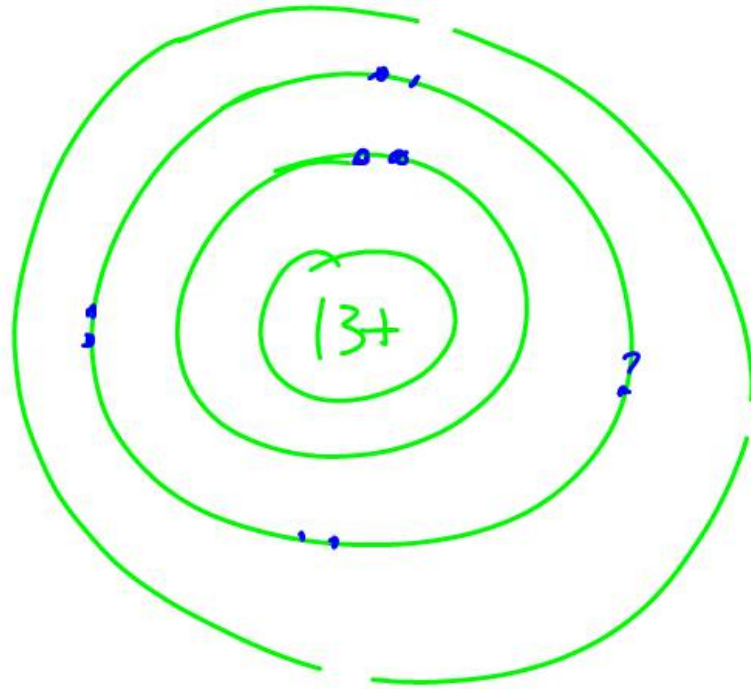


# The Atom



Online Book Intro Atom

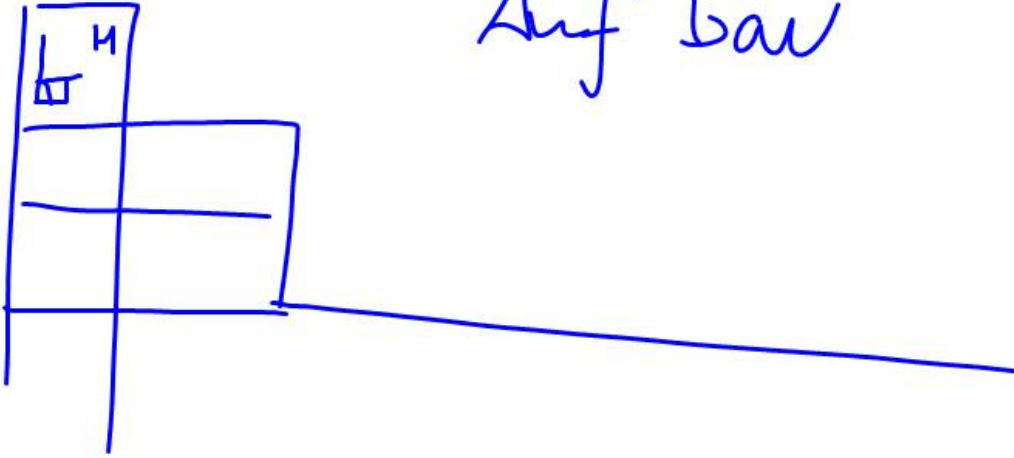


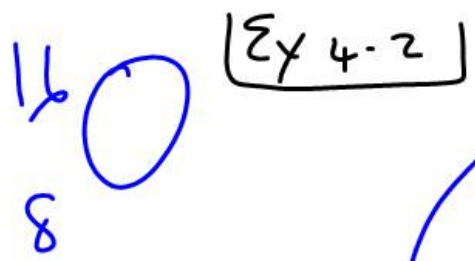


$$\begin{array}{r} 10e^- \\ 13p^+ \\ \hline + 3 \\ \hline \end{array}$$

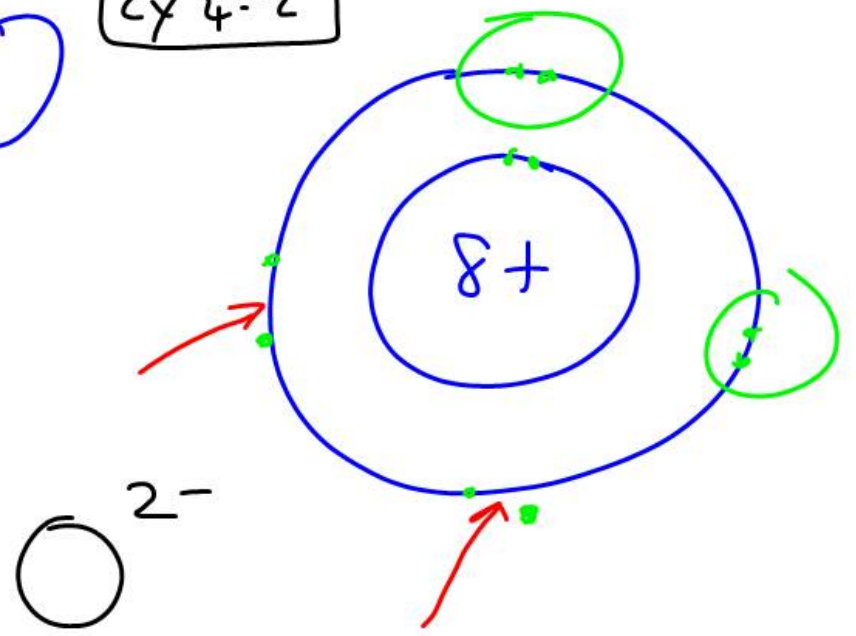


Aufbau





Lone pairs



$10e^-$

16 S

(Aufbau)

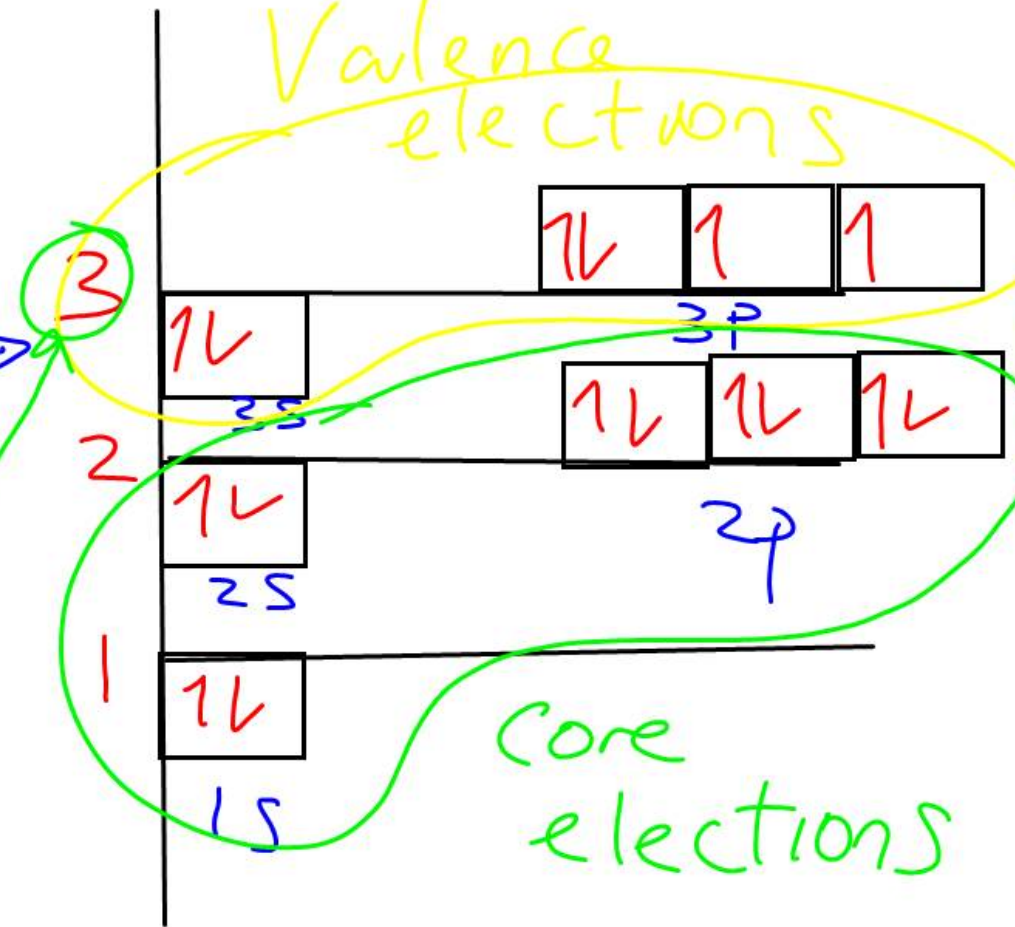
electron configuration

Valence electrons

16 e<sup>-</sup>

Group 6 →

Period 3



Core e<sup>-</sup>

1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>6</sup> (Group 2, 4)  
 3s<sup>2</sup> 3p<sup>4</sup> (Period)

[Ne] 3s<sup>2</sup> 3p<sup>4</sup>

19 K

4



4s



3p



2p

2s

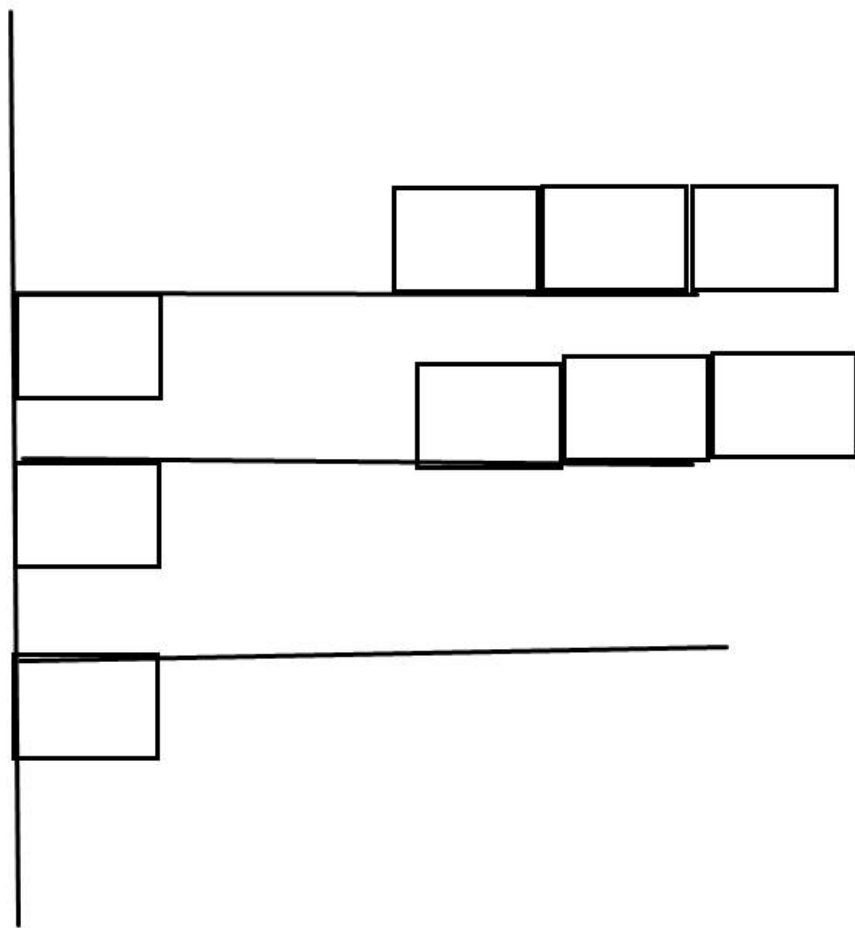


1s

$(s^2 d^2 p^6) s^2 3$   
 $3p^6 1s^1$   
 $2$

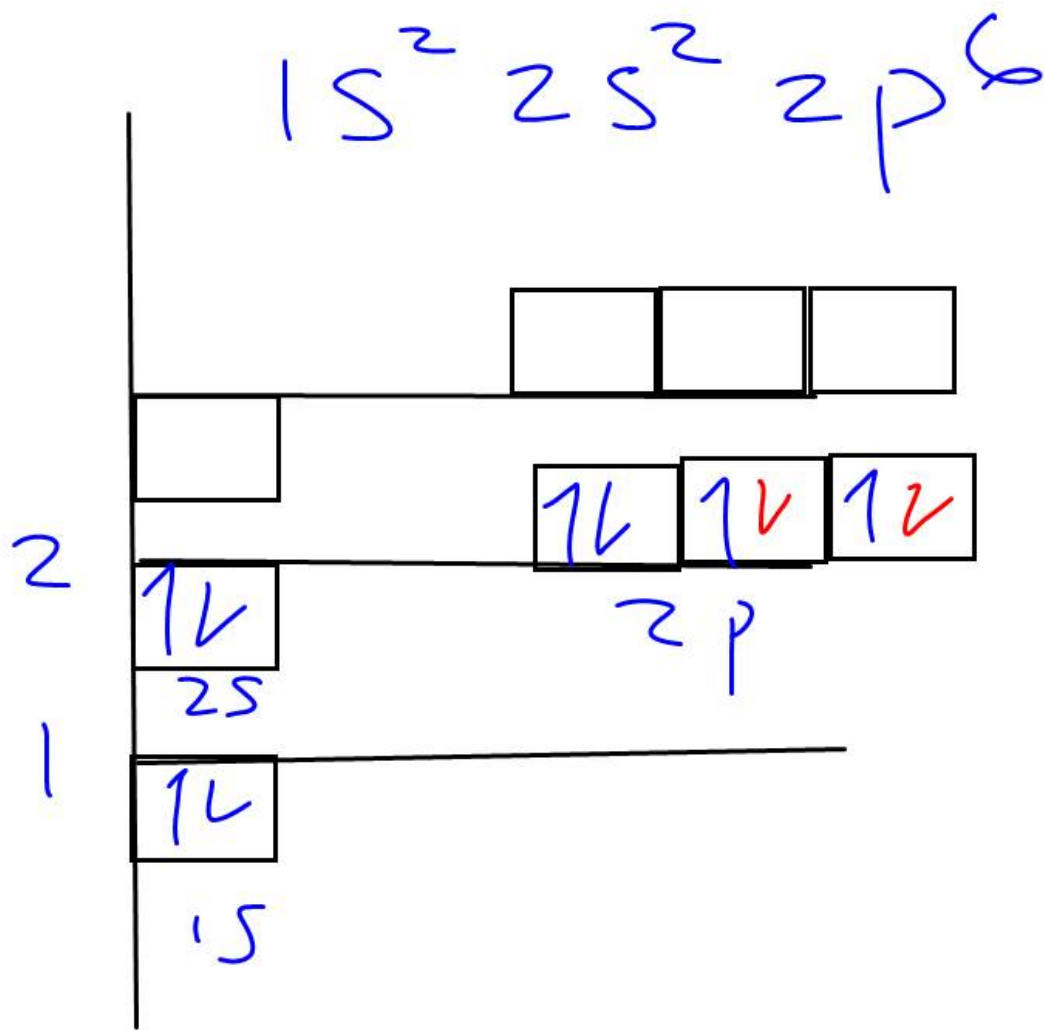
$[Ar] 4s^1$





8  $O^0$

$O^{2-}$





${}^6\text{C}$

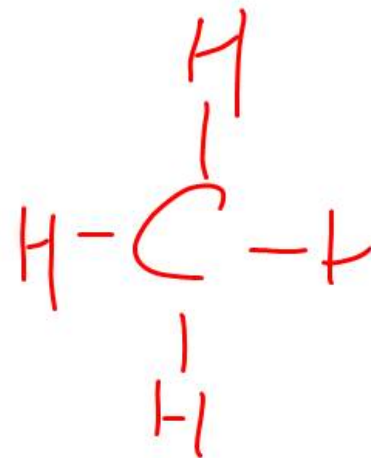
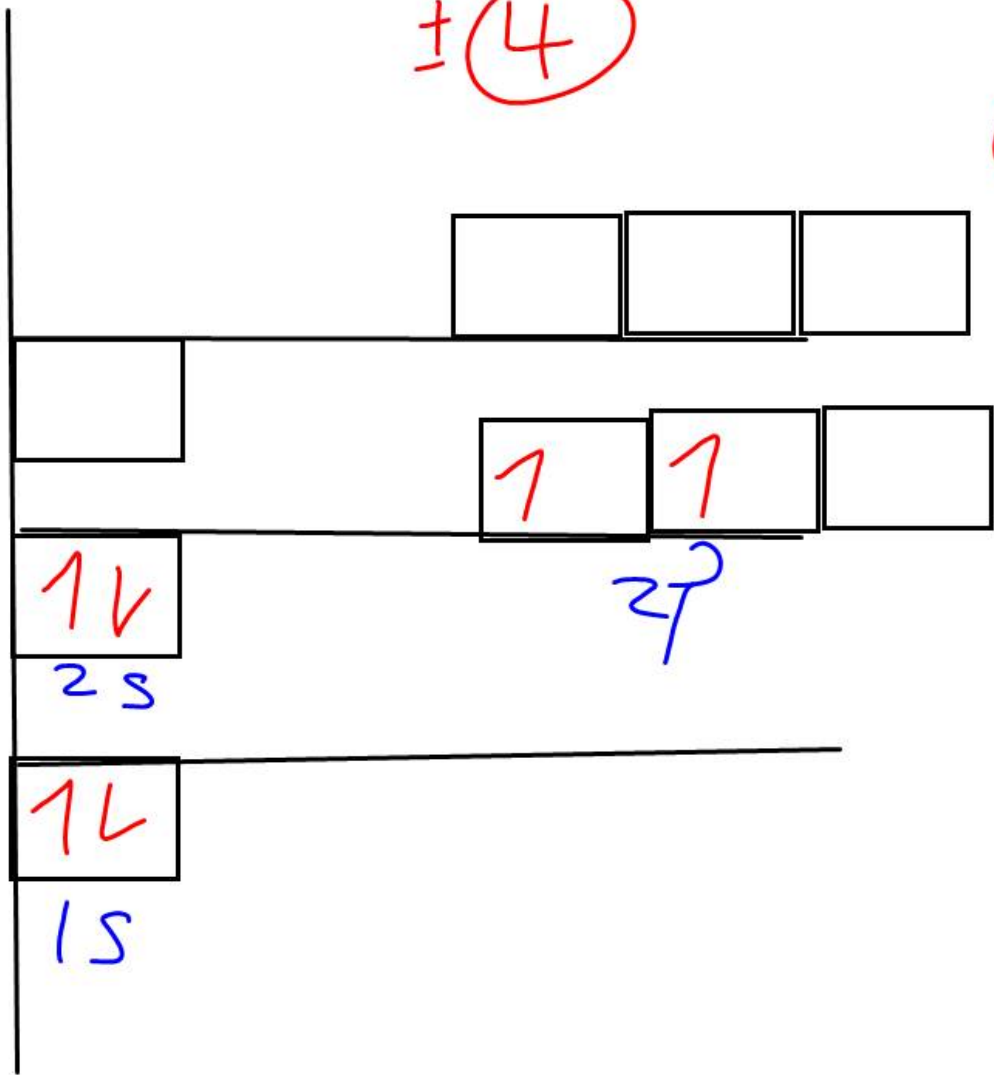
$\pm(4)$

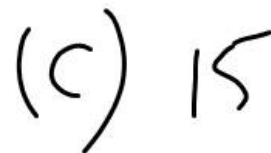
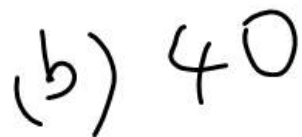
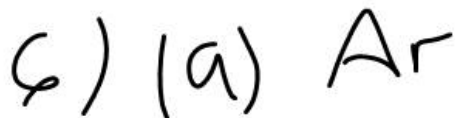
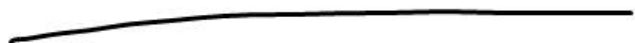
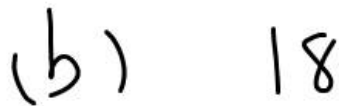
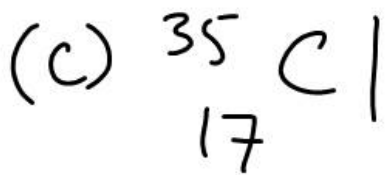
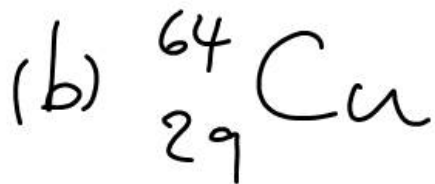
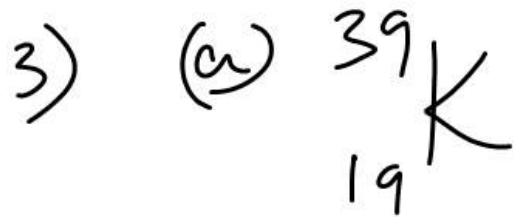


Ground state

2

1





(7)

A mass no.

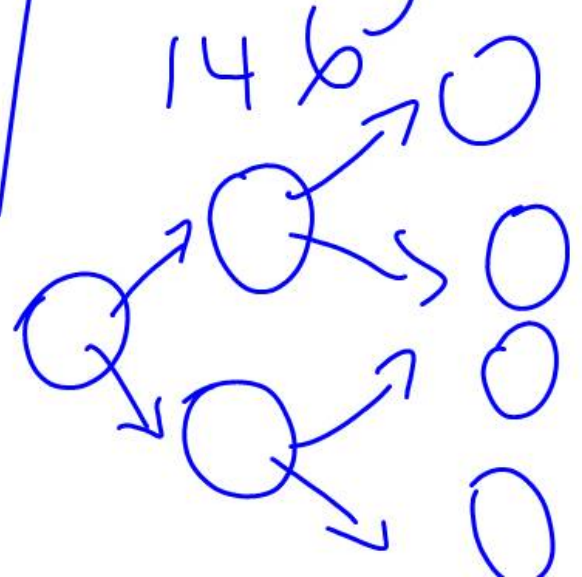
Z Atomic No.

N neutron

~~A~~  
~~Z~~

		Mass No $A$	Atomic No. $Z$	$N$
$^{235}_{92}\text{U}$		235	92	143
$^{238}_{92}\text{U}$		238	92	146

Isotopes



8

16

⑥

19,9%

B-10

R.A.M.

80,1%

B-11

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

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

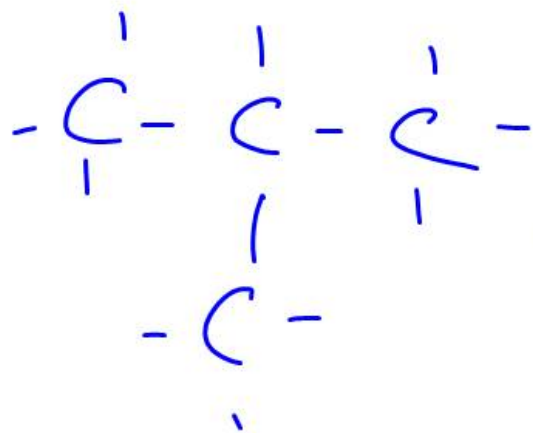
10,80  $\mu$

7) 79% Mg-24 = 18,96

10% Mg-25 = + 2,5

11% Mg-26 = + 2,86

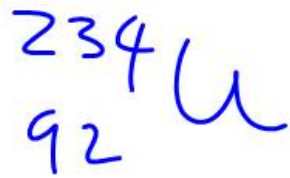
24,32 u



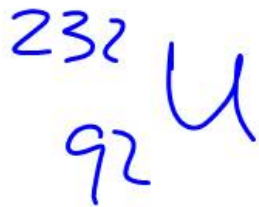
ISOMER



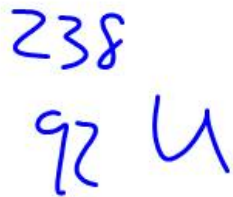
8)  $\sum X \rightarrow \text{TD Notation}$



(a)



(b)



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.



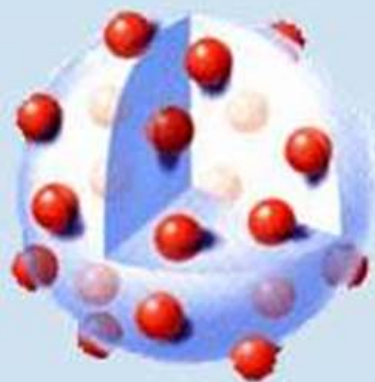


The Billiard Ball

# John Dalton



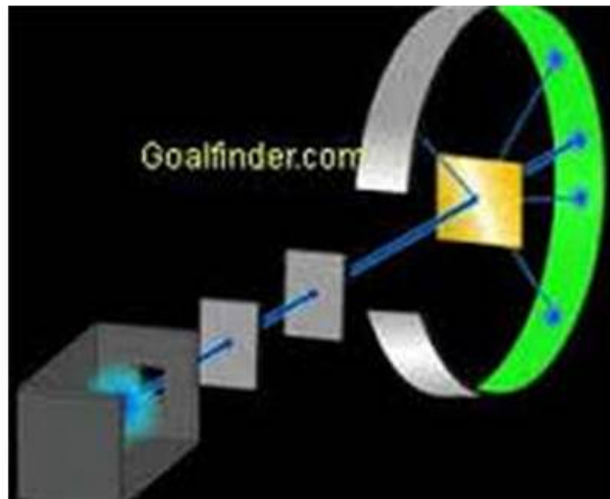
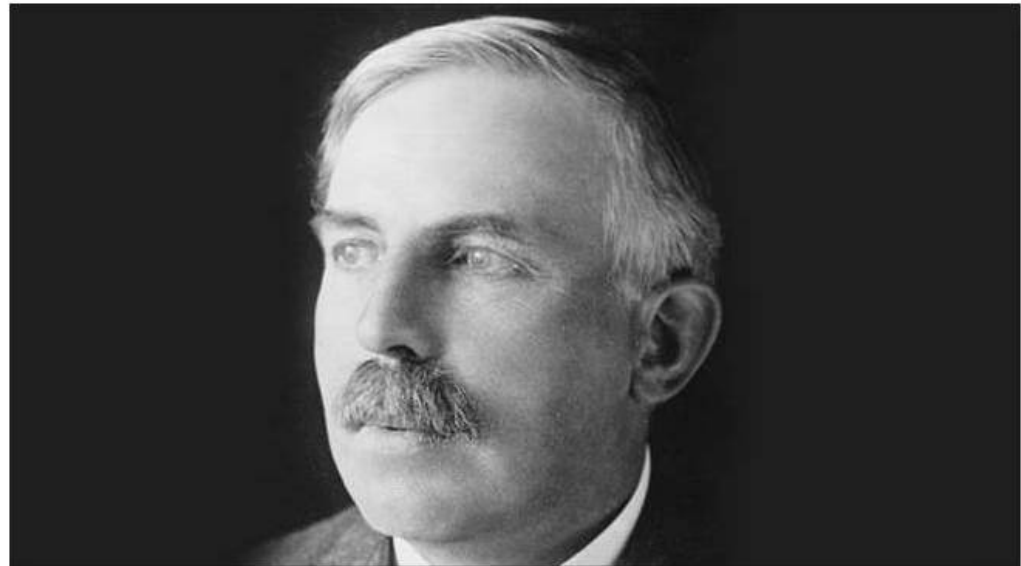
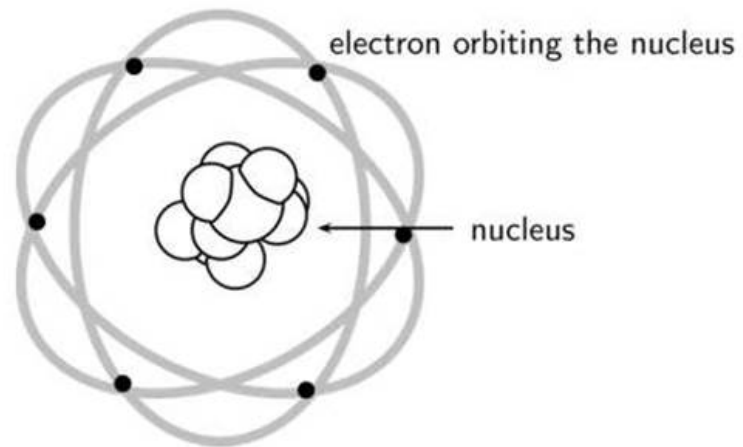
J. J. Thomson



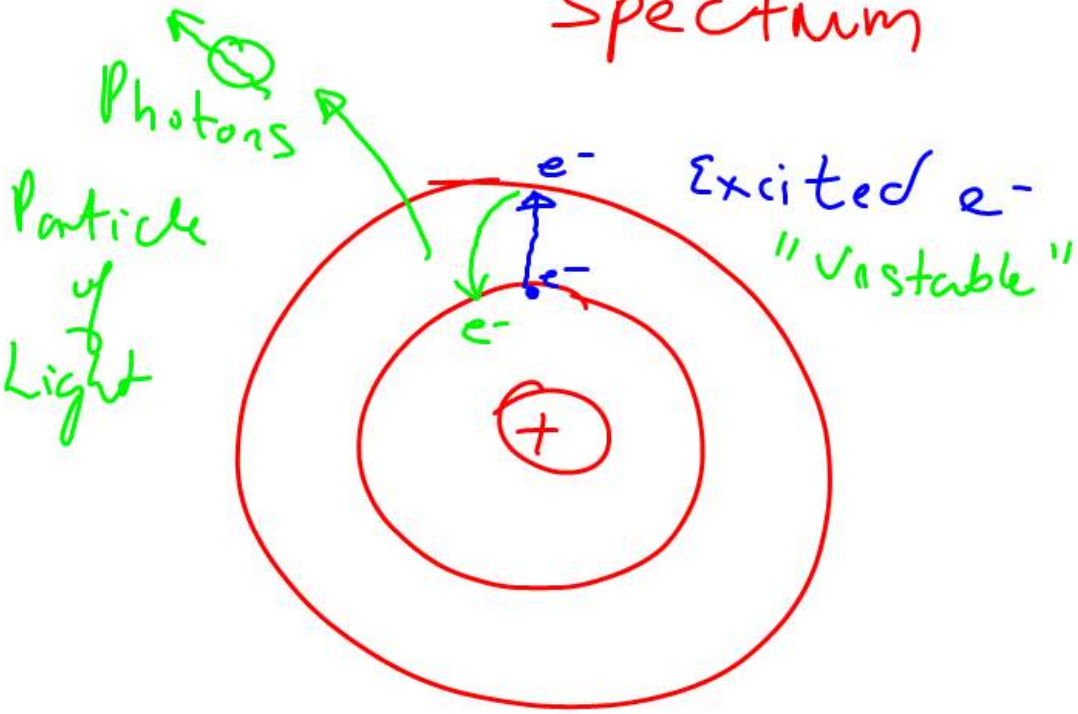
**The Plum Pudding**



# Ernest Rutherford



|||    |||    |||    |    |    |  
Spectrum



Niels Bohr

$e^-$  in fixed energy levels



## QUANTUM MECHANICS <sup>1925 -</sup> 1927

### THE UNCERTAINTY PRINCIPLE

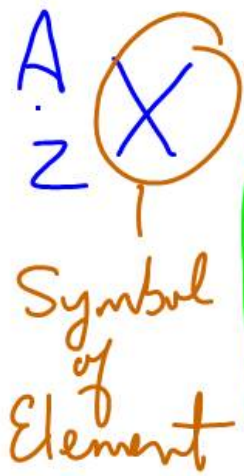
The more precisely the position is determined, the less precisely the momentum is known in this instant, and vice versa.

--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





$A$  - Mass No. — Amount of  $p^+$  +  $n^0$   
 $Z$  - Atomic No.  
Amount of  $p^+$

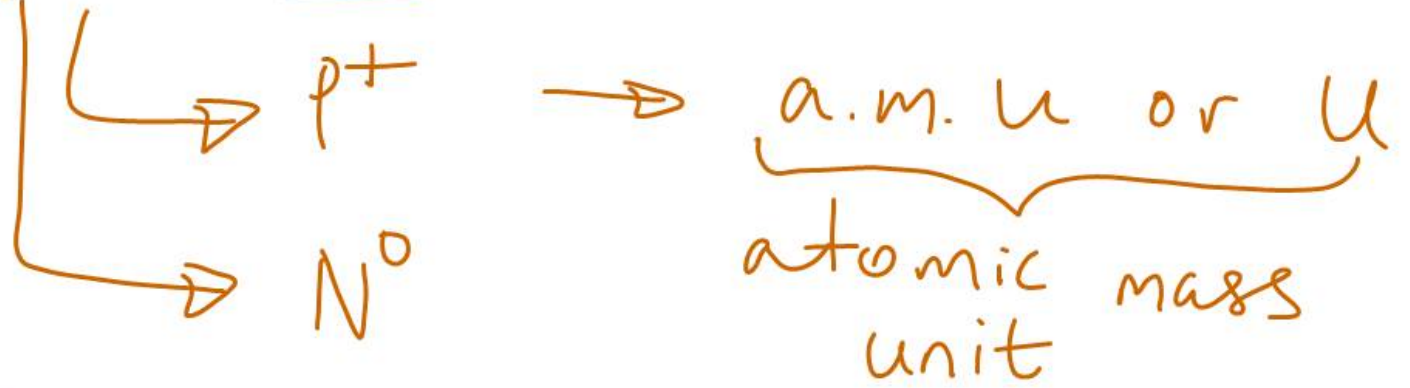
Nucleons

If the atom is

Neutral then  $p^+ = e^-$



Mass of an atom :



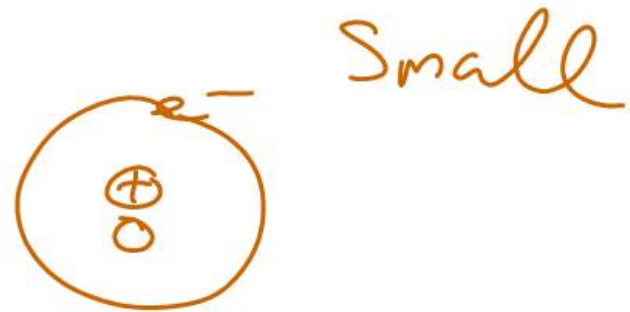
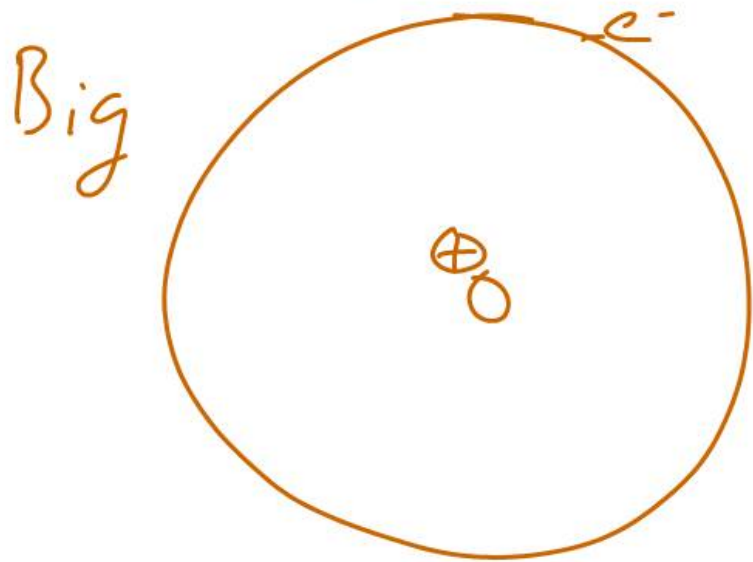
C  $\rightarrow$  assign 12 amu

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

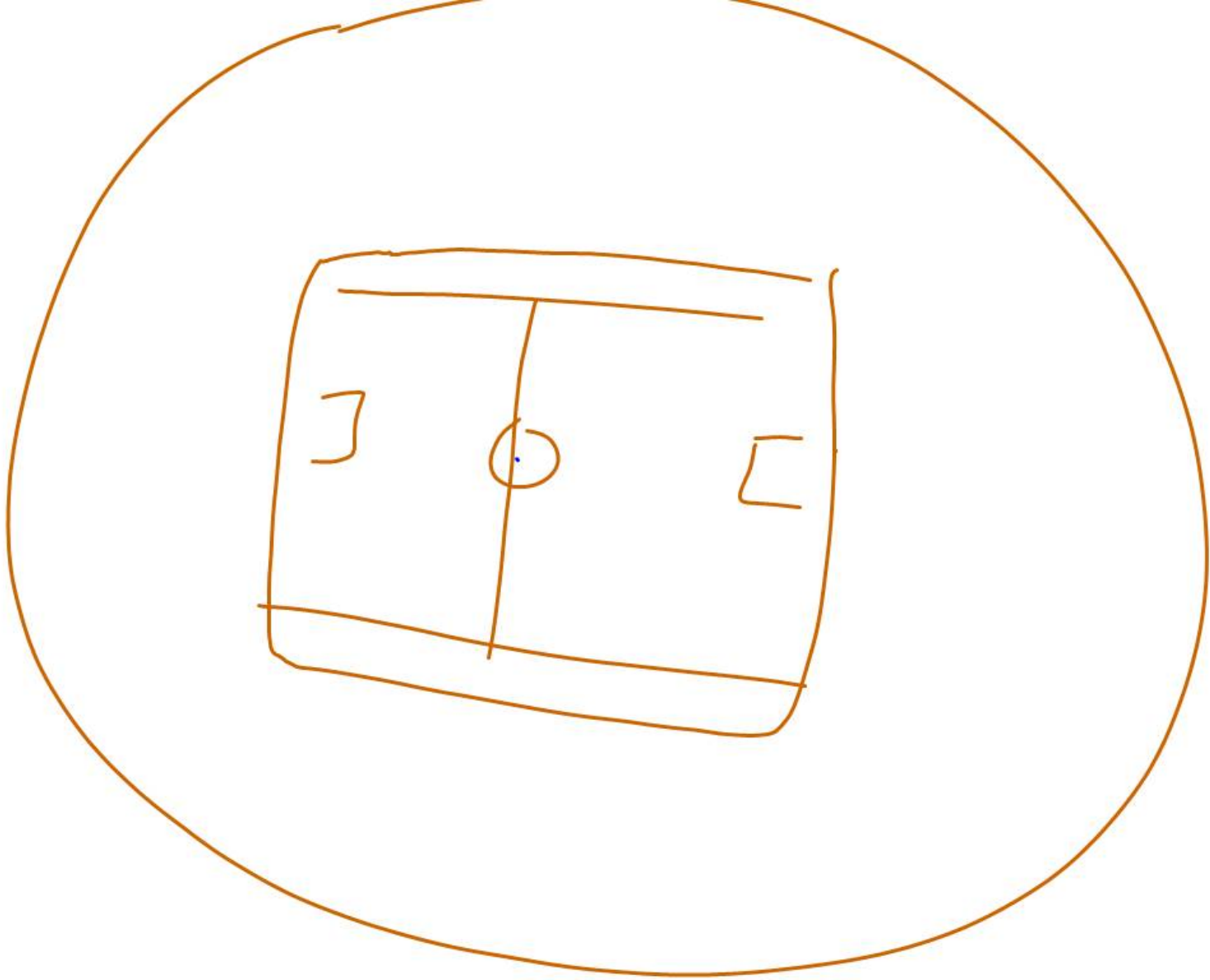
He = 2 amu  
= 2u

Volume of an Atom:

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







$^{35}_{17}\text{Cl}$  } Two ISOTOPES

75%  $\text{Cl} - 35 \Rightarrow 35 - 17 = \therefore 18 \text{ N}^{\circ}$

$^{37}_{17}\text{Cl}$  25%  $\text{Cl} - 37 \Rightarrow 37 - 17 = \therefore 20 \text{ N}^{\circ}$

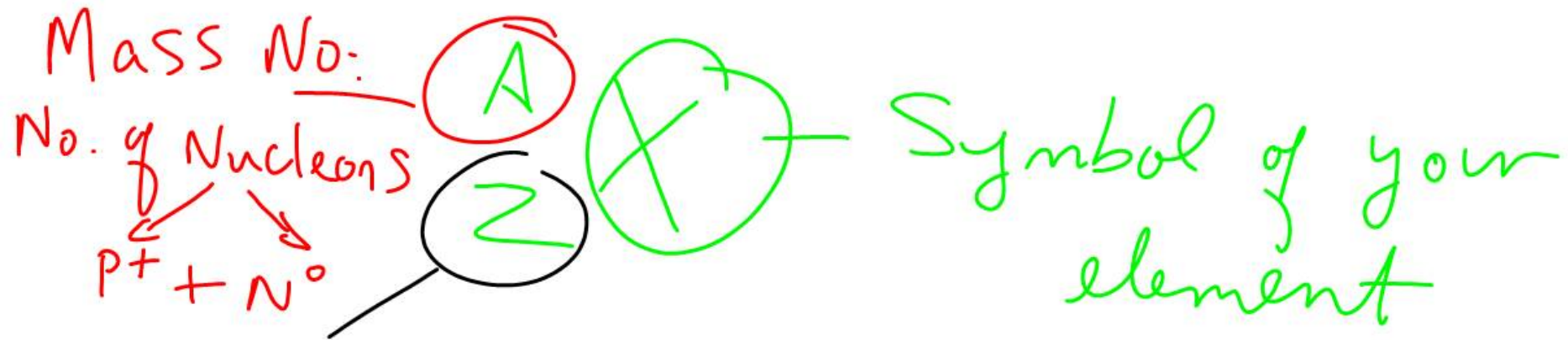
$$\frac{75}{100} \times 35 = 26,25 \mu$$

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

---

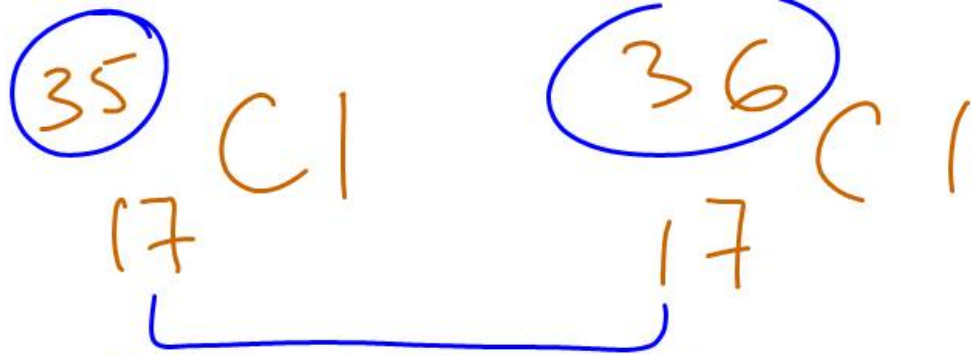
$$35,5 \mu$$

# Nuclear Notation



Atomic No : No of  $p^+$

$$\text{No of Neutrons} = A - Z$$



Same Atomic No.

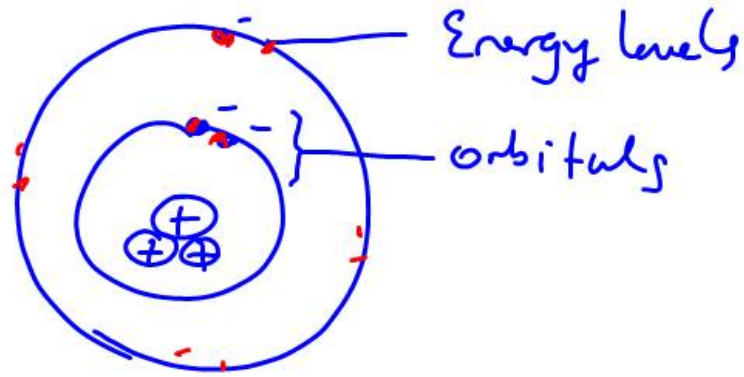
$\therefore$  Same Element.

Amount of Neutrons  
different.

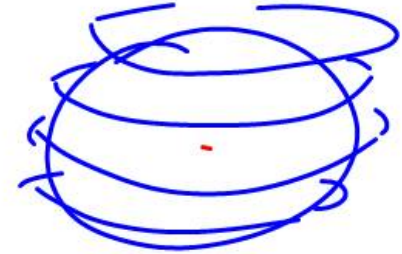
$\therefore$  Isotope  
[ Make sure it's  
the same element  
 $\therefore$  Same Atomic  
No. ]

# Electron structure

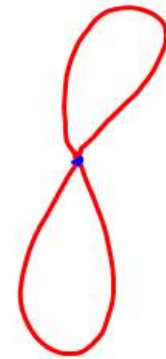
$1\text{H}$   
 $2\text{He}$   
 $3\text{Li}$

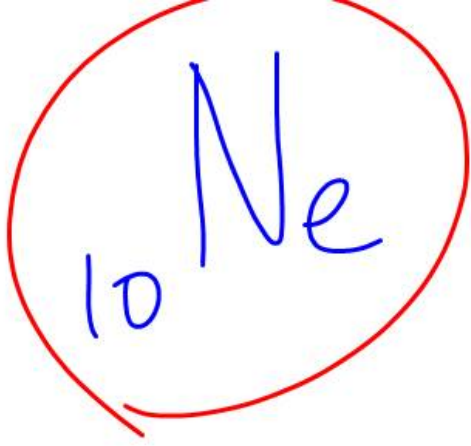


## S-orbital

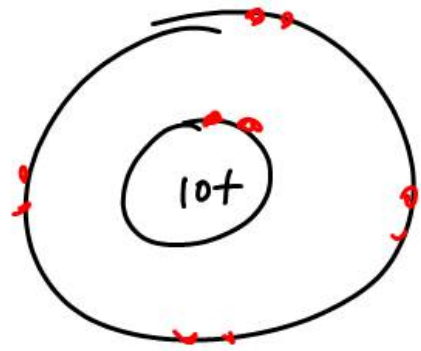


## p-orbital

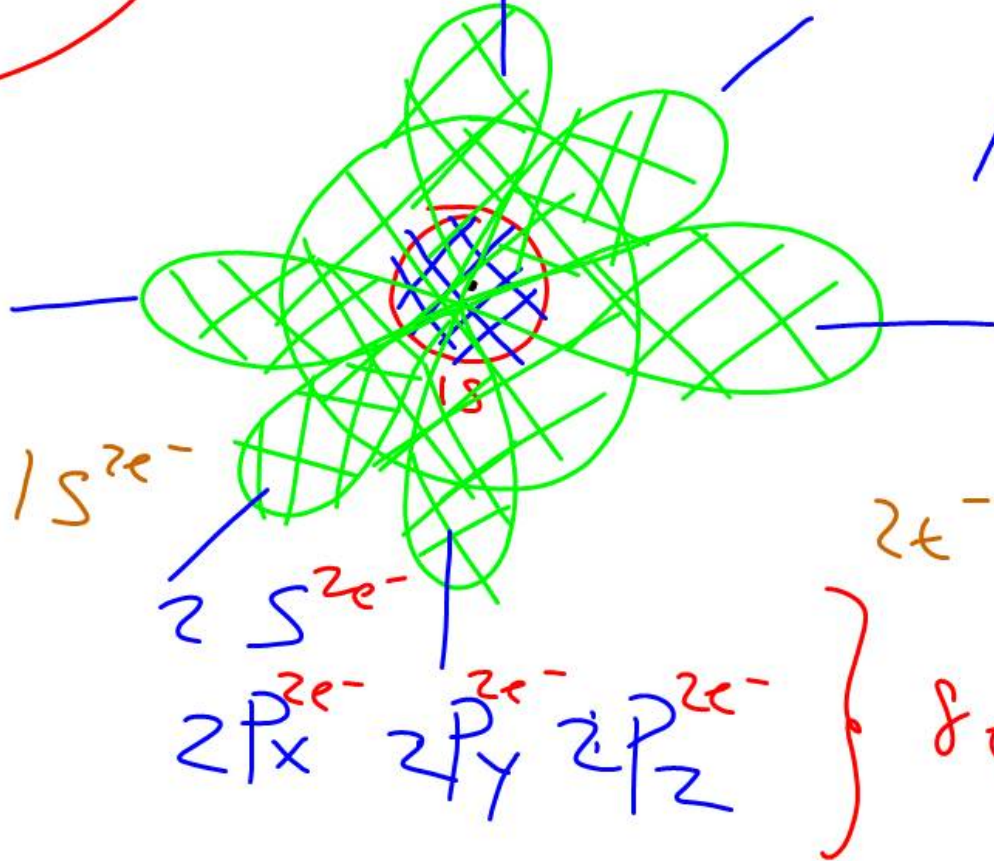




$10 p^+$   
 $\therefore 10 e^-$



Auf Bau Diagram



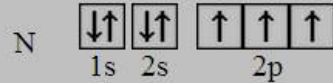
$2e^-$   
 $8e^-$  }  $10e^-$



## Hund's Rule

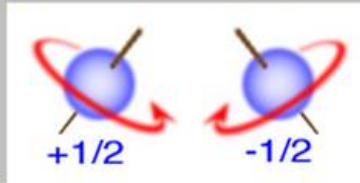
When filling sublevels other than s, electrons are placed in individual orbitals before they are paired up.

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

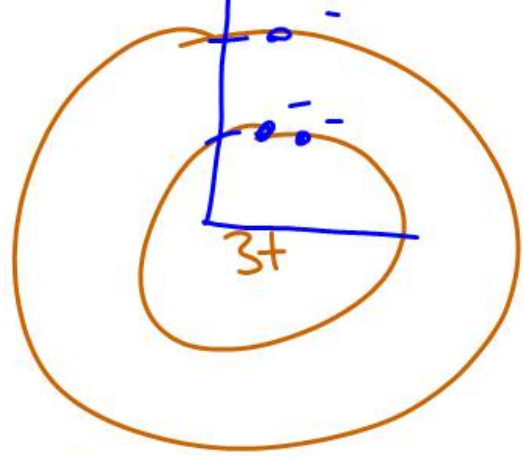
An orbital can hold 0, 1, or 2 electrons only, and if there are two electrons in the orbital, they must have



opposite (paired) spins.

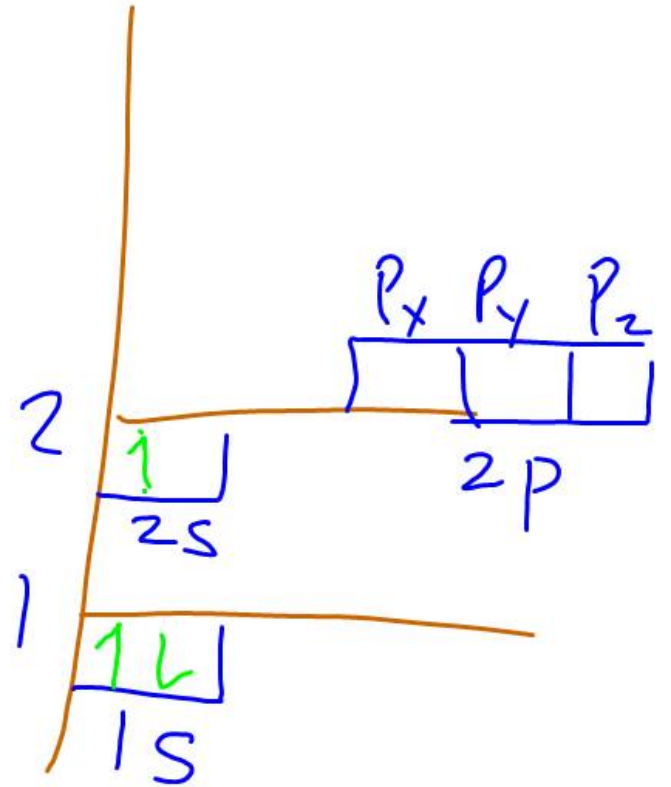
When we draw electrons, we use up and down arrows. So, if an electron is paired up in a box, one arrow is up and the second must be down.

${}^3\text{Li}$



Bohr

Aufbau



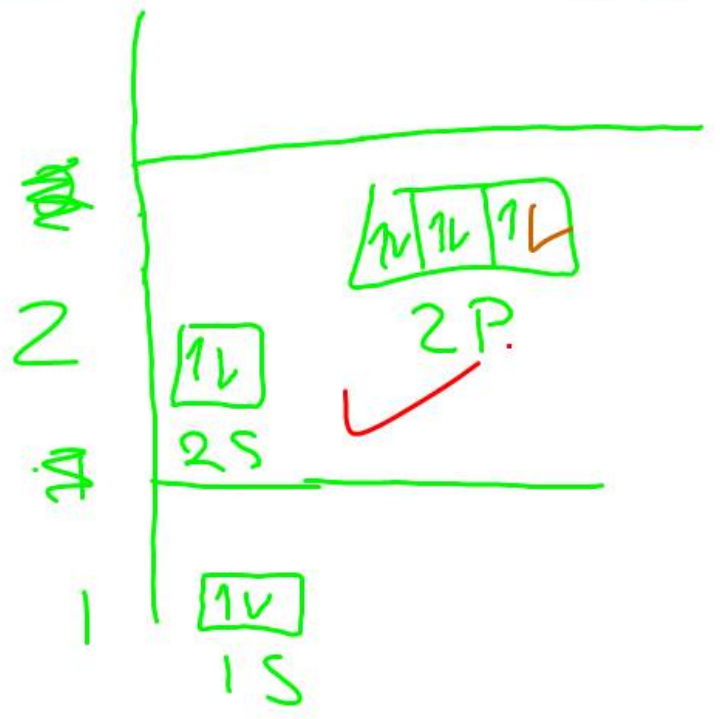
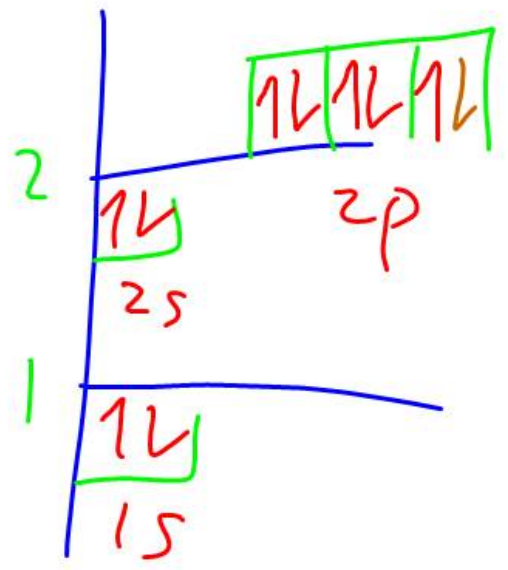
${}^3+$

$\therefore 3e^-$

${}^3\text{Li}$  electron configuration  
 $2e^-$   
 $1s^2$



9
F
Aufbau
Electron  
 $F^- \rightarrow 10e^-$ 
Configuration



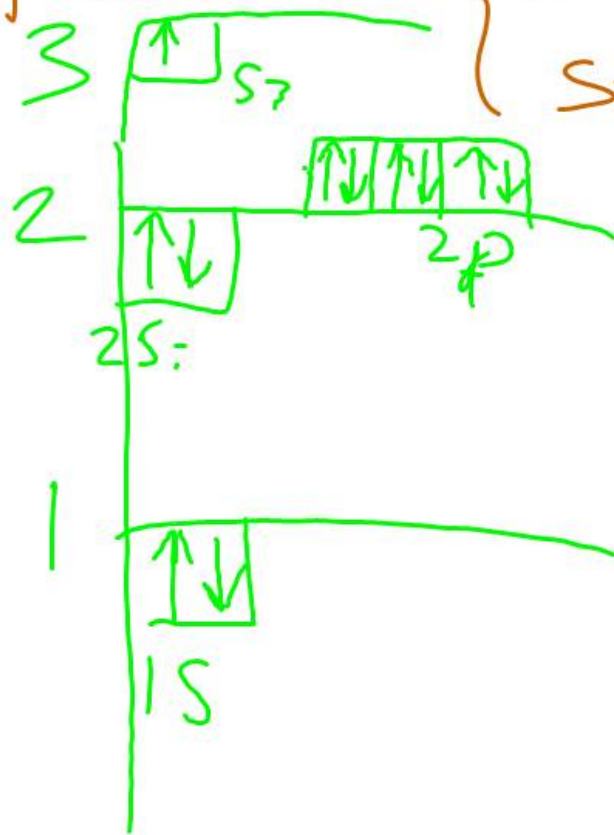
$1s^2 \cdot 2s^2 \cdot 2p^6$  ✓

11 Na

11e<sup>-</sup>

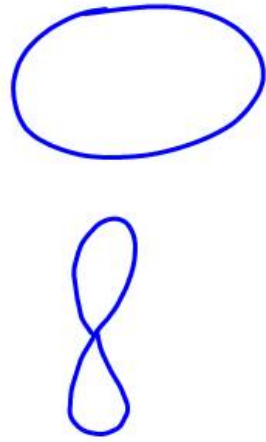
1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>6</sup> 3s<sup>1</sup>

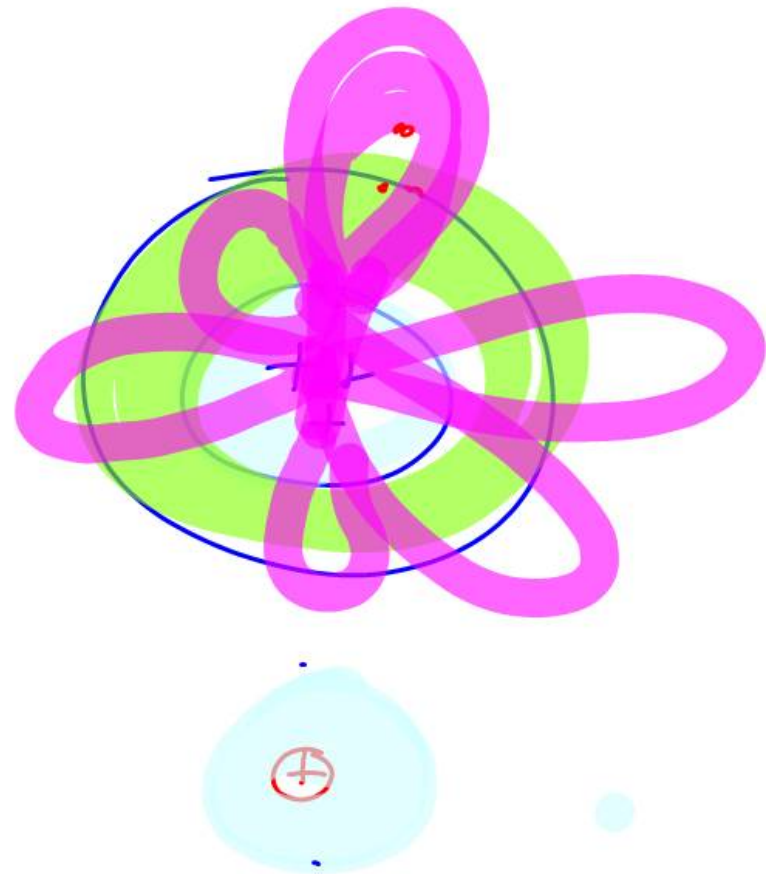
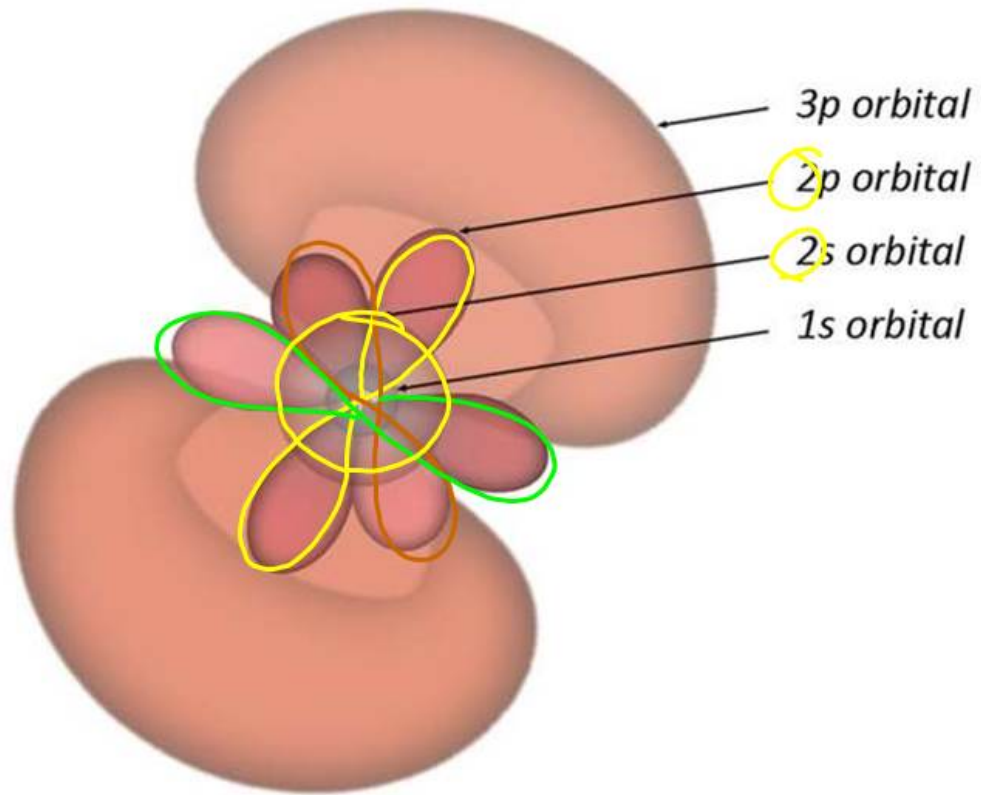
Aufbau



{ e<sup>-</sup> - configuration  
s-p notation

S - orbital  
p - orbital  
d - orbital

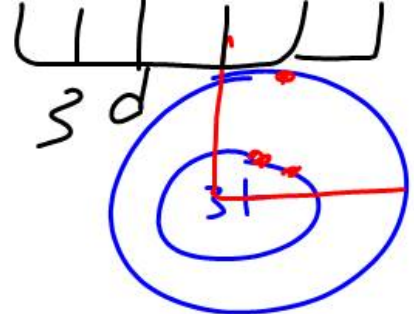
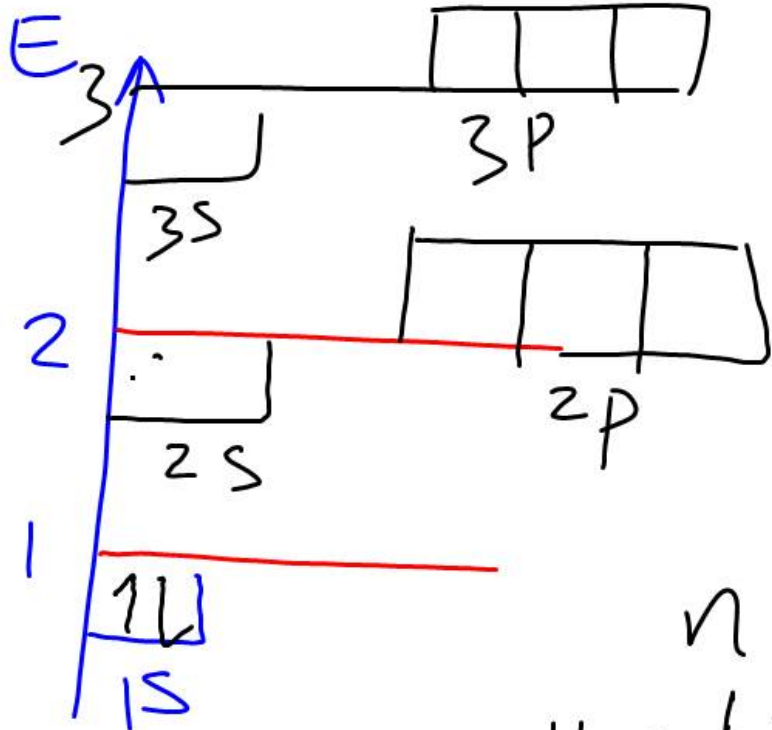
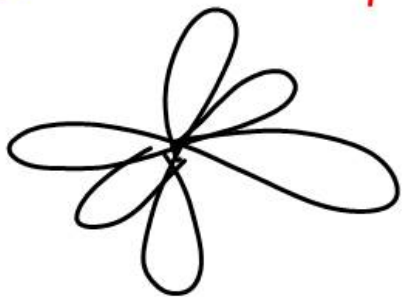




Auf.  
Bau

$\text{Li}^+$

3 Li



$3^2 = 9$   
 $n = \text{Energy level}$   
# orbitals  
 $= n^2$      $2^2 = 4$   
 $= 1^2 = 1$





PERIOD	GROUP 1 IA		GROUP 2 IIA		3	4	5	6	7	8	9
	1	2	3	4							
1	1 H 1.01 hydrogen	2 He 4.00 helium									
2	3 Li 6.94 lithium	4 Be 9.01 beryllium									
3	11 Na 22.99 sodium	12 Mg 24.31 magnesium									
4	19 K 39.10 potassium	20 Ca 40.08 calcium	21 Sc 44.96 scandium	22 Ti 47.87 titanium	23 V 50.94 vanadium	24 Cr 52.00 chromium	25 Mn 54.94 manganese	26 Fe 55.85 iron	27 Co 58.93 cobalt		
5	37 Rb 85.47 rubidium	38 Sr 87.62 strontium	39 Y 88.91 yttrium	40 Zr 91.22 zirconium	41 Nb 92.91 niobium	42 Mo 95.94 molybdenum	43 Tc 98.91 technetium	44 Ru 101.07 ruthenium	45 Rh 102.91 rhodium		
6	85 Cs 132.91 cesium	86 Ba 137.33 barium	57 La 138.91 lanthanum	72 Hf 178.49 hafnium	73 Ta 180.95 tantalum	74 W 183.84 tungsten	75 Re 186.21 rhenium	76 Os 190.2 osmium	77 Ir 192.22 iridium		
7	87 Fr (223) francium	88 Ra (226) radium	89 Ac (227) actinium	104 Rf (261) rutherfordium	105 Db (262) dubnium	106 Sg (263) seaborgium	107 Bh (264) bohrium	108 Hs (265) hassium	109 Mt (268) meitnerium		

Lanthanide series

58 Ce 140.12 cerium	59 Pr 140.91 praseodymium	60 Nd 144.24 neodymium	61 Pm (144.91) promethium	62 Sm 150.36 samarium	63 Eu 151.9 europium
90 Th 232 thorium	91 Pa 231 protactinium	92 U 238 uranium	93 Np 237 neptunium	94 Pu (244) plutonium	95 Am (243) americium

Actinide series

f block (Inner transition elements)

d block (Transition metals)

p block

s block

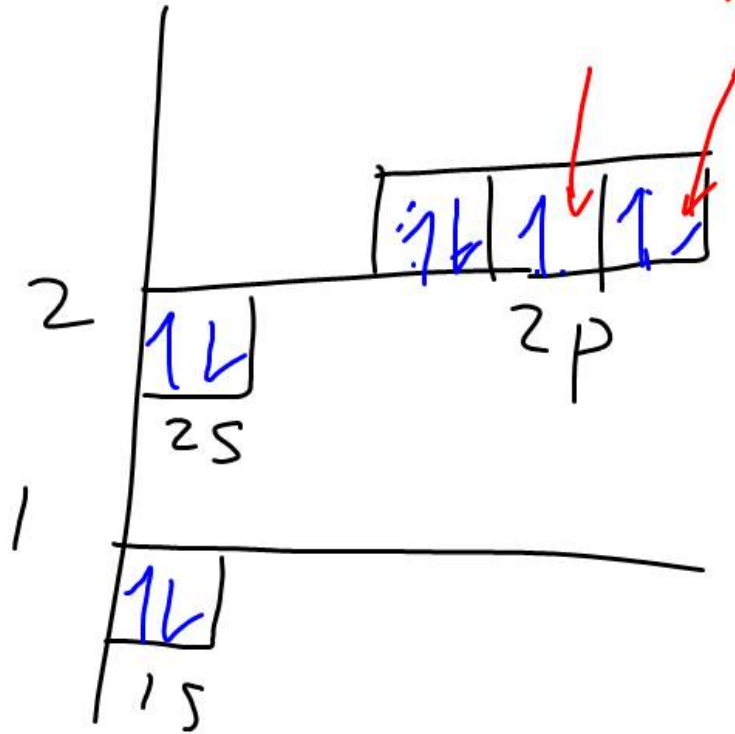
			13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIII He 4.00 helium
			5 B 10.81 boron	6 C 12.01 carbon	7 N 14.01 nitrogen	8 O 16.00 oxygen	9 F 19.00 fluorine	10 Ne 20.18 neon
			13 Al 26.98 aluminum	14 Si 28.09 silicon	15 P 30.97 phosphorus	16 S 32.07 sulfur	17 Cl 35.45 chlorine	18 Ar 39.95 argon
			28 Ni 58.69 nickel	29 Cu 63.55 copper	30 Zn 65.39 zinc	31 Ga 69.72 gallium	32 Ge 72.61 germanium	33 As 74.92 arsenic
			46 Pd 106.42 palladium	47 Ag 107.87 silver	48 Cd 112.41 cadmium	49 In 114.82 indium	50 Sn 118.71 tin	51 Sb 121.76 antimony
			76 Pt 195.08 platinum	77 Au 196.97 gold	78 Hg 200.59 mercury	81 Tl 204.38 thallium	82 Pb 207.2 lead	83 Bi 208.98 bismuth
			110 ** (269)	111 ** (272)	112 ** (277)	113 ** (285)	114 ** (285)	115 ** (285)

64 Gd 157.25 gadolinium	65 Tb 158.93 terbium	66 Dy 162.50 dysprosium	67 Ho 164.93 holmium	68 Er 167.26 erbium	69 Tm 168.93 thulium	70 Yb 173.04 ytterbium	71 Lu 174.97 lutetium
96 Cm (247) curium	97 Bk (247) berkelium	98 Cf (251) californium	99 Es (252) einsteinium	100 Fm (257) fermium	101 Md (258) mendelevium	102 No (259) nobelium	103 Lr (262) lawrencium

$8^0$

$$8^+ = 8e^-$$

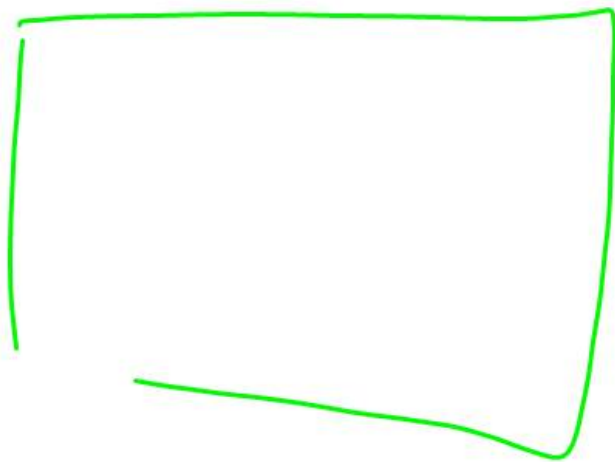
Neutra





$11 \text{ Na}$

Neutral  
Atom



Aufbau

