

Periodic Table of Elements

1	1 H																	2 He														
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne														
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar														
4	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				
5	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				
6	55 Cs	56 Ba	57 La	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	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
7	87 Fr	88 Ra	89 Ac	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	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Uuq	115 Uup	116 Uuh	117 Uus	118 Uuo

Alkali metals	Alkaline earth metals	Lanthanides	Actinides	Transition metals
Poor metals	Metalloids	Nonmetals	Halogens	Noble gases

State at standard temperature and pressure

- Atomic number in red: gas
- Atomic number in blue: liquid
- Atomic number in black: solid

solid border: at least one isotope is older than the Earth (Primordial elements)
dashed border: at least one isotope naturally arise from decay of other chemical elements and no isotopes are older than the earth
dotted border: only artificially made isotopes (synthetic elements)
no border: undiscovered

Electron Configurations.notebook

Periodic Table of the Elements

Alkali Metal
Alkaline Earth
Transition Metal
Basic Metal
Semimetals
Nonmetals
Halogens
Noble Gas
Lanthanides
Actinides

identify:

family or group

period

metal

nonmetal

metalloid

transition metal

lanthanide series

actinide series

alkali metals

alkali earth metals

halogens

noble gases

State at standard temperature and pressure

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Full valence shell= stability (lower energy state)
 (outer)

Octet Rule - atoms gain or lose e⁻ to achieve 8 e⁻ in the valence shell for stability

-stability of noble gases (except He stable at 2e⁻)



Periodic Table of the Elements

Legend:
 ■ Alkali metals (yellow)
 ■ Alkaline earth metals (orange)
 ■ Transition metals (pink)
 ■ Lanthanide series (light blue)
 ■ Actinide series (purple)
 ■ Poor metals (light green)
 ■ Nonmetals (dark green)
 ■ Noble gases (cyan)

Physical States:
 [C] Solid, [Br] Liquid, [H] Gas, [Yc] Synthetic

Common Charges:
 +1, +2, +3, +4, -3, -2, -1, 0

Atomic masses in parentheses are those of the most stable or common isotope.

Note: The subgroup numbers 1, 2, and 10 were adopted in 1984 by the International Union of Pure and Applied Chemistry. The names of elements 112-118 are the Latin abbreviations of those numbers.

5 val. electron or more
 gain to make full shell of 8

3 val. electrons or less
 lose **all** val electrons
 to eliminate shell and have next shell full

4 val. electron
 (could gain or lose 4 electrons, or share electrons)

electron configurations
 show last noble gas and electrons added since that noble gas

find outer shell electron (s and p orbitals), add electrons

Periodic Table of Elements

Group

s - block	d - block										p - block						18	
$+1$ 1 H 2 Li Na K S	$+2$ 2 Be Mg Ca	3	4	5	6	7	8	9	10	11	12	$+3$ 13 B Al 	$+4$ 14 C Si 	metalloid 15 N P 	-3 16 O S 	-2 17 F Cl 	-1 18 Ne Ar 	He
d													p					
f - block																		
*Lanthanides													f					
**Actinides													f					

ssc.in

Objectives:

Investigate the current model of electron structure through the following objectives:

I can determine electron configurations, orbital diagrams and quantum numbers for electrons in an atom

I can apply the Aufbau principle, Hund's rule and the Pauli Exclusion Principle to electron configurations

Quantum Theory

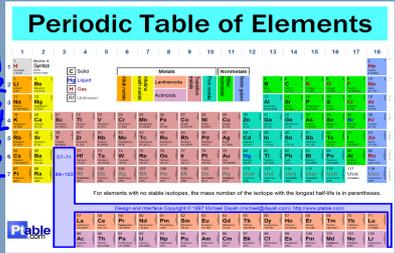
uses 4 numbers to describe each electron
(e⁻ configuration)

principal, n
angular momentum, *l*
magnetic, m
spin, s

Periodic Table of Elements

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	H Hydrogen 1.00794															
2	Li Lithium 6.941	Be Beryllium 9.012182											B Boron 10.811	C Carbon 12.011	N Nitrogen 14.007	
3	Na Sodium 22.98976928	Mg Magnesium 24.304											Al Aluminum 26.9815386	Si Silicon 28.0855	P Phosphorus 30.973762	
4	K Potassium 39.0983	Ca Calcium 40.078	Sc Scandium 44.955912	Ti Titanium 47.88	V Vanadium 50.9415	Cr Chromium 51.9961	Mn Manganese 54.938045	Fe Iron 55.845	Co Cobalt 58.933195	Ni Nickel 58.6934	Cu Copper 63.546	Zn Zinc 65.38	Ga Gallium 69.723	Ge Germanium 72.64	As Arsenic 74.9216	
5	Rb Rubidium 85.4678	Sr Strontium 87.62	Y Yttrium 88.90584	Zr Zirconium 91.224	Nb Niobium 92.90638	Mo Molybdenum 95.94	Tc Technetium 98.90625	Ru Ruthenium 101.07	Rh Rhodium 102.9055	Pd Palladium 106.42	Ag Silver 107.8682	Cd Cadmium 112.411	In Indium 114.818	Sn Tin 118.710	Sb Antimony 121.757	
6	Cs Cesium 132.90545196	Ba Barium 137.327	57-71 Lanthanoids		Hf Hafnium 178.49	Ta Tantalum 180.9479	W Tungsten 183.84	Re Rhenium 186.207	Os Osmium 190.23	Ir Iridium 192.222	Pt Platinum 195.084	Au Gold 196.966569	Hg Mercury 200.59	Tl Thallium 204.3833	Pb Lead 207.2	
7	Fr Francium [223]	Ra Radium [226]	89-103 Actinoids		Rf Rutherfordium [261]	Db Dubnium [262]	Sg Seaborgium [266]	Bh Bohrium [264]	Hs Hassium [277]	Mt Meitnerium [268]	Ds Darmstadtium [271]	Rg Roentgenium [272]	Uub Ununbium [285]	Uut Ununtrium [288]	Uuq Ununquadium [291]	
For elements with no stable isotopes, the mass number of the isotope with the longest half-life is given in brackets.																
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67	La Lanthanum 138.9047	Ce Cerium 140.118	Pr Praseodymium 140.90766	Nd Neodymium 144.242	Pm Promethium [145]	Sm Samarium 150.36	Eu Europium 151.964	Gd Gadolinium 157.25	Tb Terbium 158.92535	Dy Dysprosium 162.50015	Ho Holmium 164.93033	Er Erbium 167.259	89	Ac Actinium [227]	Th Thorium 232.0377	Pa Protactinium 231.03688
90	U Uranium 238.02891	Np Neptunium [237]	Pu Plutonium [244]	Am Americium [243]	Cm Curium [247]	Bk Berkelium [247]	Cf Californium [251]	Es Einsteinium [252]	Fm Fermium [257]	91	Th Thorium 232.0377	Pa Protactinium 231.03688	92	U Uranium 238.02891	Np Neptunium [237]	Pu Plutonium [244]

e⁻ Configurations



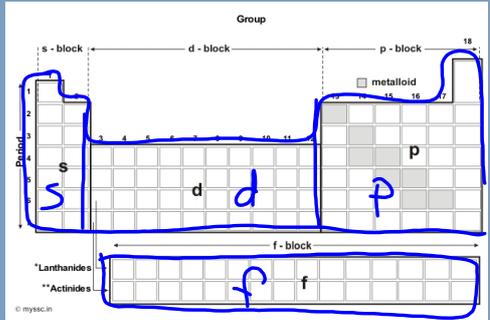
principal, n

n = main energy level of e⁻
 n = 1, 2, 3, 4, 5, 6, 7
 energy increases with higher number

angular momentum, l

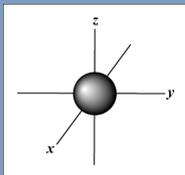
l = shape of orbit, (s, p, d, f)

letter	l
s	0
p	1
d	2
f	3



s orbital

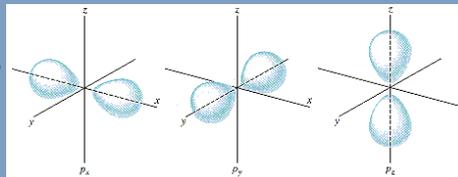
l = 0



1 sublevel, 2 e⁻ each (2 total e⁻)

p orbitals

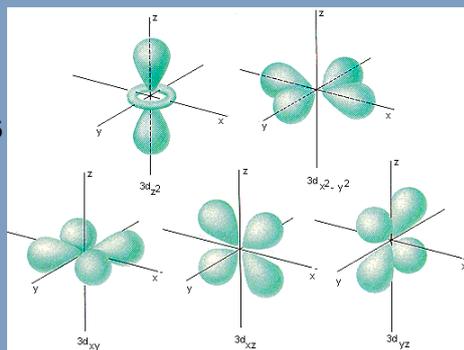
l = 1



3 sublevels, 2 e⁻ each (___ total e⁻)

d orbitals

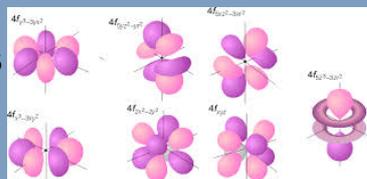
l = 2



5 sublevels, ___ e⁻ each (___ total e⁻)

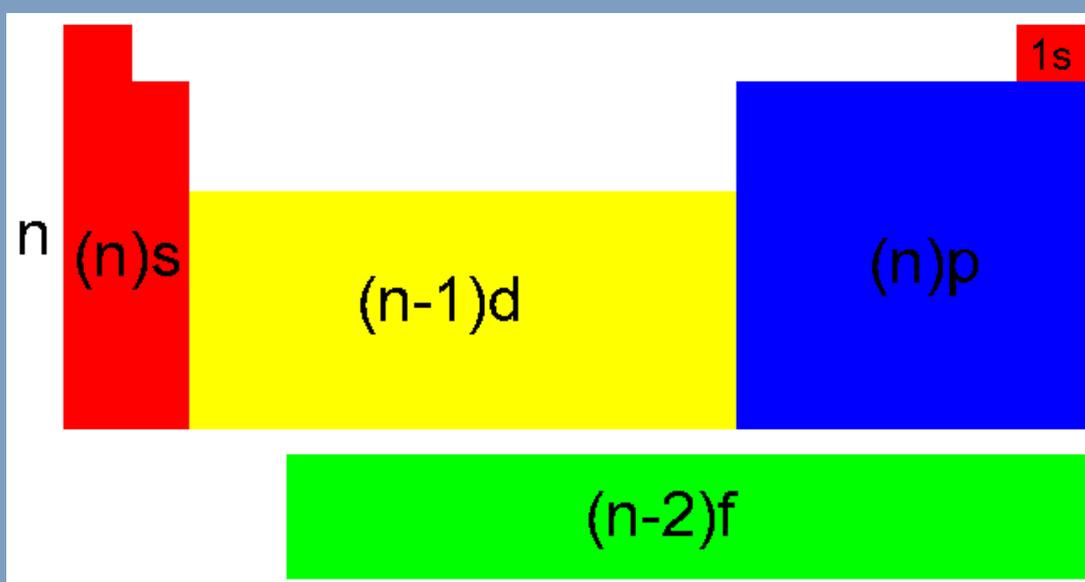
f orbitals

l = 3



7 sublevels, ___ e⁻ each (___ total e⁻)

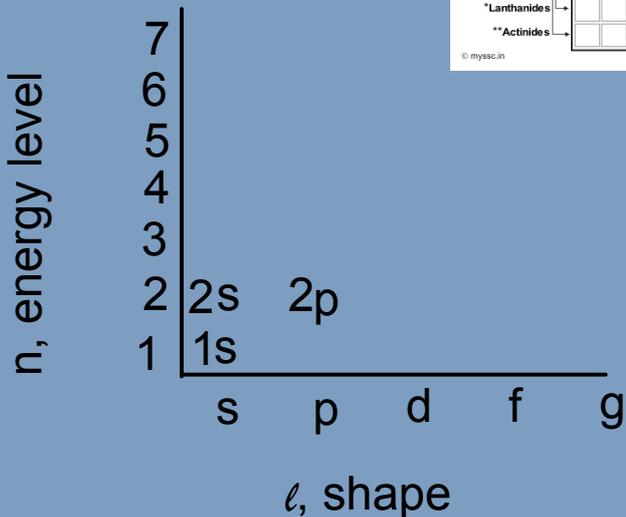
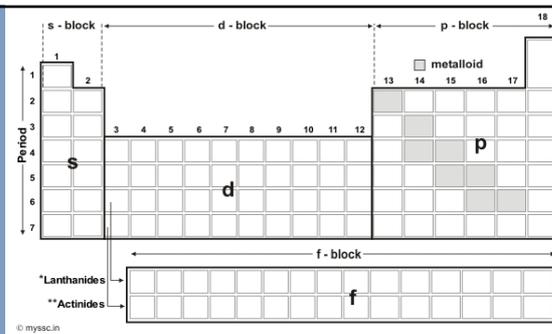
n and l:



Order of e-

Aufbau Chart

show order that electrons are added



e-configurations

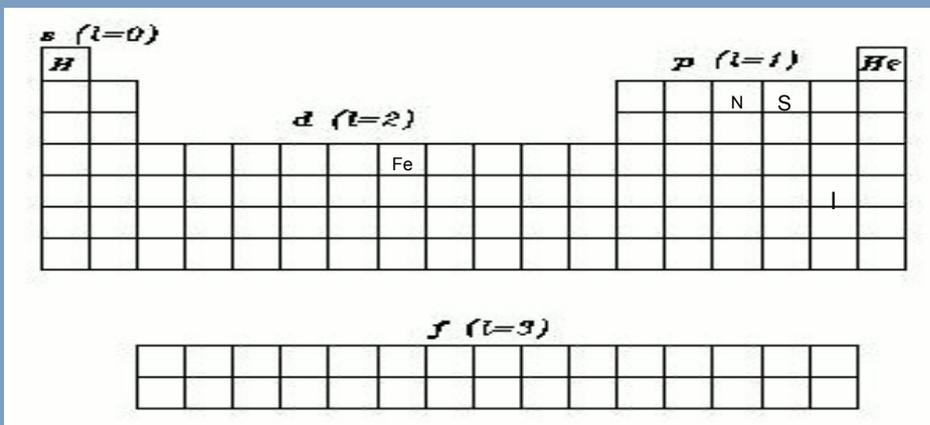
H :

N :

He :

S :

Li :



Fe:

shorthand - use previous noble gas

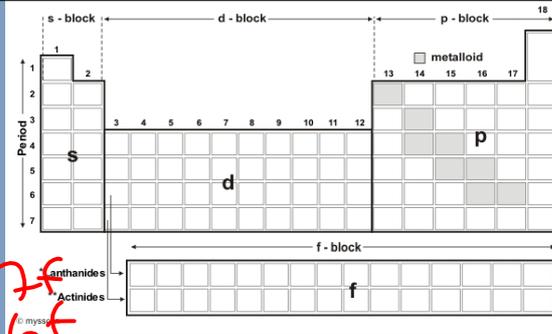
Fe:

I :

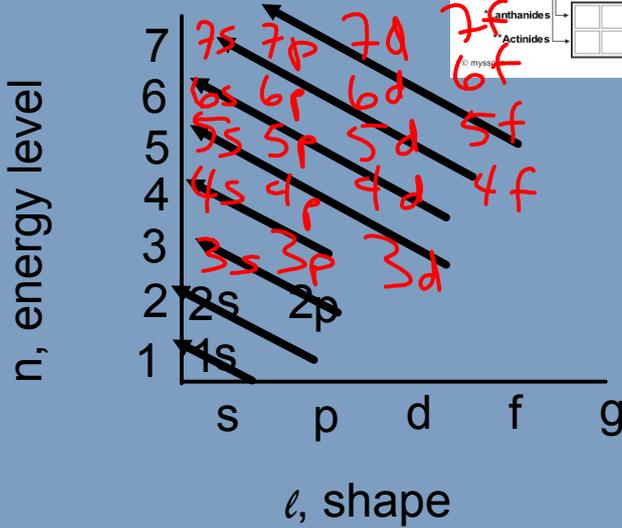
I⁻¹ :

I⁻¹ is isoelectronic with _____

Order of e-



Aufbau Chart

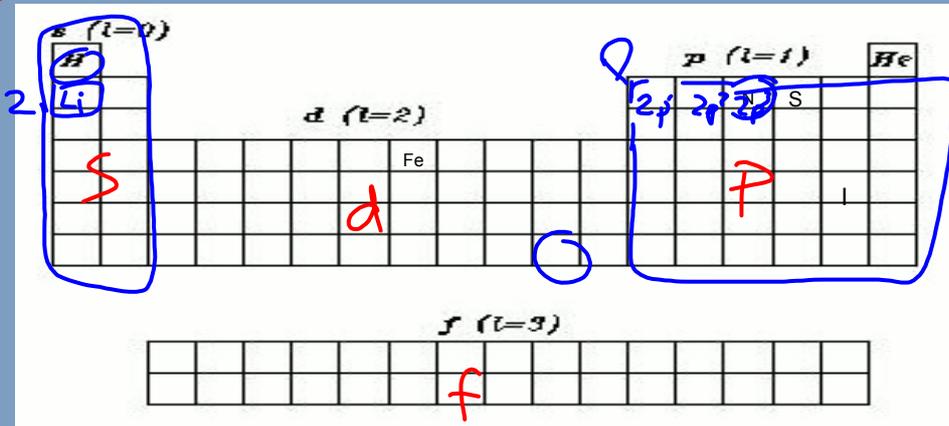


e-configurations

Principal energy level

H: $1s^1$
 He: $1s^2$
 Li: $1s^2 2s^1$

N: $1s^2 2s^2 2p^3$
 S: $1s^2 2s^2 2p^4$



Fe:

shorthand - use previous noble gas

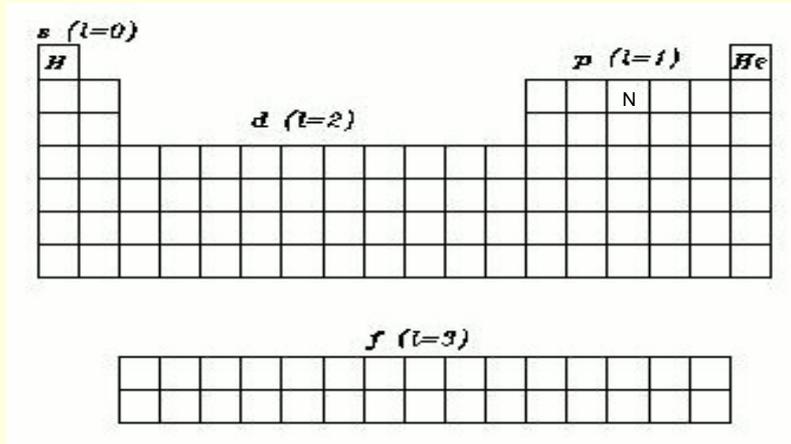
Fe:

I:

I⁻¹:

I⁻¹ is isoelectronic with _____

Orbital Diagrams

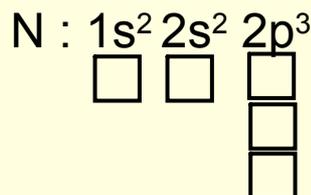
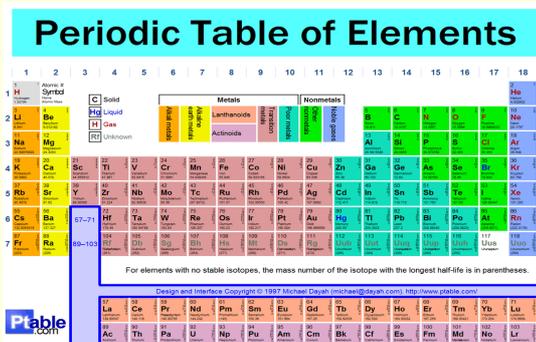


N has 7 p⁺ and 7 e⁻

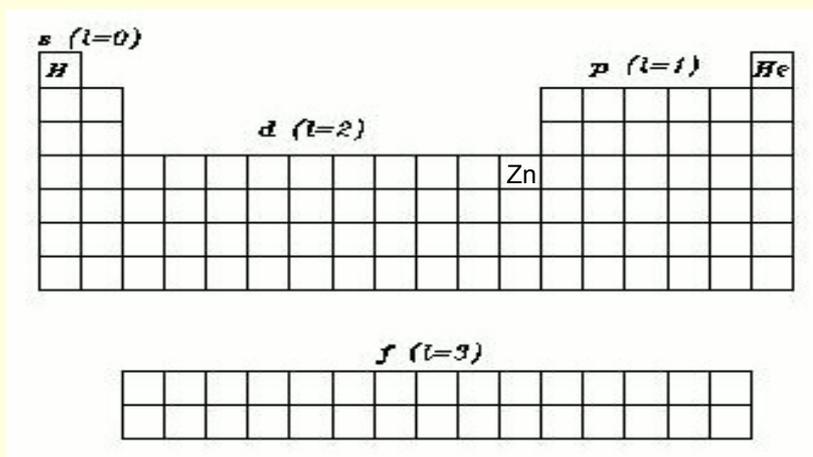
N :

4 quantum numbers

<u>principal</u>	<u>angular momentum</u>	<u>magnetic</u>	<u>spin</u>
main energy level	shape of orbital	suborbital	direction
n	l	m	s
n=1,2,3,4,5,6,7	s, l=0 p, l=1 d, l=2 f, l=3	s has 1 sublevel m=0 p has 3 sublevels m=+1,0,-1 d has 5 sublevels m=+2,+1,0,-1,-1 f has ___ sublevels m=	s= +1/2, -1/2 ↑ ↓ each sublevel has 2 e ⁻ , one in each direction



Hund's rule: fill each sublevel separately first



Zn has 30 protons

Zn⁺² has ___ e⁻

orbital diagram

Zn⁺²:

shorthand

Zn⁺²:

quantum number
for an electron

Pauli Exclusion Principle:

no 2 e⁻ can have the same set of quantum numbers