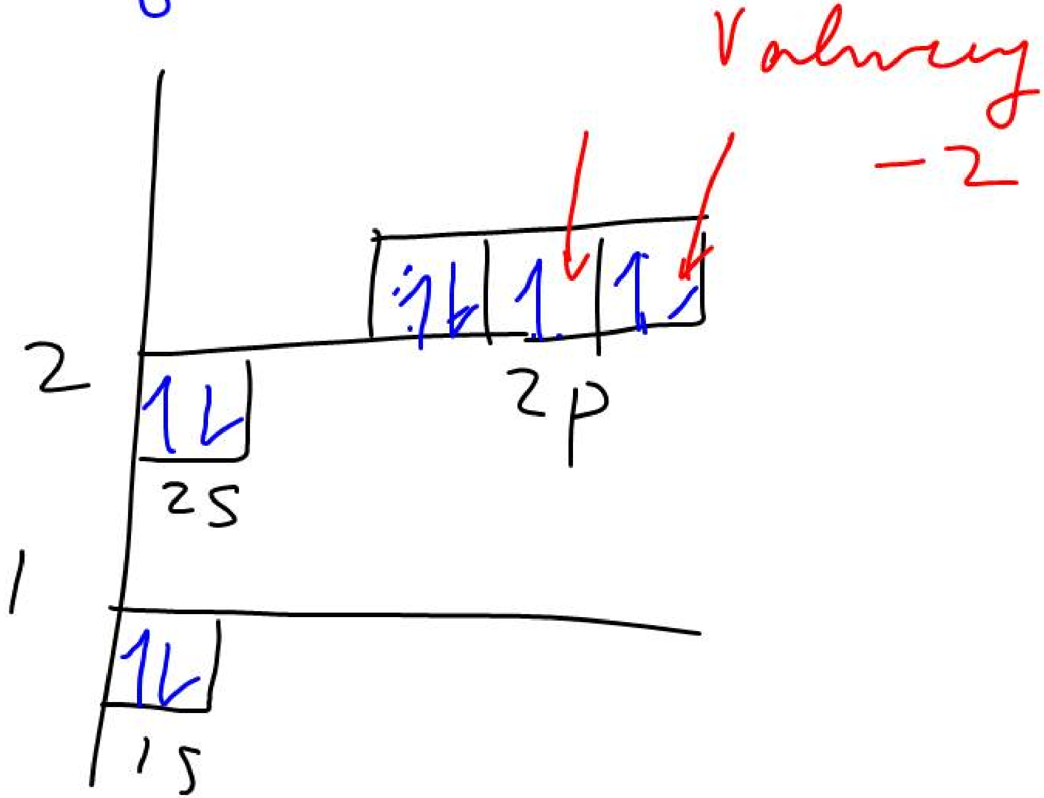
$= 1^2 = 1$



f block (Inner transition elements)
d block (Transition metals)
p block
s block
GROUP
PERIOD
s
d
p
f
Lanthanide series
Actinide series

$_{8}O$ $\quad 8^{+} = 8e^{-}$

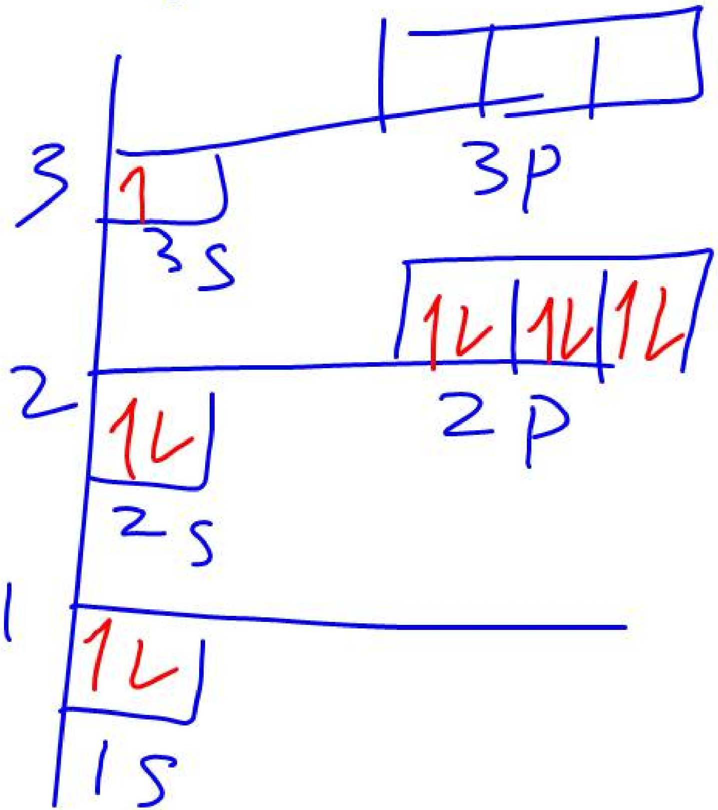
Neutra



${}_{11}Na$

Aufbau

Neutral Atom



$_{12}Mg^{2+}$

Mg^{2+}

$2Cl^-$

$MgCl_2$