

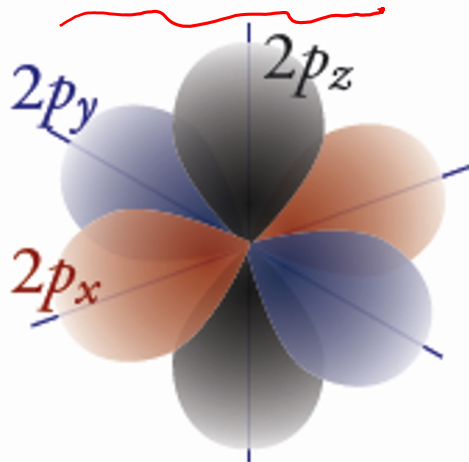
Chapter 2

12/

@chem31phys

Lecture 4

Atoms



2.5 The periodic table

A. Origin of the periodic table

- In 1860, Mendeleev and another scientist produced one of the first periodic tables
- Mendeleev arranged the elements in increasing order of their atomic weight then in order of recurring properties into periods.
- He discovered that elements of the same group are similar in their chemical properties.

Group	I	II	III	IV	V	VI	VII	VIII
Period 1	H=1							
2	Li=7	Be=9.4	B=11	C=12	N=14	O=16	F=19	
3	Na=23	Mg=24	Al=27.3	Si=28	P=31	S=32	Cl=35.5	
4	K=39	Ca=40	?=44	Ti=48	V=51	Cr=52	Mn=55	Fe=56, Co=59 Ni=59
5	Cu=63	Zn=65	?=68	?=72	As=75	Se=78	Br=80	
6	Rb=85	Sr=87	?Yt=88	Zr=90	Nb=94	Mo=96	?=100	Ru=104, Rh=104 Pd=106
7	Ag=108	Cd=112	In=113	Sn=118	Sb=122	Te=125	J=127	
8	Cs=133	Ba=137	?Di=138	?Ce=140				
9								
10			?Er=178	?La=180	Ta=182	W=184		Os=195, Ir=197 Pt=198
11	Au=199	Hg=200	Tl=204	Pb=207	Bi=208			
12				Th=231		U=240		

The Periodic table

Alkali Metals

Noble Gases

Alkaline Earths

Halogens

Main Group

Transition Metals

1 1A	2 2A											13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
H 1.00794	He 4.00260											B 10.811	C 12.011	N 14.0067	O 15.9994	F 18.9984	Ne 20.1797
3 Li 6.941	4 Be 9.01218	3B	4B	5B	6B	7B	8B			11B	12B	13 Al 26.9815	14 Si 28.0855	15 P 30.9738	16 S 32.06	17 Cl 35.4527	18 Ar 39.948
11 Na 22.9898	12 Mg 24.3050	21 Sc 44.9559	22 Ti 47.88	23 V 50.9415	24 Cr 51.9961	25 Mn 54.9381	26 Fe 55.847	27 Co 58.9332	28 Ni 58.693	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.80
19 K 39.0983	20 Ca 40.078	39 Y 88.9059	40 Zr 91.224	41 Nb 92.9064	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.906	46 Pd 106.42	47 Ag 107.868	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.757	52 Te 127.60	53 I 126.904	54 Xe 131.29
37 Rb 85.4678	38 Sr 87.62	*La	72 Hf 178.49	73 Ta 180.948	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.967	80 Hg 200.59	81 Tl 204.383	82 Pb 207.2	83 Bi 208.980	84 Po (209)	85 At (210)	86 Rn (222)
55 Cs 132.905	56 Ba 137.327	†Ac	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 (269)	111 (272)	112 (272)		114 (287)		116 (289)		118 (293)
87 Fr (223)	88 Ra 226.025																

*Lanthanide series	58 Ce 140.115	59 Pr 140.908	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.965	64 Gd 157.25	65 Tb 158.925	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04	71 Lu 174.967
†Actinide series	90 Th 232.038	91 Pa 231.036	92 U 238.029	93 Np 237.048	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

Main Group






Inner Transition Elements

B- Classification of Elements

Metals	Nonmetals
<p>Metals are solids except mercury (liquid)</p> <p><u>shiny</u></p> <p>Conductors of <u>electricity</u></p> <p><u>Ductile</u> (can be drawn into wires)</p> <p><u>Malleable</u> (hammered and rolled into sheets.)</p> <p>They form <u>alloys</u> (bronze is an alloy of copper and tin), and <u>pewter</u> alloy of tin, antimony and lead.</p> <p>During chemical reactions <u>metals</u> lose electrons.</p>	<p>Some are solid like phosphorous and iodine, bromine is a liquid and the others are gases</p> <p><u>dull</u></p> <p>Don't conduct <u>electricity</u> except graphite</p> <p><u>Not ductile</u></p> <p><u>Brittle</u></p> <p>Can form an alloys with metals</p> <p>During chemical reactions they gain electrons</p>
<p>Handwritten: <u>شام</u></p>	
<p>Handwritten: Hg</p>	
<p>Handwritten: $Fe + C$</p>	
<p>Handwritten: <u>تفقد</u></p>	
<p>Handwritten: <u>تكتسب</u></p>	

Metalloids *سبائك*

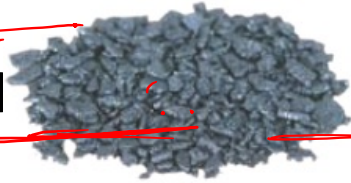
- Metalloids have some properties of metals and some properties of nonmetals.
- Some metalloid are shiny like metals but don't conduct electricity.
- Silicon is semiconductor because it does not conduct electricity at certain applied voltage so silicon is a vital element for silicon valley and electronic industry.

	IIIA (13)	IVA (14)	VA (15)	VIA (16)	VIIA (17)
 Metals (main group)	5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00
 Metals (transition)	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45
 Metals (inner transition)	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90
 Metalloids	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9
 Nonmetals					



Periodi

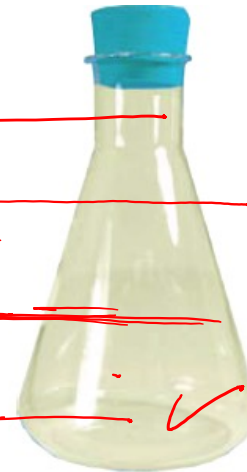
- Not on proper regular



Iodine



Bromine



Chlorine

re similar in some
).
Cl
Br
I

Element	Melting Point (oC)	Boiling Point (oC)
Fluorine	-220	-188
Chlorine	-101	-35
Bromine	-7	59
Iodine	114	184
Astatine	302	337



Alkali Metals

1A

3 Li
11 Na
19 K
37 Rb
55 Cs
87 Fr

Element	Melting Point (°C)	Boiling Point (°C)
Lithium	180	1342
Sodium	98	883
Potassium	63	760
Rubidium	39	686
Cesium	28	669

- These are the elements of group **1A**, these metals are soft i.e. easily cut by knife and their softness increases as we go down the group.
- They have relatively low melting and low boiling points.
- They react with water forming metal hydroxide MOH and H₂ gas. And the strength of the reaction increases as we go downward. They form stable compound with halogens

2.6 The Electron Configuration

$$2n^2$$

2 8 18 3 2

- Bohr in 1913 discovered the electrons orbit the nucleus in definite energy levels. Each energy level contains a number of electrons and each energy level has a certain amount of energy (quantized energy).
- The lowest possible energy level is known as ground state.



$$n = 6$$

$$n = 5$$

$$n = 4$$

$$s + p + d + f$$

$$n = 3$$

$$s + p + d$$

$$n = 2$$

$$s + p$$

$$n = 1$$

s



A- Electrons are distributed in Shells, subshells and Orbitals

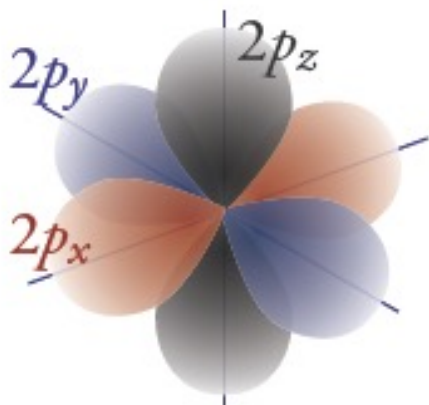
Sublevel	Shape	Number of Orbitals	Number of Electrons
s	Symmetrical spherical shape	1	2
p	Dumbbell shaped	3	6
d		5	10

Handwritten notes: 1, 2, 3, 4, ← S, P, d, f; 14; F; 7

- Each energy level is divided into a number of sublevels, and each sublevel consists of a number of orbitals.
- The sublevel takes the symbols s, p, d, and f.
- Orbital: "it is a region of space around the nucleus that can hold up to two electrons."

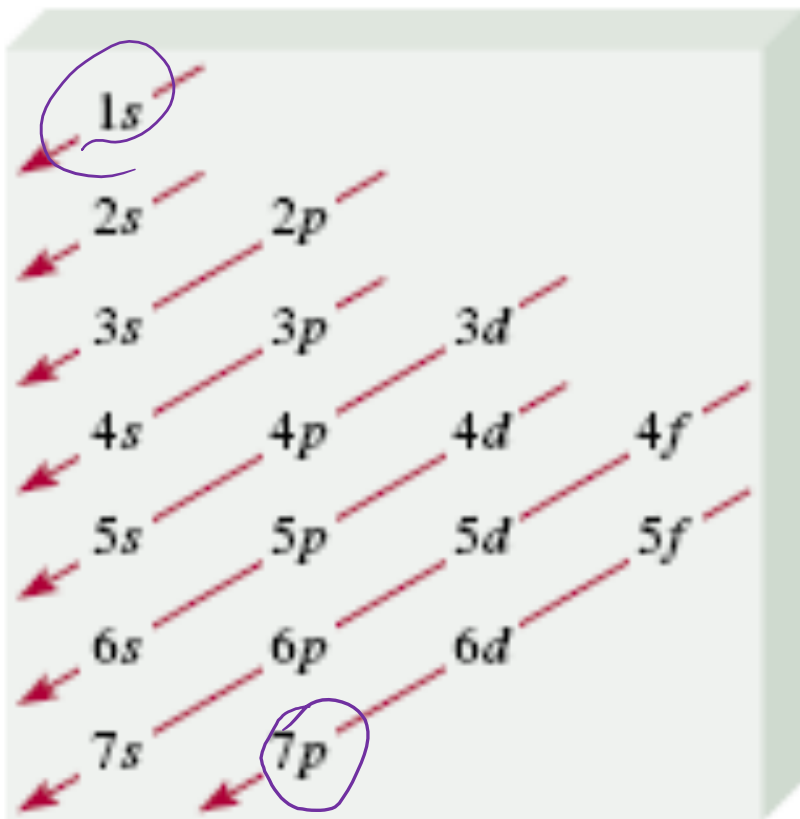
<u>Shell</u>	<u># of subshells</u>	<u>Letters specifying subshells</u>			
$n = 4$	4	s	p	d	f
$n = 3$	3	s	p	d	
$n = 2$	2	s	p		
<u>$n = 1$</u>	<u>1</u>	s			

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C- Electron Configurations of atoms Are Governed by Three Rules

- **Rule 1.** Electrons fill the orbitals in order of increasing orbital energy.
- **Rule 2-** Each orbital can hold up to two electrons with spins paired.
- **Rule 3.** when there is a set of orbitals of equal energy, each orbital becomes half filled before any of them becomes completely filled.



~~Q~~ Q₁ The natural abundance of three stable isotopes of magnesium are 78.99% magnesium-24 (23.99 amu), 10.00% magnesium-25 (24.99), and 11.01% magnesium-26 (25.98). Calculate the atomic weight of magnesium.

Q₂ Write the condensed ground state electron configuration for each of the following elements. The elements atomic number is given in the parentheses.

- He (4) $1s^2 2s^2$
- Na (11) $1s^2 2s^2 2p^6 3s^1$
- Cl (17) $1s^2 2s^2 2p^6 3s^2 3p^5$
- P (15) $1s^2 2s^2 2p^6 3s^2 3p^3$

Cr
24

Cr
24

@ Chem 31 phys

End of The Lecture

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دعواتكم
بالتوفيق والبر