



SRI AKILANDESWARI WOMEN'S COLLEGE, WANDIWASH

PERIODIC PROPERTIES

Class : I UG CHEMISTRY

Ms. K. RANJITHA

Assistant Professor

Department of Chemistry

**SWAMY ABEDHANADHA EDUCATIONAL TRUST,
WANDIWASH**

PERIODICITY OF PROPERTIES

- ▶ *The repetition of properties of elements after certain regular intervals is known as Periodicity of Properties.*

CAUSE OF PERIODICITY

- ▶ Periodicity may be defined as *the repetition of the similar properties of the elements placed in a group and separated by certain definite gap of atomic numbers.*
- ▶ The *cause* of periodicity is the resemblance in properties of the elements is *the repetition of the same valence shell electronic configuration*

The Periodic Table

H 1.008																	He 4.0026
Li 6.941	Be 9.0122											B 10.811	C 12.011	N 14.007	O 15.999	F 18.998	Ne 20.180
Na 22.990	Mg 24.305											Al 26.982	Si 28.086	P 30.974	S 32.06	Cl 35.453	Ar 39.948
K 39.098	Ca 40.078	Sc 44.956	Ti 47.88	V 50.942	Cr 52.004	Mn 54.938	Fe 55.845	Co 58.933	Ni 58.693	Cu 63.546	Zn 65.38	Ga 69.723	Ge 72.64	As 74.922	Se 78.96	Br 79.904	Kr 83.8
Rb 85.468	Sr 87.62	Y 88.906	Zr 91.224	Nb 92.906	Mo 95.94	Tc 98.906	Ru 101.07	Rh 102.91	Pd 106.42	Ag 107.87	Cd 112.41	In 114.82	Sn 118.71	Sb 121.76	Te 127.6	I 126.905	Xe 131.29
Cs 132.905	Ba 137.327	Lu 174.967	Hf 178.49	Ta 180.948	W 183.85	Re 186.207	Os 190.23	Ir 192.22	Pt 195.084	Au 196.967	Hg 200.59	Tl 204.38	Pb 207.2	Bi 208.98	Po 209	At 210	Rn 222
Fr 223	Ra 226	Lr 260	Rf 261.103	Db 262.103	Sg 263.103	Bh 264.103	Hs 265.103	Mt 266	Ds 267	Rg 268	Cn 269	Uut 270	Fl 271	Uup 272	Lv 273	Uus 274	Uuo 275

La 138.905	Ce 140.12	Pr 140.908	Nd 144.24	Pm 144.913	Sm 150.36	Eu 151.964	Gd 157.25	Tb 158.925	Dy 162.5	Ho 164.930	Er 167.259	Tm 168.930	Yb 173.054
Ac 227.033	Th 232.038	Pa 231.036	U 238.029	Np 237.048	Pu 244.064	Am 243.061	Cm 247.070	Bk 247.070	Cf 251.08	Es 252.083	Fm 257.103	Md 258.103	No 259.103

118 ELEMENTS AND THEIR SYMBOLS AND ATOMIC NUMBERS

Name of the Element	Symbol of the Element	Atomic Number	Name of the Element	Symbol of the Element	Atomic Number
Hydrogen	H	1	Aluminium	Al	13
Helium	He	2	Silicon	Si	14
Lithium	Li	3	Phosphorus	P	15
Beryllium	Be	4	Sulfur	S	16
Boron	B	5	Chlorine	Cl	17
Carbon	C	6	Argon	Ar	18
Nitrogen	N	7	Potassium	K	19
Oxygen	O	8	Calcium	Ca	20
Fluorine	F	9	Scandium	Sc	21
Neon	Ne	10	Titanium	Ti	22
Sodium	Na	11	Vanadium	V	23
Magnesium	Mg	12	Chromium	Cr	24

Name of the Element	Symbol of the Element	Atomic Number	Name of the Element	Symbol of the Element	Atomic Number
<u>Manganese</u>	Mn	25	<u>Strontium</u>	Sr	38
<u>Iron</u>	Fe	26	<u>Yttrium</u>	Y	39
<u>Cobalt</u>	Co	27	<u>Zirconium</u>	Zr	40
<u>Nickel</u>	Ni	28	<u>Niobium</u>	Nb	41
<u>Copper</u>	Cu	29	<u>Molybdenum</u>	Mo	42
<u>Zinc</u>	Zn	30	<u>Technetium</u>	Tc	43
<u>Gallium</u>	Ga	31	<u>Ruthenium</u>	Ru	44
<u>Germanium</u>	Ge	32	<u>Rhodium</u>	Rh	45
<u>Arsenic</u>	As	33	<u>Palladium</u>	Pd	46
<u>Selenium</u>	Se	34	<u>Silver</u>	Ag	47
<u>Bromine</u>	Br	35	<u>Cadmium</u>	Cd	48
<u>Krypton</u>	Kr	36	<u>Indium</u>	In	49
<u>Rubidium</u>	Rb	37	<u>Tin</u>	Sn	50

Name of the Element	Symbol of the Element	Atomic Number	Name of the Element	Symbol of the Element	Atomic Number
<u>Antimony</u>	Sb	51	<u>Gadolinium</u>	Gd	64
<u>Tellurium</u>	Te	52	<u>Terbium</u>	Tb	65
<u>Iodine</u>	I	53	<u>Dysprosium</u>	Dy	66
<u>Xenon</u>	Xe	54	<u>Holmium</u>	Ho	67
<u>Cesium</u>	Cs	55	<u>Erbium</u>	Er	68
<u>Barium</u>	Ba	56	<u>Thulium</u>	Tm	69
<u>Lanthanum</u>	La	57	<u>Ytterbium</u>	Yb	70
<u>Cerium</u>	Ce	58	<u>Lutetium</u>	Lu	71
<u>Praseodymium</u>	Pr	59	<u>Hafnium</u>	Hf	72
<u>Neodymium</u>	Nd	60	<u>Tantalum</u>	Ta	73
<u>Promethium</u>	Pm	61	<u>Tungsten</u>	W	74
<u>Samarium</u>	Sm	62	<u>Rhenium</u>	Re	75
<u>Europium</u>	Eu	63	<u>Osmium</u>	Os	76

Name of the Element	Symbol of the Element	Atomic Number	Name of the Element	Symbol of the Element	Atomic Number
<u>Iridium</u>	Ir	77	<u>Actinium</u>	Ac	89
<u>Platinum</u>	Pt	78	<u>Thorium</u>	Th	90
<u>Gold</u>	Au	79	<u>Protactinium</u>	Pa	91
<u>Mercury</u>	Hg	80	<u>Uranium</u>	U	92
<u>Thallium</u>	Tl	81	<u>Neptunium</u>	Np	93
<u>Lead</u>	Pb	82	<u>Plutonium</u>	Pu	94
<u>Bismuth</u>	Bi	83	<u>Americium</u>	Am	95
<u>Polonium</u>	Po	84	<u>Curium</u>	Cm	96
<u>Astatine</u>	At	85	<u>Berkelium</u>	Bk	97
<u>Radon</u>	Rn	86	<u>Californium</u>	Cf	98
<u>Francium</u>	Fr	87	<u>Einsteinium</u>	Es	99
<u>Radium</u>	Ra	88	<u>Fermium</u>	Fm	100

Name of the Element	Symbol of the Element	Atomic Number	Name of the Element	Symbol of the Element	Atomic Number
<u>Mendelevium</u>	Md	101	<u>Darmstadtium</u>	Ds	110
<u>Nobelium</u>	No	102	<u>Roentgenium</u>	Rg	111
<u>Lawrencium</u>	Lr	103	<u>Copernicium</u>	Cn	112
<u>Rutherfordium</u>	Rf	104	<u>Nihonium</u>	Nh	113
<u>Dubnium</u>	Db	105	<u>Flerovium</u>	Fl	114
<u>Seaborgium</u>	Sg	106	<u>Moscovium</u>	Mc	115
<u>Bohrium</u>	Bh	107	<u>Livermorium</u>	Lv	116
<u>Hassium</u>	Hs	108	<u>Tennesine</u>	Ts	117
<u>Meitnerium</u>	Mt	109	<u>Oganesson</u>	Og	118

TRENDS IN MODERN PERIODIC TABLE

- ▶ The trends observed in some important properties of the elements in :
- ▶ moving down the group (from top to bottom of the table)
and
- ▶ across a period (from left to right in a period)

VALENCY

- ▶ *Valency may be defined as the combining capacity of the atom of an element with atoms of other elements in order to acquire the stable configuration* (i.e. 8 electron in valence shell. In some special cases it is 2 electrons).
- ▶ **The valency of an element is determined by the number of valence electrons present in the outermost shell of its atom (i.e. the combining capacity of an element is known as its valency).**
- ▶ **In Period:** On moving from left to right in a period, the valency first increases from 1 to 4 and then decreases to zero .
Example; valency of 2nd period elements are 0
- ▶ **In Groups:** On moving from top to bottom in a group, the valency remains same because the number of valence electrons remains the same. Example: Valency of first group elements = 1
Valency of second group elements = 2.

ATOMIC SIZE

- ▶ ***Atomic size refers to radius of an atom. It also refers to the distance between the centre of nucleus of an isolated atom to its outermost shell containing electrons.***

THE TREND OF ATOMIC SIZE (RADIUS) IN MOVING FROM LEFT TO RIGHT IN A PERIOD:

- ▶ On moving from left to right along a period, *the atomic number of elements increases which means that the number of protons and electrons in the atoms increases . As electrons are added to the same shell so due to the large positive charge on the nucleus, effective nuclear charge increases and thus the electrons are pulled in more closely to the nucleus and the size of the atom decreases.*
- ▶ Example: Size of second period elements:
 $\text{Li} > \text{Be} > \text{B} > \text{C} > \text{N} > \text{O} > \text{F}$
Point to know: *The atomic size of noble gases in corresponding period is largest due to presence of fully filled electronic configuration (i.e. complete octet).*

THE TREND OF ATOMIC SIZE (RADIUS) IN MOVING DOWN A GROUP:

- ▶ On going down in a group of the Periodic Table, a new shell of electrons is added to the atoms at every step which causes more screening of the outermost electron from nucleus. So there is an increase in distance between the outermost shell electrons and the nucleus of the atom and thus the atomic size increases
- ▶ Atomic size of first group element : $\text{Li} < \text{Na} < \text{K} < \text{Rb} < \text{Cs} < \text{Fr}$
Atomic size of 17th group elements : $\text{F} < \text{Cl} < \text{Br} < \text{I}$

IONISATION ENERGY

- ▶ It is defined as the amount of energy required to remove the outermost electron from an atom.
- ▶ Greater the force of attraction between the nucleus and outermost electron ,greater will be the ionisation energy.

VARIATION OF IONISATION ENERGY ON MOVING DOWN A GROUP:

- ▶ On going down in a group of the Periodic Table, a new shell of electrons is added to the atoms at every step which causes more screening of the outermost electron from nucleus. So the atomic size **increases** and force of attraction between the outermost shell electrons and the nucleus **of the atom decreases** and thus the **ionisation energy decreases**
- ▶ Atomic size of first group element : $\text{Li} < \text{Na} < \text{K} < \text{Rb} < \text{Cs} < \text{Fr}$
- ▶ Ionisation energy of first group element:
 $\text{Li} > \text{Na} > \text{K} > \text{Rb} > \text{Cs} > \text{Fr}$
- ▶ Atomic size of 17th group elements : $\text{F} < \text{Cl} < \text{Br} < \text{I}$
- ▶ Ionisation energy of 17th group elements : $\text{F} > \text{Cl} > \text{Br} > \text{I}$

VARIATION OF IONISATION ENERGY ON MOVING FROM LEFT TO RIGHT IN A PERIOD:

- On moving from left to right along a period, *the atomic number of elements increases which means that the number of protons and electrons in the atoms increases . As electrons are added to the same shell so due to the large positive charge on the nucleus, effective nuclear charge increases and thus the electrons are pulled in more closely to the nucleus and the size of the atom decreases thus ionisation energy increases.*
- **Size of second period elements: $\text{Li} > \text{Be} > \text{B} > \text{C} > \text{N} > \text{O} > \text{F}$**
- **Ionisation energy of second period elements:**
- **$\text{Li} < \text{Be} < \text{B} < \text{C} < \text{N} < \text{O} < \text{F}$**

METALLIC CHARACTER

- ▶ *It is the tendency of an atom to lose electrons. Greater the ease of loss of electron, greater will be the metallic character.*
- ▶ *Metallic character \propto atomic radii*
- ▶ In Period: Along the period from left to right, *metallic characters decrease because a tendency to lose electron decreases due to the increase in effective nuclear charge.*
- ▶ Metallic character of second period elements: $\text{Li} > \text{Be} > \text{B} > \text{C} \gg \text{N} > \text{O} > \text{F}$
In Group: On moving from top to bottom, Metallic character increases because the atomic size increases due to the decrease in effective nuclear charge and hence the tendency to lose electrons increases.
First group element : $\text{Li} < \text{Na} < \text{K} < \text{Rb} < \text{Cs}$
17th group elements: $\text{F} < \text{Cl} < \text{Br} < \text{I}$

NON-METALLIC CHARACTER

- ▶ *It is tendency of an atom to gain electrons. Greater the ease of gain of electron, greater will be the non-metallic character.*
- ▶ *Non-Metallic character \propto (1/ atomic radii)*
- ▶ **In Period:** Along the period from left to right, non-metallic character increases because tendency to gain electrons increases due to increase in effective nucleus charge.
- ▶ **Non-metallic character of 2nd period elements :**
 $\text{Li} < \text{Be} < \text{B} < \text{C} < \text{N} < \text{O} < \text{F}$
- ▶ **In Group:** On moving from top to bottom in a group, non-metallic character decreases because atomic size increases and tendency to gain electrons decreases.
- ▶ **Non-metallic character of 17th period element: $\text{F} > \text{Cl} > \text{Br} > \text{I}$**

CHEMICAL REACTIVITY

- ▶ In metals: Chemical reactivity of metals increases down the group because tendency to lose electrons increases.

Example ; $\text{Li} < \text{Na} < \text{K} < \text{Rb} < \text{Cs}$ (1st group)

- ▶ In non-metals: Chemical reactivity of non-metals decreases down the group because tendency to gain electrons decreases.

Example: $\text{F} > \text{Cl} > \text{Br} > \text{I}$ (17th group)

ELECTRONEGATIVITY

- ▶ *It is tendency of an element to attract the shared pair of electrons towards it in a covalently bonded molecule.*
- ▶ It increases with increase of nuclear charge or decrease in atomic size.
- ▶ *Along the period electronegativity increases.*
Example ; Li < Be < B < C < N < O < F.
- ▶ Down the group electronegativity decreases.
Example ; Li > Na > K > Rb > Cs
F > Cl > Br > I

NATURE OF OXIDES

- ▶ Metal oxides are basic in nature. Ex. Na_2O , MgO etc.
- ▶ Non-metal oxides are acidic in nature. Ex. Cl_2O_7 , SO_3 , P_2O_5 ,
- ▶ In the case of metal reactivity, *it increases down the group because of the tendency to lose electrons increases.*
- ▶ In the case of non-metal, *reactivity decreases down the group because of the tendency to gain electrons decreases.*

TRENDS IN MODERN PERIODIC TABLE

Property	Valency	Atomic Size	Metallic Character	Nonmetallic Character	Electro-negativity
Variation in period	Increases from 1 to 4 then decreases to zero	Decreases	Decreases	Increases	Increases
Reason	No. of atomic shells remains the same & atomic number increases by 1 unit.	This is due to an increase in effective nuclear charge which tends to pull the electrons closer to the nucleus and reduces the size of the atom.	Effective nuclear charge increases in periods. Hence tendency to lose electron decreases.	Effective nuclear charge increases as electron are added to the same shell in periods. Hence tendency to gain electron increases	Effective nuclear charge increases in periods. Hence tendency to attract the shared pair of electron increases

TRENDS IN MODERN PERIODIC TABLE

Property	Valency	Atomic Size	Metallic Character	Nonmetallic Character	Electro-negativity
Variation in group	Remains same	Increases	Increases	Decreases	Decreases
Reason	No. of atomic shells increase but the number of valence electrons remains same	New shells are being added as we go down the group. This increases the distance between the outermost electrons and the nucleus so that the atomic size increases in spite of the increase in nuclear charge.	Effective nuclear charge decreases and thus the force of attraction between nucleus and outermost electron also decreases	Effective nuclear charge decreases. Hence tendency to gain electron decreases	Effective nuclear charge decreases. Hence tendency to attract shared pair of electron decreases

VARIATIONS OF PERIODIC PROPERTIES IN GROUPS

AS ATOMIC NUMBER INCREASE IN A GROUP

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NUMBER OF ATOMIC SHELLS AND SCREENING EFFECT
ALSO INCREASES ON MOVING DOWN THE GROUP

THUS, EFFECTIVE NUCLEAR CHARGE DECREASES BETWEEN NUCLEUS AND OUTERMOST
ELECTRON

↓

ATOMIC SIZE INCREASES,
IONISATION ENERGY DECREASES,
ELECTROPOSITIVE OR METALLIC CHARACTER INCREASES
ELECTRONEGATIVE CHARACTER OR NON METALLIC CHARACTER DECREASES

VARIATIONS OF PERIODIC PROPERTIES IN PERIODS

AS ATOMIC NUMBER INCREASE IN A PERIOD

NUMBER OF ATOMIC SHELL REMAINS SAME AND SCREENING EFFECT DONOT OCCURS

EFFECTIVE NUCLEAR CHARGE INCREASES BETWEEN NUCLEUS AND OUTERMOST ELECTRON SO OUTERMOST ELECTRONS GETS TIGHTLY BOUND TO THE NUCLEUS AND THUS,

ATOMIC SIZE DECREASES,
IONISATION ENERGY INCREASES,
ELECTROPOSITIVE OR METALLIC CHARACTER DECREASES
ELECTRONEGATIVE CHARACTER OR NON METALLIC CHARACTER INCREASES

THANKS

