

PERIODIC TABLE AND ELECTRON CONFIGURATION

15-16 year-olds

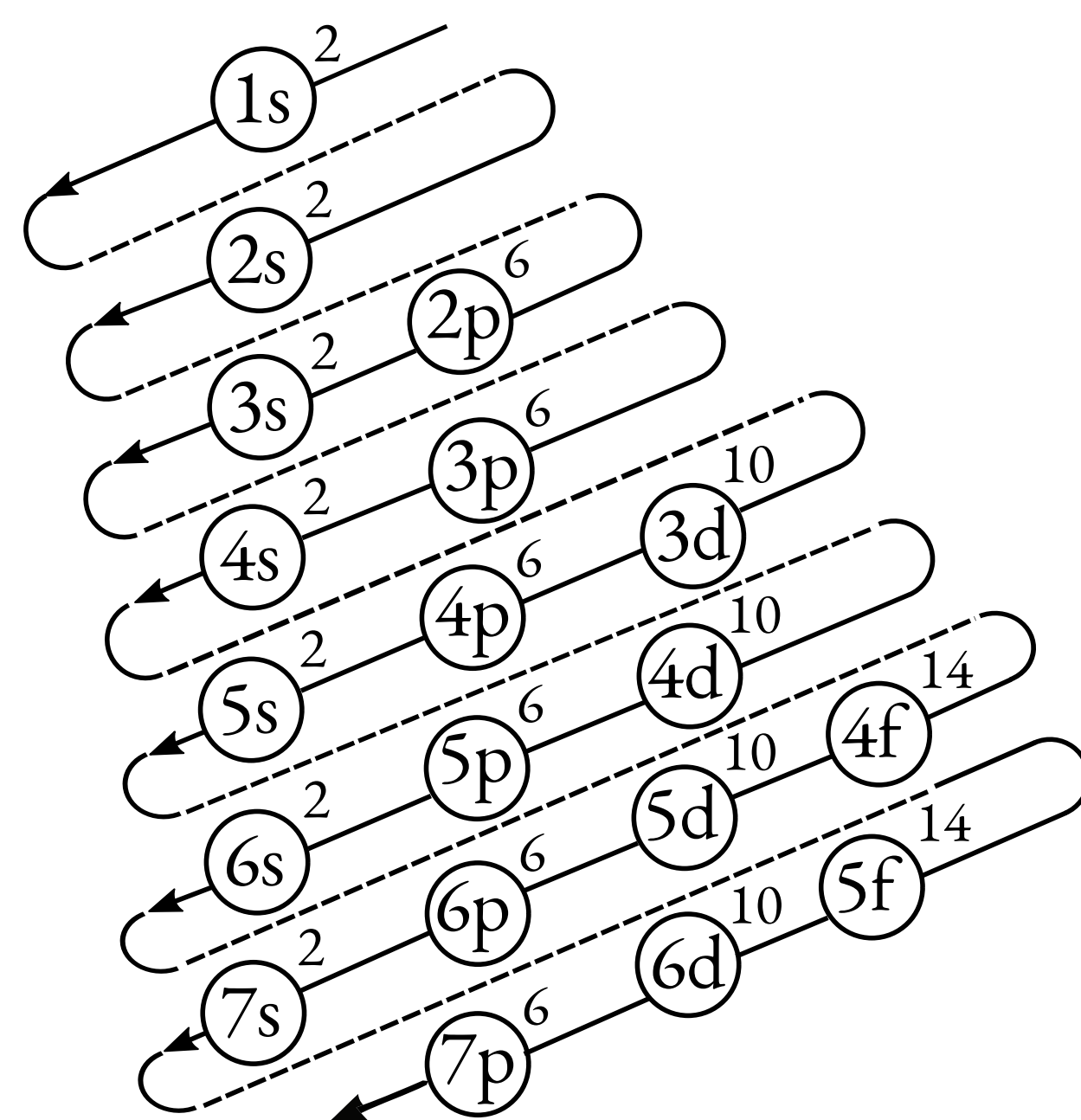
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Electron Configuration

The **electron configuration** is the **distribution** of the **electrons** of an **atom** into **atomic orbitals** (s, p, d y f). **Möller's diagram** helps us to know the **order** in which the different **orbitals** should be **filled**, following the **arrows**.

Orbital	Shape	Maximum number of electrons
s		2 e ⁻
p		6 e ⁻
d		10 e ⁻
f		14 e ⁻



Möller's diagram. Adapted from https://commons.wikimedia.org/wiki/File:Diagrama_de_Configuraci%C3%B3n_electr%C3%B3nica.svg.

Images adapted from <https://www.coursehero.com/sg/general-chemistry/quantum-theory/>.

Ground state

State of **minimum energy**. Electrons *follow* **Möller's diagram**.

Excited state

Orbitals are not **filled** following **Möller's diagram**.

Forbidden state

Any **orbital** has **more electrons** than **allowed** $\left(\begin{array}{c} s \ p \ d \ f \\ 2 \ 6 \ 10 \ 14 \end{array} \right)$.

Valence Electrons

Valence electrons are those of the **outer shell** of an **atom**, being **responsible** for the **interactions** between **atoms** and the **formation** of chemical **bonds**.

Examples			
	GROUND (NEUTRAL)	GROUND (CATION)	EXCITED (NEUTRAL)
	$\overbrace{1s^2 2s^2 2p^6 3s^1}^{11 \ e^-}$ 1 valence e ⁻	$\overbrace{1s^2 2s^2 2p^6}^{10 \ e^-}$ 8 valence e ⁻	$\overbrace{1s^2 2s^2 2p^5 3s^2}^{11 \ e^-}$
	$\overbrace{1s^2 2s^2 2p^4 3s^3}^{11 \ e^-}$		
Sodium (Na)			

Periodic Table of Elements

The **periodic table of elements** arrange the **118 elements** known into **7 periods** (rows) and **18 groups** (columns), **order by its atomic number Z**.

PERIODIC PROPERTIES		
GROUP	OUTER SHELL ELECTRONIC CONFIGURATION	VALENCE ELECTRONS
1	ns ¹	1
2 (and He)	ns ²	2
13	ns ² np ¹	3
14	ns ² np ²	4
15	ns ² np ³	5
16	ns ² np ⁴	6
17	ns ² np ⁵	7
18 (except He)	ns ² np ⁶	8

Z

Mass

Symbol

Statate

Name

State at room T

→ Solid

→ Liquid

→ Gas

→ Radioactive

SYNTHETIC

5	6	7	8	9	10	11	12	13	14	15	16	17	18		
B	C	N	O	F	Ne										
Boron	Carbon	Nitrogen	Oxygen	Fluorine	Neon										
13	14	15	16	17	18										
Al	Si	P	S	Cl	Ar										
Aluminium	Silicon	Phosphorus	Sulfur	Chlorine	Argon										
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Scandium	Titanium	Vanadium	Chromium	Manganese	Iron	Cobalt	Nickel	Copper	Zinc	Gallium	Germanium	Arsenic	Selenium	Bromine	Krypton
39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Yttrium	Zirconium	Niobium	Molybdenum	Technetium	Ruthenium	Rhodium	Palladium	Silver	Cadmium	Indium	Tin	Antimony	Tellurium	Iodine	Xenon
71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Lutetium	Hafnium	Tantalum	Wolfram	Rhenium	Osmium	Iridium	Platinum	Gold	Mercury	Thallium	Lead	Bismuth	Polonium	Astatine	Radon
103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118
Lr	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og
Lawrencium	Rutherfordium	Dubnium	Seaborgium	Bohrium	Hassium	Meitnerium	Darmstadtium	Roentgenium	Copernicium	Nihonium	Flerovium	Moscovium	Livermorium	Tennessee	Oganesson
57	58	59	60	61	62	63	64	65	66	67	68	69	70		
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb		
Lanthanum	Cerium	Praseodymium	Neodymium	Promethium	Samarium	Europium	Gadolinium	Terbium	Dysprosium	Holmium	Erbium	Thulium	Ytterbium		
89	90	91	92	93	94	95	96	97	98	99	100	101	102		
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No		
Actinium	Thorium	Protactinium	Uranium	Neptunium	Plutonium	Americium	Curium	Berkelium	Californium	Einsteinium	Fermium	Mendelevium	Nobelium		

Classification of Chemical Elements

Chemical elements can be classified into **metals**, **metalloids**, **nonmetals** and **noble gases**, according to their **physical** and **chemical properties**:

Metals

Shiny appearance, they are **good conductors** of **heat** and **electricity** and they can make **alloys** with other metals. Most of them are **solids** at room *T* (**Hg** is 💧).

Ion formation They tend to **lose electrons**, forming **cations** (⊕ charged ions). **Examples**: $\text{Li} \longrightarrow \text{Li}^+ + 1 \text{e}^-$; $\text{Mg} \longrightarrow \text{Mg}^{2+} + 2 \text{e}^-$; $\text{Al} \longrightarrow \text{Al}^{3+} + 3 \text{e}^-$.

Metalloids

Breakable solids with a **metallic aspect** that are **semiconductors** and **behave like nonmetals**.

Nonmetals

Dull appearance, they are **bad conductors** of **heat** and **electricity** and they can be **breakable**. They can be **solids**, **liquids** or **gases** at room temperature.

Ion formation They tend to **gain electrons**, forming **anions** (⊖ charged ions). **Examples**: $\text{Cl} + 1 \text{e}^- \longrightarrow \text{Cl}^-$; $\text{O} + 2 \text{e}^- \longrightarrow \text{O}^{2-}$; $\text{P} + 3 \text{e}^- \longrightarrow \text{P}^{3-}$.

Noble gases



He, Ne, Ar, Kr, Xe and ☢️ Rn. **Odourless** and **colorless monoatomic gases** which **barely react** chemically, since they have **eight electrons** in their **outer shell**.