Periodic Table

"The Periodic Table is arguably the most important concept in chemistry, both in principle and in practice. It is a remarkable demonstration of the fact that the chemical elements are not a random cluster of entities but instead display trends and lie together in families".

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As long as chemistry is studied there will be a periodic table. And even if someday we communicate with another part of the universe, we can be sure that one thing that both cultures will have in common is an ordered system of the elements that will be instantly recognizable by both intelligent life forms.

J. Emsley, *The Elements*

Antiquity	Au, Ag, Cu, Fe, Sn, Pb, Sb, Hg, S, C	
Middle Ages	As, Bi, Zn, P, Pt	
1700		
1710		
1720		
1730	Co	
1740		
1750	Ni, Mg	
1760	H	
1770	N, O, Cl, Mn, Ba	
1780	Mo, W, Te, Zr, U	Lavoisier
1790	Ti Y, Be	
1800	V, Nb, Ta, Rh, Pa, Os, Ir, Ce	Dalton, Avogadro
	K, Na, B, Ca, Sr, Ru, Ba	Davy
1810	I, Th, Li, Se, Cd	
1820	Si, Al, Br	Döbereiner
1830	La	
1840	Er	Gmelin
1850		Cannizzaro

1860	Cs, Rb, Tl, In, He	Mendeleev, Lothar Meyer
1870	Ga, Ho, Yb, Sc, Tm	
1880	Gd, Pr, Nd, Ge, F, Dy	
1890	Ar, He, Kr, Ne, Xe, Po, Ra, Ac	Ramsay, Rayleigh
1900	Rn, Eu, Lu	Thomson
1910	Pa	Lewis, van den Broek, Moseley
1920	Hf, Re, Tc	Bohr, Pauli, Schrödinger
1930	Fr	
1940	Np, At, Pu, Cm, Am, Pm, Bk	Seaborg
1950	Cf, Es, Fm, Md, No	
1960	Lr, Rf, Db	
1970	Sg	
1980	Bh, Mt, Hs	
1990	Ds, Rg, 112, 114, 116	
2000		

Sun	☉	Gold
Moon	☽	Silver
Mercury	☿	Mercury
Venus	♀	Copper
Mars	♂	Iron
Jupiter	♃	Tin
Saturn	♄	Lead

ORIGINS OF ELEMENT NAMES

Places

Regions	Element
Magnesia, Thessaly, Greece	Magnesium
Scandinavia	Scandium, Thulium
Rhine, Germany	Rhenium
Cyprus	Copper
Europe	Europium
America	Americium
California, USA	Californium
Hess, Germany	Hassium
Countries	
France	Gallium (Gaul), Francium
Germany	Germanium
Russia	Ruthenium
Poland	Polonium
Sweden	Holmium
Cities	
Ytterby, Sweden	Yttrium, Terbium, Erbium, Ytterbium
Dubna, Russia	Dubnium
Copenhagen, Denmark	Hafnium
Paris, France	Lutetium
Stockholm, Sweden	Holmium
Strontian, Scotland	Strontium
Berkeley, California, USA	Berkelium
Darmstadt, Germany	Darmstadtium

Colours

Colour	Element
White	Boron
pale green	Chlorine
colour	Chromium
deepest red	Rubidium
gold colour	Zirconium
yellow orpiment	Arsenic
rose	Rhodium
indigo	Indium
violet	Iodine
sky blue	Cesium
green twin	Promethium
rainbow	Iridium
White mass	Bismuth
silver	Platinum
green twig	Thallium

Gods/Goddesses

God/Goddess	Element
Aurora	Aurium (gold)
Iris	Iridium
Mercury	Mercury
Titans	Titanium
Freyja Vanadis	Vanadium
Niobe	Niobium
Goblin	Cobalt, Nickel
Tantalos	Tantalum
Thor	Thorium
Prometheus	Promethium

Celestial Body	Element
moon	Selenium
Pallas	Palladium
Sun	Helium
Mercury	Mercury
Ceres	Cerium
Uranus	Uranium
Neptune	Neptunium
Pluto	Plutonium

People

Name of Person	Element
Johan Gadolin	Gadolinium
Cadmus, mythological King of Phoenicia	Cadmium
Albert Einstein	Einsteinium
Enrico Fermi	Fermium
Dimitri Mendeleev	Mendelevium
Alfred Nobel	Nobelium
Lise Meitner	Meitnerium
Ernest O. Lawrence	Lawrencium
Marie and Pierre Curie	Curium
Ernest Rutherford	Rutherfordium
Colonel Samarski	Samarium
Glenn T. Seaborg	Seaborgium
Niels Bohr	Bohrium
Wilhelm Roentgen	Roentgenium

Pre-Periodic Table Chemistry …

- …was a mess!!!
- No organization of elements.
- Imagine going to a grocery sto… …niza
- Difficult to find information.
- Chemistry didn't make sense.

During the nineteenth century, chemists began to categorize the elements according to similarities in their physical and chemical properties. The end result of these studies was our modern periodic table.

Lavoisier (1789) classified elements into metal

Dobereiner's triads [John Dobereiner (1829)]

In 1829, he classified some elements into groups of three, which he called triads.

The elements in a triad had similar chemical properties and orderly physical properties.

S.No	Triad	Atomic masses of elements of triad	Arithmetic mean of atomic masses of first and third element
1	Cl,Br,I	35.5, 80, 127	$\frac{35.5 + 127}{2} = 81.25$
2	Li,Na,K	7, 23, 39	$\frac{7 + 39}{2} = 23$
3	Ca,Sr,Ba	40,87.5,137	$\frac{40+137}{2} = 88.5$

Model of triads

John Newlands

In 1863, he suggested that elements be arranged in “octaves” because he noticed (after arranging the elements in order of increasing atomic mass) that certain properties repeated every 8th element.

Law of Octaves

1838 - 1898

Newland's law of octaves [John Newland (1862)]

Element	Li	Be	B	C	N	O	F
Atomic mass	7	9	11	12	14	16	19
Element	Na	Mg	Al	Si	p	S	Cl
Atomic mass	23	24	27	28	31	32	35.5
Element	K	Ca					
Atomic mass	39	40					

ublish the list of elements in
er of atomic masses.

Dmitri Mendeleev

In 1869 he published a table of the elements organized by increasing atomic mass.

Mendeleev's periodic table was published in 1905 when no

Only 63 elements were known.

Groups

- 8 vertical rows.
- 7 groups were subdivided in A and B.
- 8th group has 9 elements in the group of 3 each.

Periods

- 7 horizontal rows.

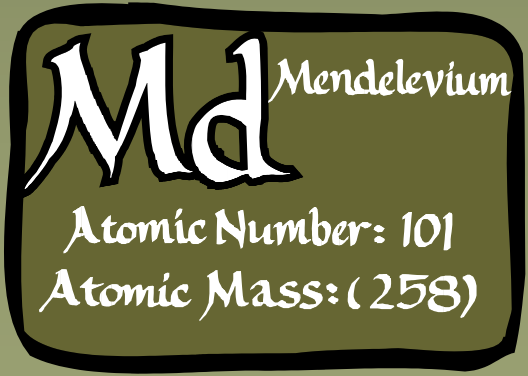
Mendeleev's periodic table

Groups: General Formulae: Family:	I R_2O RCl A B	II RO RCl_2 A B	III R_2O_3 RCl_3 A B	IV RH_4 RO_2 A B	V RH_3 R_2O_5 A B	VI RH_2 RO_3 A B	VII RH R_2O_7 A B	VIII RO_4 A B
1 2	H Li	 Ba	 B	 C	 N	 O	 F	
3 4	Na K	Mg Ca	Al	Si Ti	P V	S Cr	Cl Mn	 Fe, Co, Ni
5 6	Cu Rb	Zn Sr	 Yt?	 Zr	As Nb	Se Mo	Br	 Ru, Rh, Pd
7 8	Ag Cs	Cd Bd	In Di?	Sn Ce?	Sb	Te	I	
9 10			 Er?	 La?	 Ta	 W		Os, Ir, Pt
11 12	Au	Hg	Ti	Pb Th	Bi	 U		

Dmitri Mendeleev: Father of the Table

HOW HIS WORKED…

- Put elements in rows by increasing atomic weight.
- Put elements in columns by the way they reacted.



SOME PROBLEMS…

- He left blank spaces for what he said were undiscovered elements. (Turned out he was right!)
- He broke the pattern of increasing atomic weight to keep similar reacting elements together.

Mendeleev's Predictions for the Elements Eka-aluminium (Gallium) and Eka-silicon (Germanium)

Property	Eka-aluminium (predicted)	Gallium (found)	Eka-silicon (predicted)	Germanium (found)
Atomic weight	68	70	72	72.6
Density / (g/cm^3)	5.9	5.94	5.5	5.36
Melting point /K	Low	302.93	High	1231
Formula of oxide	E_2O_3	Ga_2O_3	EO_2	GeO_2
Formula of chloride	ECl_3	$GaCl_3$	ECl_4	$GeCl_4$

Merits of Mendeleev's periodic table

Prediction of new elements
(Ge, Ga, Sc)

1

ematic study
elements

2

Correction of
atomic mass
(Be, Au, Pt)

3

Defects of Mendeleev's periodic table

Position of hydrogen.

alous pairs.
nd K, Co and
, Te and I)

Position of isotopes
e.g. $_1H^1$, $_1H^2$, $_1H^3$

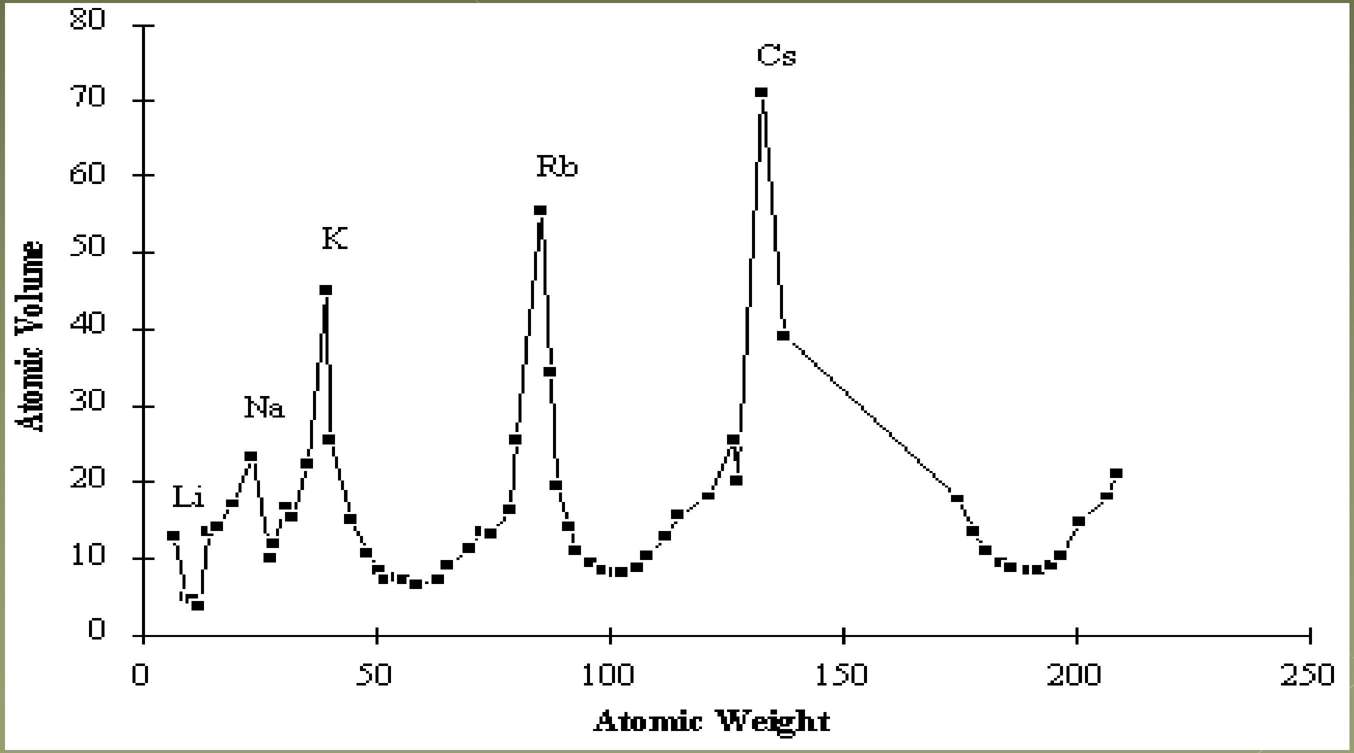
Defects of Mendeleev's periodic table

Chemically dissimilar elements are grouped together. (Cu-IA and Na-IB)

Chemically similar elements are placed in different groups. [Cu (I) and Hg (II)].

Lothar Meyer

At the same time, he published his own table of the elements organized by increasing atomic mass.



Lother-Meyer's atomic volume curve [Lother Meyer (1869)]

- Both Mendeleev and Meyer arranged the elements in order of increasing atomic mass.
- Both left vacant spaces where unknown elements should fit.

So why is Mendeleev called the "father of the modern periodic table" and not Meyer, or both?

Mendeleev…

- stated that if the atomic weight of an element caused it to be placed in the wrong group, then the weight must be wrong. (He corrected the atomic masses of Be, In, and U)
- was so confident in his table that he used it to predict the physical properties of three elements that were yet unknown.
- After the discovery of these unknown elements between 1874 and 1885, and the fact that Mendeleev's predictions for Sc, Ga, and Ge were amazingly close to the actual values, his table was generally accepted.

Henry Moseley

In 1913, through his work with X-rays, he determined the actual nuclear charge (atomic number) of the elements. He rearranged the elements in order of increasing atomic number.

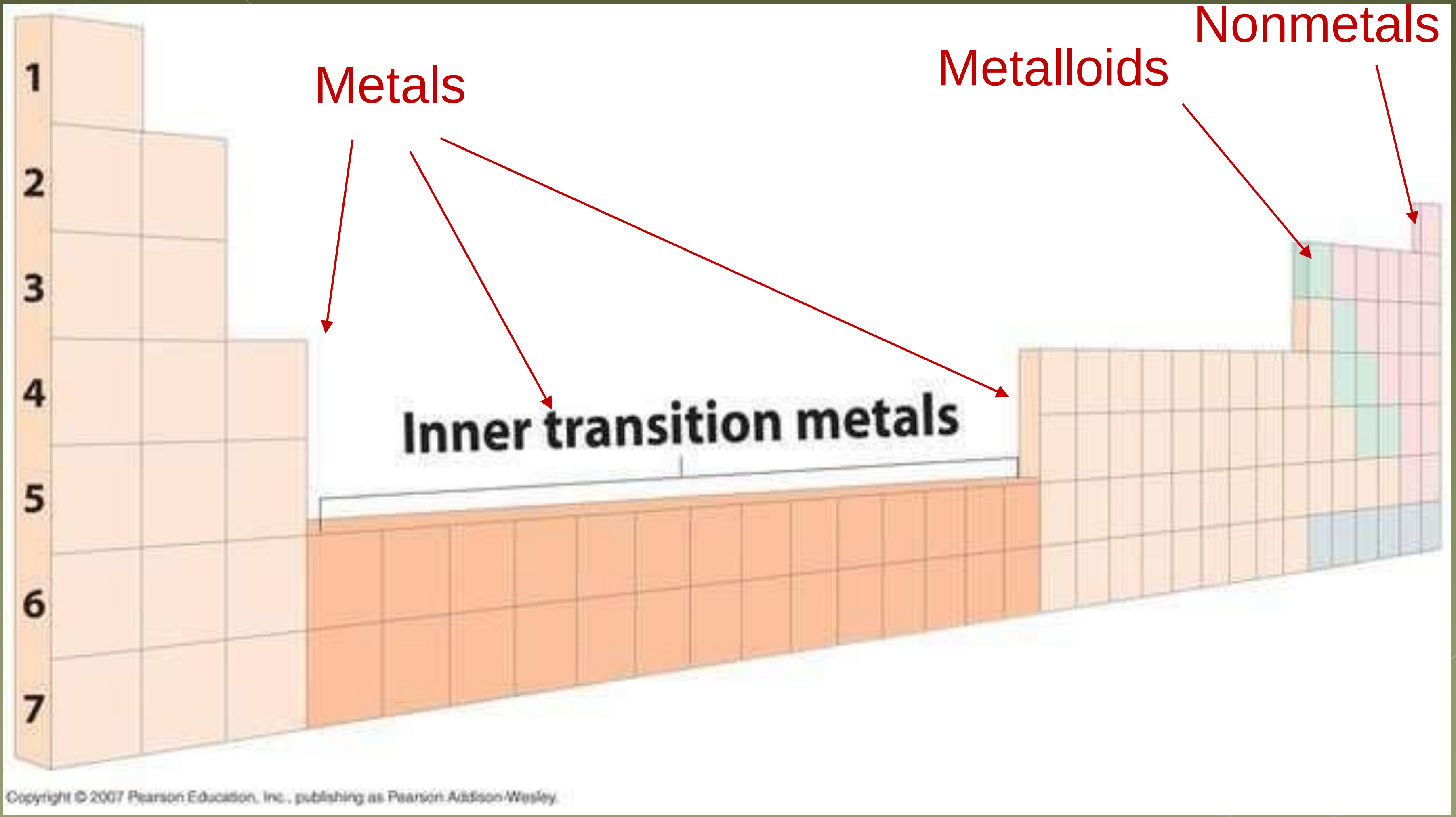
Glenn T. Seaborg

After co-discovering 10 new elements, in 1944 he moved 14 elements out of the main body of the periodic table to their current location below the Lanthanide series. These became known as the Actinide series.

He is the only person to have an element named after him while still alive.

"THIS IS THE GREATEST HONOR EVER BESTOWED UPON ME – EVEN BETTER, I THINK, THAN WINNING THE NOBEL PRIZE."

1912 - 1999


Nonmetals
Metalloids
Metals
Inner transition metals
1
2
3
4
5
6
7
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Periodic Table of Elements

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
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	57–71	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	89–103	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Uub	113 Uut	114 Uuq	115 Uup	116 Uuh	117 Uus	118 Uuo

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
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

Atomic #
Symbol
Name
Atomic Mass

C Solid
Hg Liquid
H Gas
Rf Unknown

Metals: Alkali metals · Alkaline earth metals · Lanthanoids · Actinoids · Transition metals · Poor metals

Nonmetals: Other nonmetals · Noble gases

For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.

s block elements

- **Electronic configuration**:

  ns^1 or ns^2

- **Groups**: IA and IIA

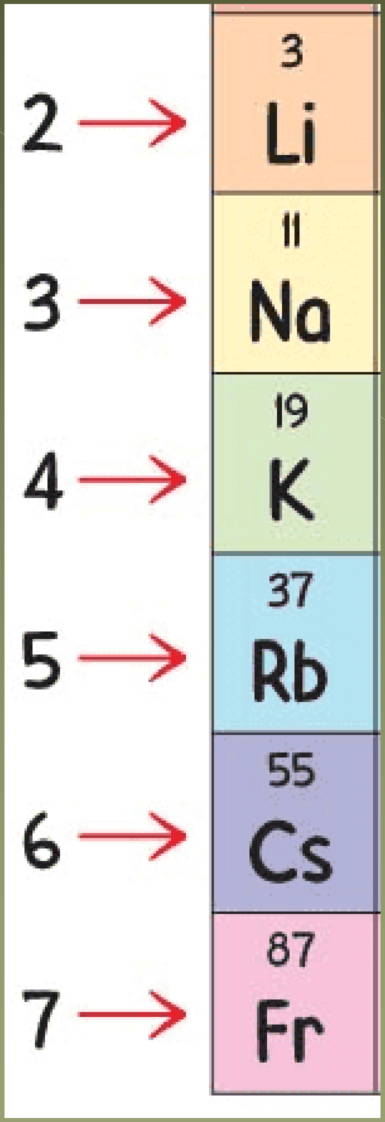
- **Low ionisation energy and low melting and boiling points, electropositive elements.**

- **Colourless compounds.**

Group 1- Alkali Metals

- 1 valence electron (ns^{1})
- Form a 1+ ion.
- Note: Hydrogen, a nonmetal, is located in the first column because it has one valence electron.

Group 1- Alkali Metals



Lithium

Sodium

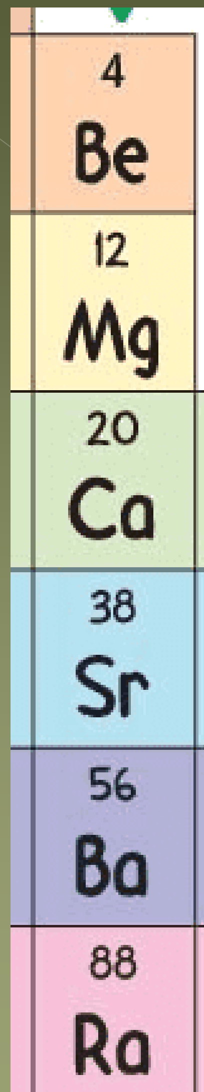
Potassium

Rubidium

Cesium

Francium

Group 2- Alkali Earth Metals



Beryllium

Magnesium

Calcium

Strontium

Barium

Radium

p block elements

- **Electronic configuration**:

  ns^2,np^{1-6}

- **Groups**:

  III A to VII A and zero group.

- **Non-metals, electronegative.**

- **Form covalent compounds.**

d block elements

- **Electronic configuration:**

  $(n-1)d^{1-10}\ ns^{1or2}$

- **Groups:**

  I B to VII B and VIII groups.

- **Variable valency high melting and boiling point.**

- **Coloured compounds and catalytic property.**

F BLOCK ELEMENTS

- **Electronic configuration:**

  $(n-2)f^{1-14}(n-1)d^{0-1}ns^2$

- **Present below the periodic table in two rows**

- **Lanthanides-elements after lanthanum**

- **Actinides-elements after actinium.**

- **Have high melting and boiling point.**

Features of long form of periodic table

- Contains elements arranged in increasing order of atomic no.s.
- Explains the position of an element in relation to other elements.
- Consists of groups and periods.

Groups **Vertical column**

Total 18. Numbered 1-18 or IA to VII A, IB to VII B, VIII and zero.

Elements in a group have similar but not identical electronic configuration and properties

Periods **Horizontal column**

Total 7 numbered from 1 to 7.

Contains 2,8,8,18,18,32 and 28 elements respectively.

Features of long form of periodic table

Groups **Vertical column**

Total 18. Numbered 1-18 or
IA to VII A, IB to VII B, VIII and zero.

Elements in a group have similar but not identical electronic configuration and properties

Periods **Horizontal column**

Total 7 numbered from 1 to 7.

Contains 2,8,8,18,18,32 and 28 elements respectively.

Defects of long form of periodic table

It is unable to include lanthanides and actinides in its main body.

The problem of the position of hydrogen in the table has not been solved completely

Configuration of Helium($1s^2$) is different from inert gases (ns^2, np^6) but are placed in the same group.

Nomenclature of the elements with atomic number>100

Digits	Name	Abbreviation
0	nil	n
1	un	u
2	bi	b
3	tri	t
4	quad	q
5	pent	p
6	hex	h
7	sept	s
8	oct	o
9	enn	e

Name=digits name+ium

e.g. atomic number 115 will be named a
=ununpentium
and symbol is Uup

Causes of periodicity

Repetition of similar valence shell configuration after regular interval.

Element	Atomic no.	Electronic configuration
Li	3	$1s^2,2s^1$
Na	11	$1s^2,2s^2,2p^6,3s^1$
K	19	$1s^2,2s^2,2p^6,3s^2,3p^6,4s^1$
Rb	37	$1s^2,2s^2,2p^6,3s^2,3p^6,4s^2,$ $3d^{10},4p^6,5s^1$

Effective Nuclear Charge

- In any atom the nucleus exerts an attractive force on the electrons.
- Across a period the number of protons in the nucleus steadily increases. The effective charge increases with the nuclear charge as there is no change in the number of inner electrons.
- The effective nuclear charge experienced by an atom's outer electrons increases with the group number of the element.
- It increases across a period but remains approximately the same down a group.

Effective nuclear charge (Z_{eff}) is the "positive charge" felt by an e

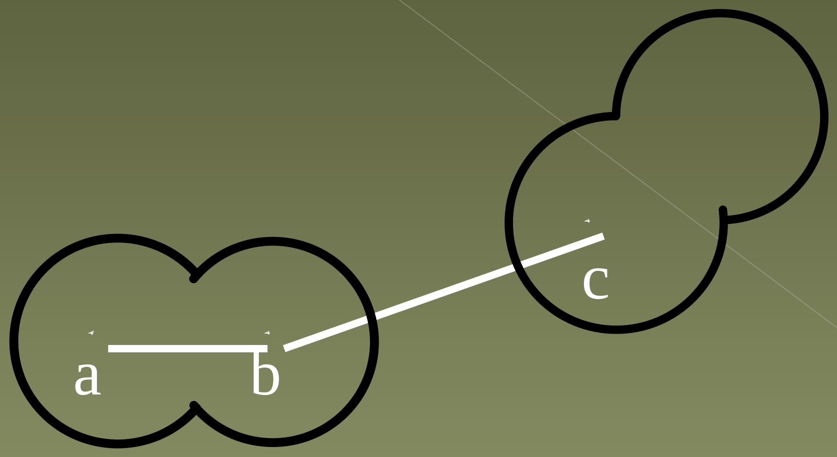
$Z_{eff} = Z - \sigma$ $0 < \sigma < Z$ (σ = shielding constant)

$Z_{eff} \approx Z$ – number of inner or core electrons

	Z	Core	Z_{eff}	Radius (pm)
Na	11	10	1	186
Mg	12	10	2	160
Al	13	10	3	143
Si	14	10	4	132

Atomic size

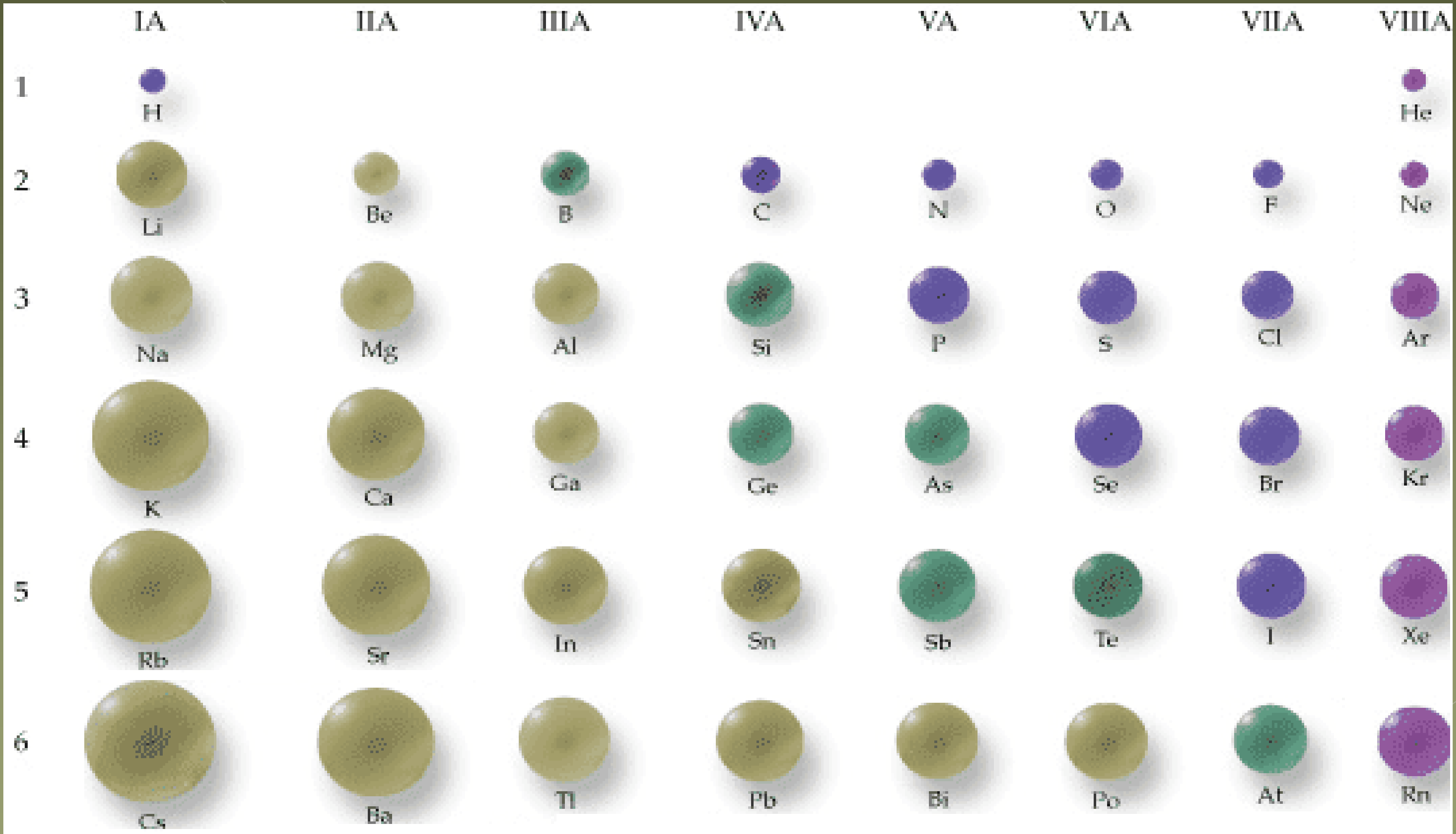
Covalent and van der waal’s radius:



$$\text{Covalent radius} = \frac{\text{Distance between a and b}}{2}$$

$$\text{van der Waal's radius} = \frac{\text{Distance between b and c}}{2}$$

Trends of Atomic Size



Size of cation

	Fe	Fe^{2+}	Fe^{3+}
Protons	26	26	26
Electrons	26	24	23

Size of anion

	Cl	Cl^{-}
Protons	17	17
Electrons	17	18

Isoelectronic ions

$$r_{C^{4-}} > r_{N^{3-}} > r_{O^{2-}} > r_{F^-}$$

no. of electrons	10	10	10	10
nuclear charge	+6	+7	+8	+9

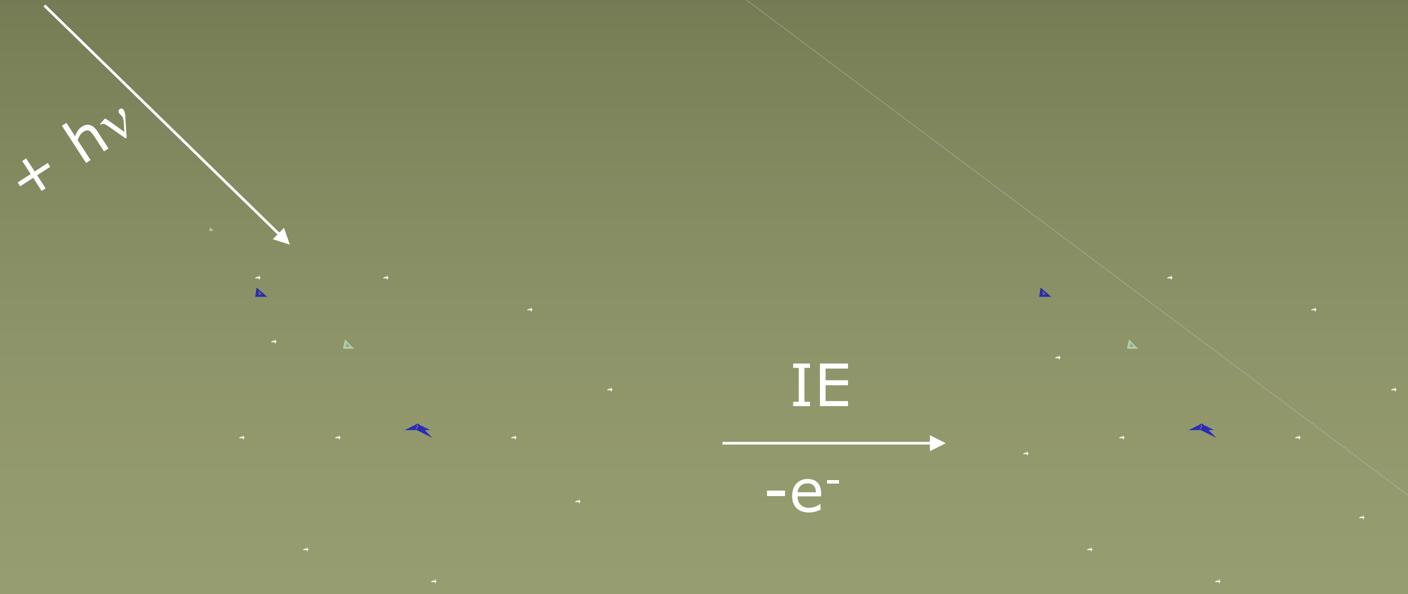
$$r_{Na^+} > r_{Mg^{2+}} > r_{Al^{3+}}$$

no. of electrons	10	10	10
nuclear charge	+11	+12	+13

- Note for isoelectronic series Na^+, Mg^{2+}, Al^{3+}, N^{3-}, O^{2-}, F^-,
- $N^{3-} > O^{2-} > F^- > Na^+ > Mg^{2+} > Al^{3+}$
- Most positive ion the smallest, most negative the largest

Ionisation energy

- Minimum energy required to remove an electron from a ground-state, gaseous atom
- Energy always positive (requires energy)
- Measures how tightly the e^- is held in atom (think size also)
- Energy associated with this reaction



Isolated gaseous atom

Successive ionisation energies

$$M \xrightarrow[IE_1]{-e} M^+ \xrightarrow[IE_2]{-e} M^{2+} \xrightarrow[IE_3]{-e} M^{3+}$$

$IE_3 > IE_2 > IE_1$

Factors affecting values of ionisation energy

1. Size

$$\text{Ionisation energy} \propto \frac{1}{\text{Atomic size}}$$

	Li	Be
Atomic size	1.23	0.89
Ionisation energy KJ/mole	520	899

2. Effective nuclear charge

Is net nuclear attraction towards the valence shell electrons .

Ionization energy α Effective nuclear charge

	Li	Be
Effective nuclear charge	+3	+4
Ionisation energy KJ/mole	520	899

3. Screening effect or shielding effect

Combined effect of attractive and repulsive forces between electron and proton.

$$\text{Ionisation energy} \propto \frac{1}{\text{Number of inner shells}}$$

	Li	Na
No. of inner shells	1	2
Ionisation energy KJ/mole	520	496

4. Penetrating power of orbitals

s>p>d>f

5. Complete octet

Elements having ns^2,np^6 configuration have extremely high ionisation energy.

6. Stable Configuration

Trend of ionisation energy in period and groups

<u>Exceptions</u>

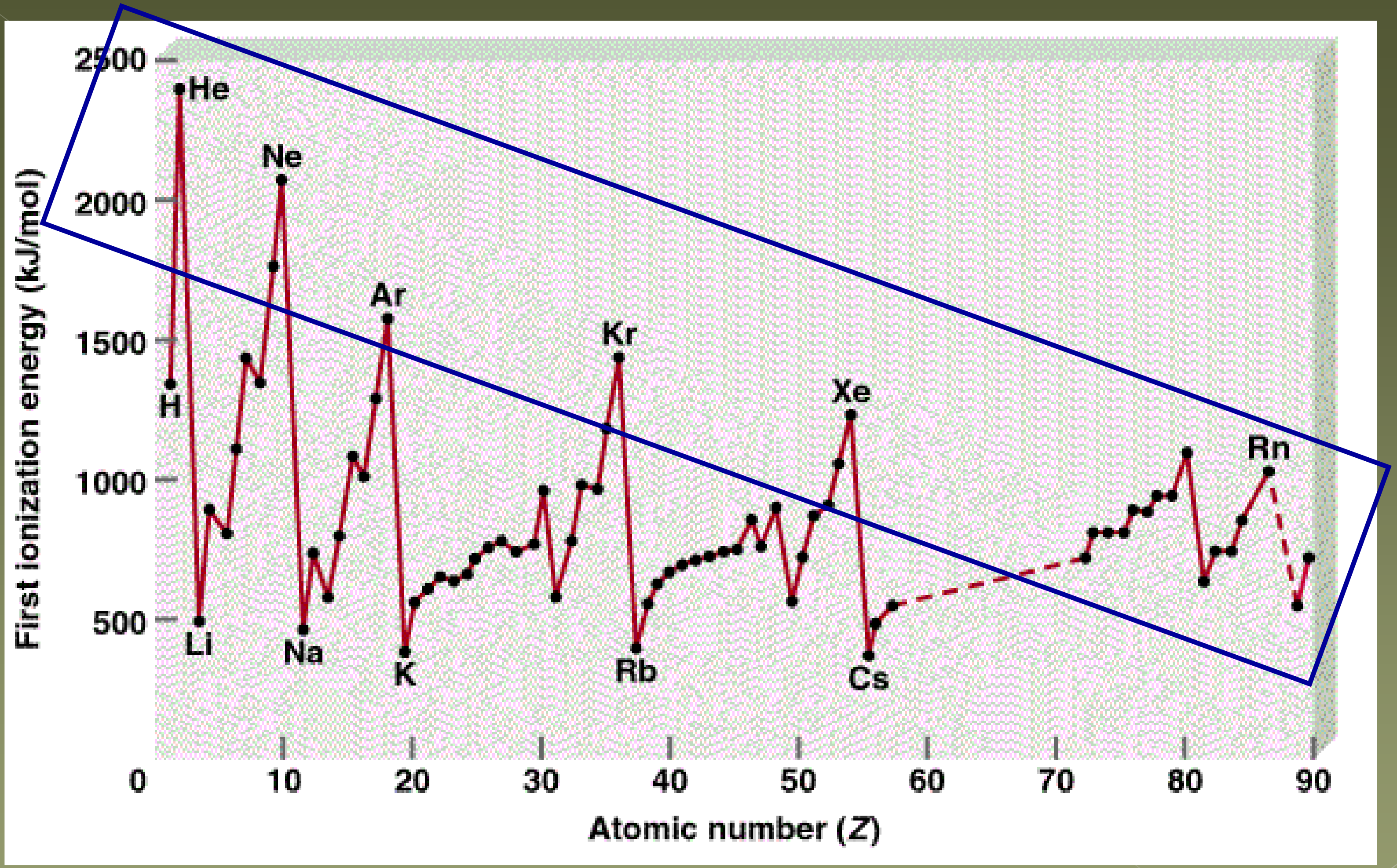
i) IE > IE
II A III A
ns^2 ns^2, np^1

(ii) IE > IE
V A VI A
ns^2, np^3 ns^2, np^4

(iii) Ionisation energy of Al > Ga

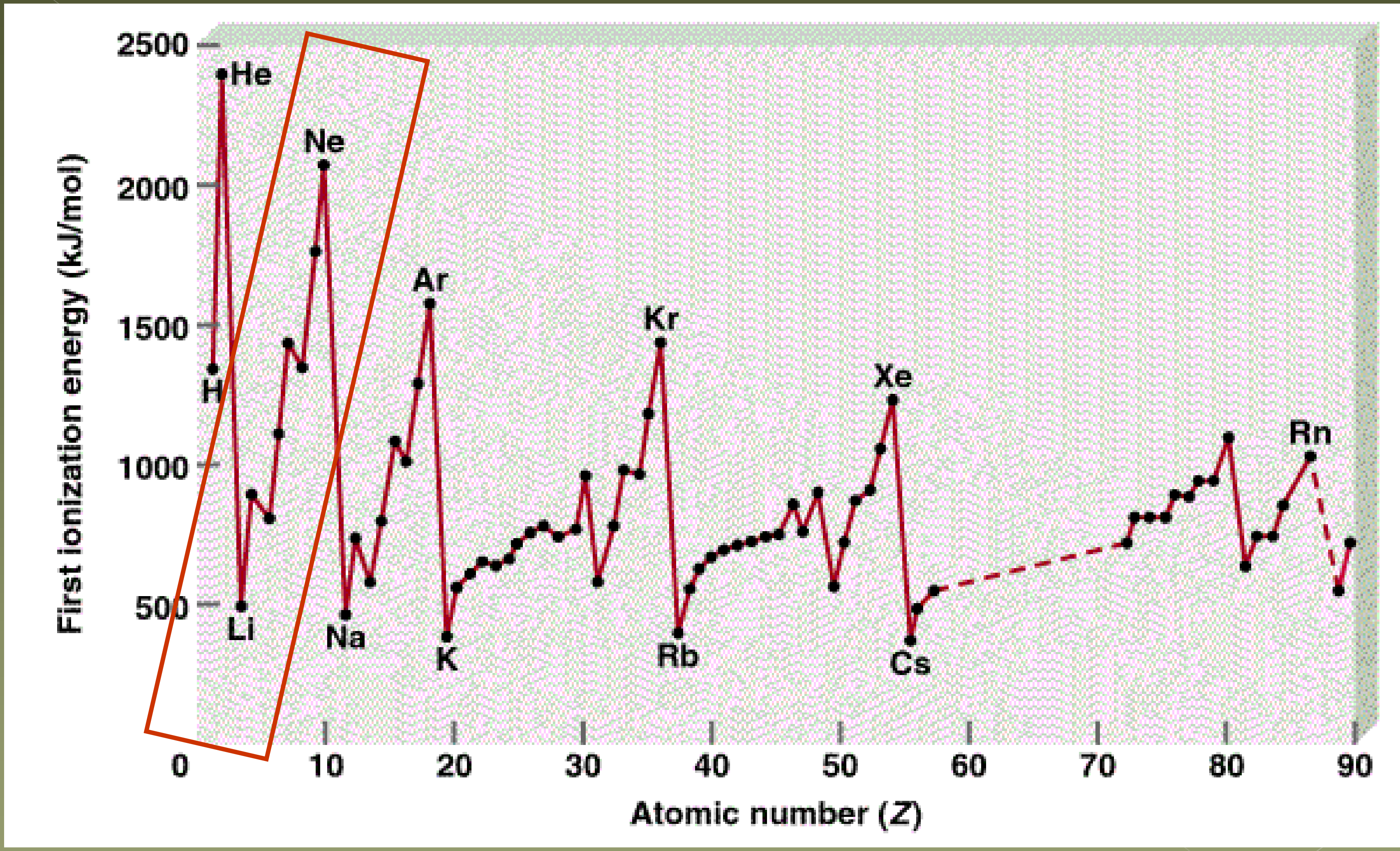
Absence of d electrons in Al

Variation of I_1 with Z



In a group (column), I_1 decreases with increasing Z. valence e's with larger n are further from the nucleus, less tightly held

Variation of I_1 with Z



Across a period (row), I_1 mainly <u>increases</u> with <u>increasing Z</u>.
Because of increasing nuclear charge (Z).

Illustrative example

First ionisation energy of Be is more than Li but the second ionisation energy of Be is less than Li. Why?

Solution:

$$\underset{2s^1}{Li} - e^- \xrightarrow{IE_1} \underset{2s^0}{Li^+} \qquad \underset{2s^2}{Be} - e^- \xrightarrow{IE_1} \underset{2s^1}{Be^+}$$

$$\underset{1s^2}{Li^+} - e^- \xrightarrow{IE_2} \underset{1s^1}{Li^{2+}} \qquad \underset{2s^1}{Be^+} - e^- \xrightarrow{IE_2} \underset{2s^0}{Be^{2+}}$$

$IE_1 Be > IE_1 Li$ $\therefore$ Be has stable ($2s^2$) configuration.

$IE_2 Li > IE_2 Be$ $\therefore$ Li acquires stable configuration when it loses one electron.

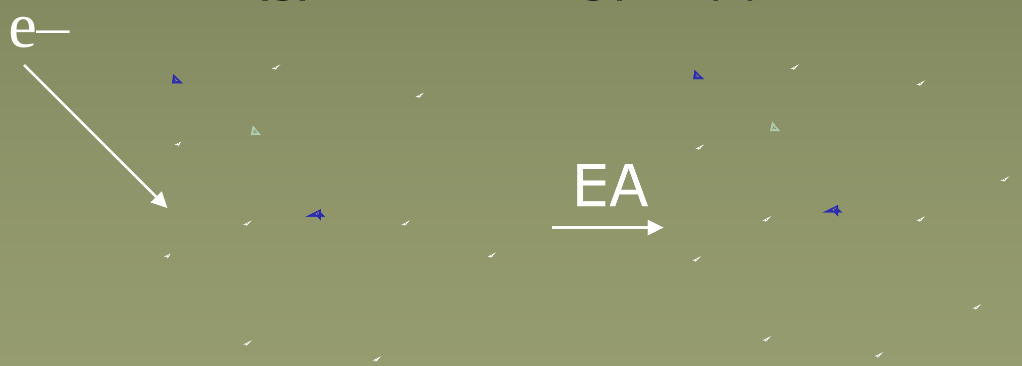
Electron affinity

- Electron affinity is energy change when an e^- adds to a gas-phase, ground-state atom
- Positive EA means that energy is released, e- addition is favorable and anion is stable!
- First EA's mostly positive, a few negative

Successive affinities

$$A(g) + e^- \xrightarrow{EA_1} A^-(g) + \text{energy released}$$

$$A^-(g) + e^- + \text{energy supplied} \xrightarrow{EA_2} A^{2-}(g)$$

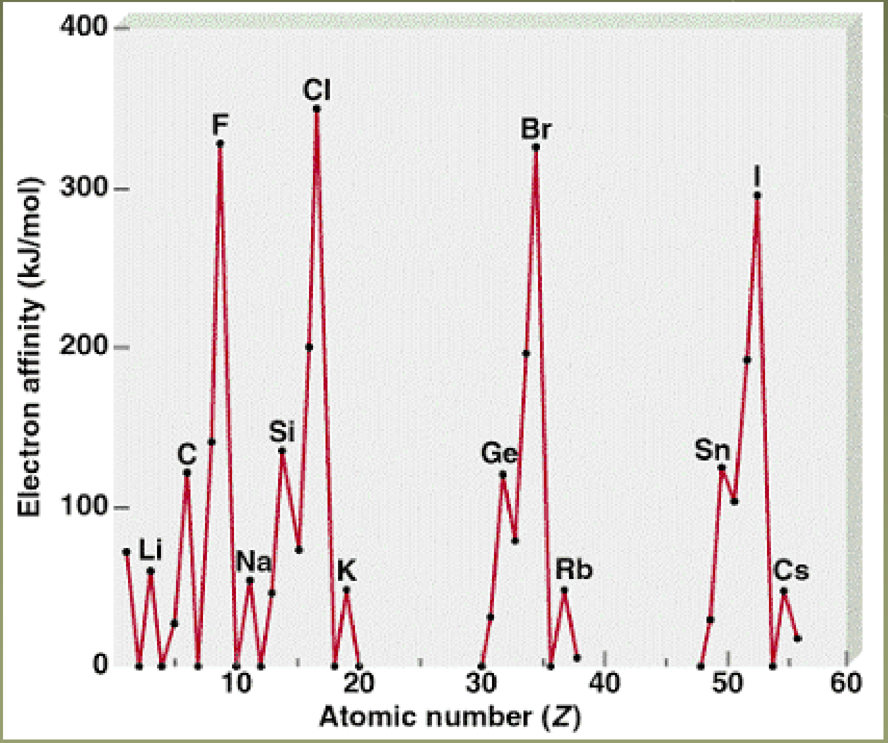


Isolated gaseous atom

Stable configuration leads to high electron affinity

TRENDS IN ELECTRON AFFINITIES

- Decrease down a group and increase across a period in general but there are not clear cut trends as with atomic size and I.E.
- Nonmetals are more likely to accept e-s than metals. VIIA's like to accept e-s the most.



Exceptions

1. EA of Cl > EA of F
2. Group II A have almost zero electron affinities due to stable ns^2 configuration of valence shell.
3. Group V A have very low values of electron affinities due to ns^2,np^3 configuration of valence shell.

More the value of electron affinity greater is the oxidising power.

Electronegativity χ

It is the relative tendency to attract shared pair of electrons towards itself.

<u>Factors effecting electronegativity</u>

1. Electronegativity $\alpha \dfrac{1}{\text{Atomic size}}$

2. Electronegativity is higher for nearly filled configuration e.g. O(3.5) and F(4.0).

Pauling scale of electronegativity

Pauling's Electronegativity

$E_{AB} = 1/2(E_{AA} + E_{BB}) + \Delta_{AB}$

$\Delta_{AB} = 96.49(X_A - X_B)^2$ or $|X_A - X_B| = 0.102\Delta_{AB}$

where X_A and X_B are constants

characteristic of the atoms A and B.

Mulliken Electronegativity

Mulliken Electronegativity is simply the average of the first ionization energy and electron affinity. Unlike Pauling Electronegativity, Mulliken's equations are absolute and need no starting reference point.

$x^m = (IE_1+EA_1)/2$

Allred-Rochow Electronegativity

Allred-Rochow Electronegativity is a measure that determines the values of the electrostatic force exerted by the effective nuclear charge on the valence electrons. The value of the effective nuclear charges is estimated from Slater's rules. The higher charge, the more likely it will attract electrons. Although, Slater's rule are partly empirical. So the Allred-Rochow electronegativity is no more rigid than the Pauling Electronegativity.

Slater's rules

Slater's rules are rules that provides the values for the effective nuclear charge concept, or Z_{eff}. These rules are based on experimental data for electron promotion and ionization energies, and Z_{eff} is determined from this equation:

$$Z_{eff} = Z - S$$

Where Z = nuclear charge, Z_{eff} = effective nuclear charge, and S = shielding constant

Periodic variation

(i) In period

	Li	Be	B	C	N	O	F
Valence shell configuration	$2s^1$	$2s^2$	$2s^2,2p^1$	$2s^2,2p^2$	$2s^2,2P^3$	$2s^2,2P^4$	$2s^2,2P^5$
Electronegativity	1.0	1.5	2.0	2.5	3.0	3.5	4.0

(ii) In groups-decreases down the group

Decreasing order of electro negativity

F > O > Cl ≈ N > Br > C > I > H

Valency

The valency of an element is decided by number of electrons present in outermost shell.

All the elements of a group have same valency.

E.g.- All the group I elements show 1 valency. Valency of p block elements is

Equal to number of electrons in valence shell.

e.g.- Al has 3 electrons in valence shell. Therefore, its valency is 3.

Or

8-number of electrons in valence shell. e.g- valency of oxygen is 8 – 6 =2

Li	3	$1s^2,2s^1$
Na	11	$1s^2,2s^2,2p^6,3s^1$
K	19	$1s^2,2s^2,2p^6,3s^2,3p^6,4s^1$
Rb	37	$1s^2,2s^2,2p^6,3s^2,3p^6,4s^2,$ $3d^{10},4p^6,5s^1$

Diagonal relationship

2^{nd} period	Li	Be	B	C
3^{rd} period	Na	Mg	Al	Si

Causes of diagonal relationship

- Similarity in size.
- Similarity in ionisation energy.
- Similarity in electron affinity.

Lanthanide contraction

Lanthanide contraction describe the greater than expected decrease in ionic radii of the elements in the lanthanide series from atomic number 57,lanthanum, to 71, lutetium.

The effect results from poor shielding of nuclear charge (nuclear attractive force on electrons) by 4f electrons; the 6s electrons are drawn towards the nucleus, thus resulting in a smaller atomic radius.

Class Test

❖ X, Y and Z are the elements of Dobereiner's triad. If atomic mass of element X is 32 and that of element Z is 128, find the atomic mass of Y.

(a) 32
(b) 80
(c) 128
(d) 160

Solution

The question is based on Dobereiner's law of triads.

$\therefore$ Atomic mass of element Y = $\frac{32 + 128}{2} = \frac{160}{2} = 80$

Hence, answer is (b).

- Newland's law of octave is applied to all the elements having atomic mass less than

(a) 20 (b) 40 (c) 30 (d) 10

Solution:

From Newland's law of Octave.
Hence, answer is (b).

- Discovery of __________ is responsible for failure of law of octave.

(a) lanthanides (b) actanides
(c) transition elements (d) noble gases

Solution

(d)

In which orbitals does the differentiating electron enters in case of inner transition elements?

(a) $(n-1)d$ (b) ns^1

(c) ns^2, np^{1-6} (d) $(n-2)f$

Solution:

f-block elements are known as inner-transition elements.

Hence, answer is (d).

✓ The relative electronegativities of F, O, N, C and H are

(a) F > C > H > N > O

(b) F > O > N > C > H

(c) F > N > C > H > O

(d) F > N > H > C > O

Solution:

The correct order of electronegativities is

$$\underset{4.0}{F} > \underset{3.5}{O} > \underset{3.0}{N} > \underset{2.5}{C} > \underset{2.1}{H}$$

Hence, answer is (b).

- Which one of the following is correct order of ionic size?

(a) $Ca^{2+} > K^{1+} > Cl^{-} > S^{2-}$
(b) $S^{2-} > Cl^{-} > K^{+} > Ca^{2+}$
(c) $Ca^{2+} > Cl^{-} > K^{1+} > S^{2-}$
(d) $S^{2-} > Ca^{2+} > Cl^{-} > K^{+}$

Solution:

Size of iso electronic species decreases with increase in nuclear charge, more interelectronic repulsion in S and Cl is the reason of their increased size.

Hence, answer is (b).

- The electron affinities of N,O, S and Cl are
  (a) N < O < S < Cl
  (b) O < N < Cl < S
  (c) O = Cl < N = S
  (d) O < S < Cl < N

Solution:

The correct order of electron affirmities is
N < O < S < Cl

Hence, answer is (a).

- In which of the following pairs there is an exception in the periodic trend for the ionization energy?

  (a) Fe – Ni (b) C – N
  (c) Be – B (d) O – F

Solution:

Since Be has stable configuration ($2s^2$) as compared to B ($2s^2$, $2p^1$).

Hence, answer is (c).

- The first three successive ionisation energies of an element Z are 520, 7297 and 9810 kJ mol^{-1} respectively. The element Z belongs to

(a) group 2 (b)group 1
(c) group 15 (d) group 16

Solution:

Since the difference in first and second ionisation energies is very high, it belongs to group 1.

Hence, answer is (b).

- A, B, C and D have following electronic configurations

  A : $1s^2, 2s^2, 2p^1$

  B : $1s^2, 2s^2, 2p^6, 3s^2, 3p^1$

  C : $1s^2, 2s^2, 2p^6, 3s^2, 3p^4$

  D : $1s^2, 12s^2, 2p^6, 3s^2, 3p^6, 4s^1$

  Find out the periods of A, B, C and D.

Solution:

Period number is equal to maximum value of principal quantum number.

Element A — 2nd period
Element B — 3rd period
Element C — 3rd period
Element D — 4th period

Hence, answer is (b).