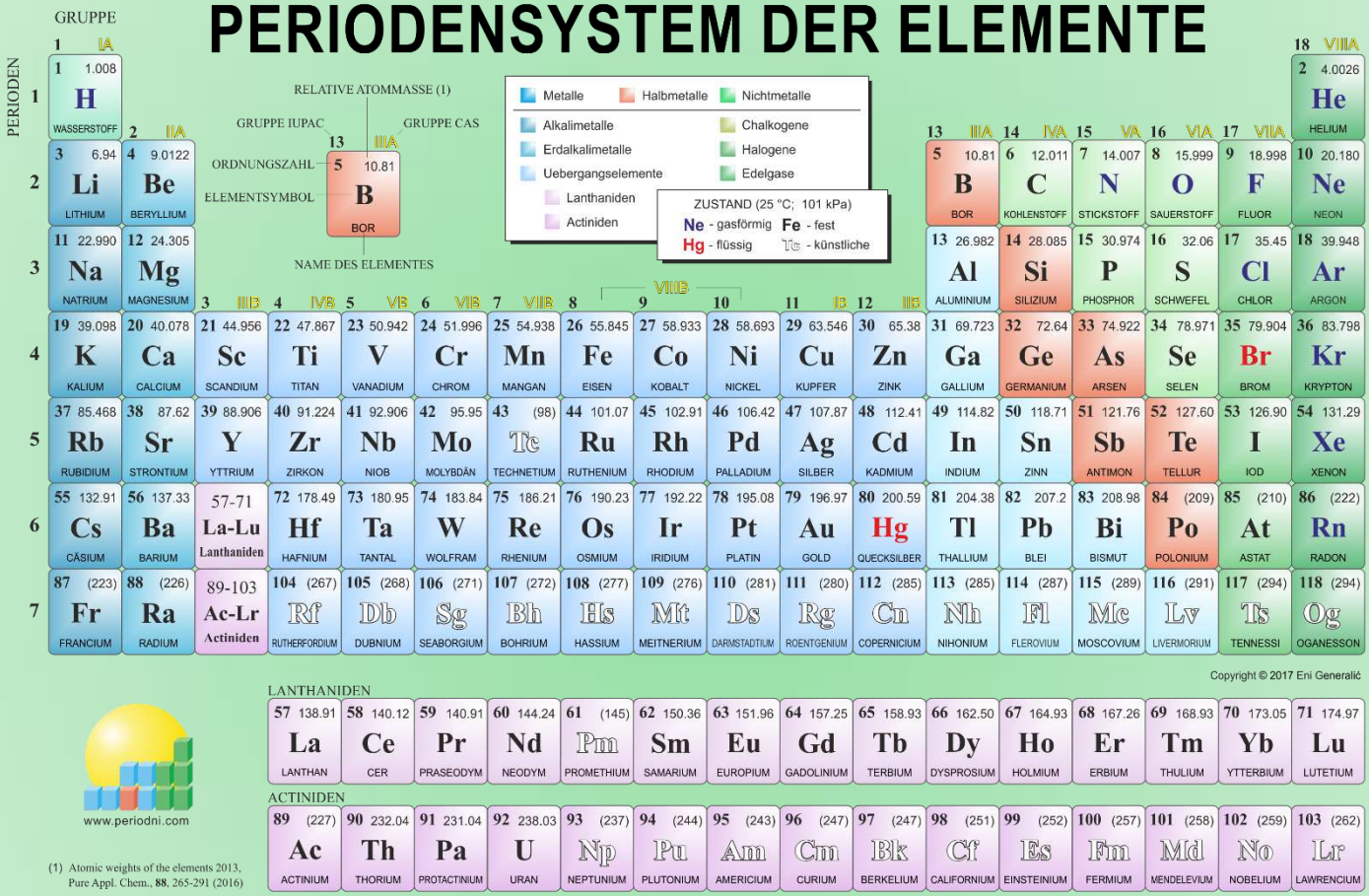
3. CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES



Ramanujan School of Mathematics and Physics

Theory + NCERT MCQs+ Practice Questions + NEET PYQs

Atomic Mass
X
Atomic Number
Element Name

GENESIS OF CLASSIFICATION

DOBEREINER'S TRIAD (1892)
Middle element of each triads had an atomic weight about half way between the atomic weight of other two and also properties between the other two.
Eg. (Li, Na, K), (Ca, Sr, Ba).

LAW OF OCTAVES (1865)
J. Alexander Newlands arranged the elements in increasing order of their atomic weight. every 8th element had similar properties to 1st element.
Eg. Li resembles with Na.

LOTHER MEYER
Lothmeya found a periodc pattern by plotting physical properties like atomic volume, B.P and M.P against atomic weight.

MENDELEEV PERIODIC LAW
Properties of elements are a periodic function of their atomic weights.
Mendeleev periodic elements Eka-Aluminium as Gallium.

35.5
Cl
17
CHLORINE

NEED FOR CLASSIFICATION

To make it easier to understand the chemistry of all the elements and their compounds separately.

TRENDS IN PHYSICAL PROPERTIES

	Properties	Group	Period
(a)	Atomic Radius Distance between the Atomic nucleus and the outermost shell containing electron.	Increases	Decreases
(b)	Electron Gain Enthalpy Energy released when an electron is added to the valance shell of an isolated gaseous atom.	Decreases	Increases
(c)	Ionisation Energy Amount of energy required to remove an electron from an isolated gaseous atom.	Decreases	Increases
(d)	Electronegativity Tendency of an element to attract shared electrons towards itself.	Decreases	Increases
(e)	Metallic Character	Increases	Decreases
(f)	None-Metallic Character	Decreases	Decreases

TRENDS IN CHEMICAL PROPERTIES

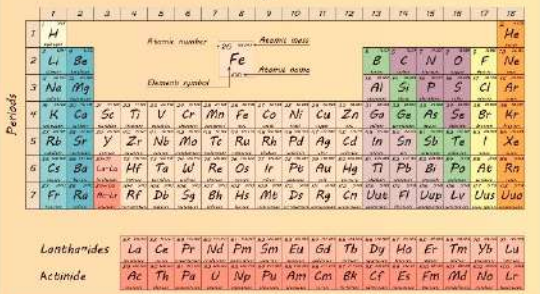
- The valance or representative elements is generally equal to valence electron or (8-valence electrons).
- Anomalous behaviour of 2nd period elements is due to their small size, large charge/radius radio, high electronegativity and only 4 valence orbitals.
- Diagonal relationship: Li and Be is more similar to Mg as Al respectively.
- The normal oxides formed by the element on extreme left is most basic (E.g. Na_2O) and formed by elements on extreme right is most acidic (E.g. Cl_2O_7).
- Oxides of centre elements are amphoteric (Eg. Al_2O_3) or neutral (Eg. N_2O)

  Amphoteric oxides are basic in acidic medium and vice versa.

CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES

MODERN PERIODIC TABLE

- Modern Periodic Law: Physical and chemical properties of elements are periodic functions of their atomic number.
- Father of modern Periodic table: Dimitri Mendeleev
- 7 Horizontal rows: Periods; 18 vertical columns: Groups



NOMENCLATURE OF ELEMENTS (ATOMIC NO. >100)

Derived from Atomic Number of Element using Numerical roots for 0 and Number 1-9 Nad 'ium' is added at the end of Name

Digit	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

STUDY OF PERIODIC TABLE

S-Block Elements
(i) Electronic configuration: ns^{1-2}
(ii) Consist of Group 1 (alkali metals)
(iii) and also group 2 (alkali earth metals)

P-Block Elements
(i) Electronic configuration: ns^2np^{1-6}
(ii) Consist of Group 1 to 18
(iii) Also known as Representative or main group Elements.

D-Block Elements
(i) Electronic configuration: $(n-1)d^{1-10}ns^{0-2}$
(ii) Consist of Group 3 to 12
(iii) also known as transition Elements

F-Block Elements
(i) Electronic configuration: $(n-2)f^{1-14}(n-1)d^{0-1}ns^2$
(Z = 58-71) (Z = 90-103)
(ii) Consist of Lanthanoids and Actinoids
(iii) also known as Inner transition Elements

CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES

Introduction:

Classification of elements was proposed in order to study all the elements in a systematic manner. In this Unit, we shall study the development of the Periodic Law and the Periodic Table. Mendeleev's Periodic Table was based on atomic masses. Modern Periodic Table arranges the elements in the order of their atomic numbers in seven horizontal rows (periods) and eighteen vertical columns (groups or families).

Why Do We Need Classification?

Elements are the basic units of all types of matter. At present, 118 elements are known. With such a large number of elements, it is very difficult to study individually the chemistry of all these elements and their number of compounds. So to make the study of chemistry simpler, scientists searched for a systematic way to organise their knowledge by classifying the elements. Main aim behind this classification was to keep the elements of same properties together, so that by studying one element out of that group, we can have general idea about the properties of all the elements in that group.

Periodic Table

Periodic table may be defined as the tabular arrangement of elements in such a way that the elements having same properties are kept together.

Dobereiner's Triads Law

1st attempt towards the classification of elements was made by Johann W. Dobereiner in 1817. He arranged elements in the groups of three and in such a way that the atomic weight of middle element was equal or nearly equal to the average of atomic weights of other two elements.

	ELEMENTS	SYMBOL	ATOMIC MASS
1	Lithium	Li	6.9
	Sodium	Na	23
	Potassium	K	39
2	Calcium	Ca	40.1
	Strontium	Sr	87.6
	Barium	Ba	137.3
3	Chlorine	Cl	35.5
	Bromine	Br	79.9
	Iodine	I	126.9

Drawback: Only limited triads were arranged in this pattern.

Newland's Law of Octaves

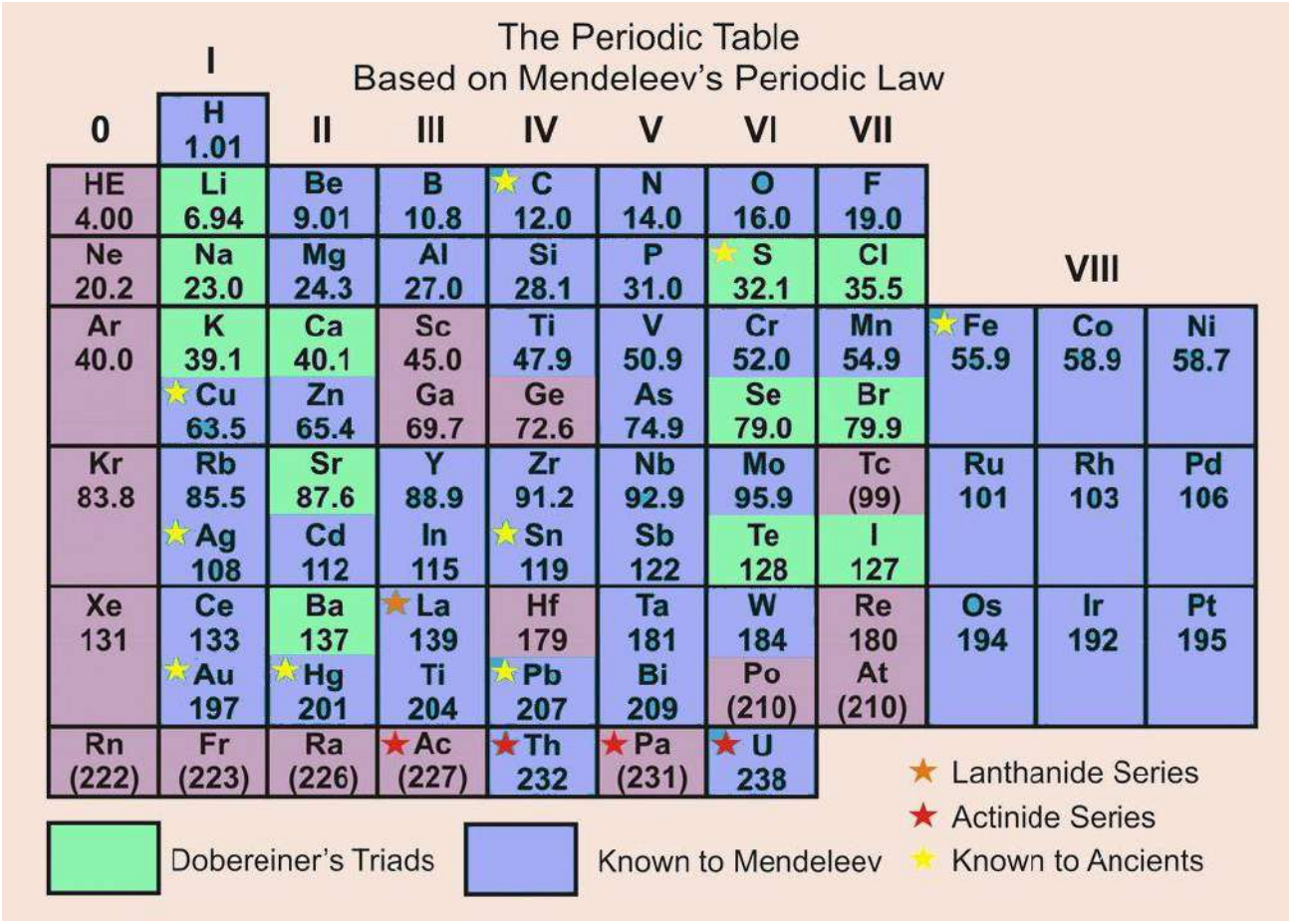
In 1865, John Newland observed that in a series of elements arranged in the increasing order of atomic weights, 1st and 8th elements have same properties. Now, a days, 1st and 9th elements have same properties in that series because noble gases were discovered late.

1	2	3	4	5	6	7	8
Li	Be	B	C	N	O	F	Ne Na
9	10	11	12	13	14	15	16
Mg	Al	Si	P	S	Cl	Ar K	Ca

Mendeleev's Periodic Table

"The physical and chemical properties of elements are a periodic function of atomic weights".

Mendeleev arranged elements in horizontal rows and vertical columns of a table in order of their increasing atomic weights in such a way that the elements with similar properties occupied the same vertical column or group. Vertical Colums are called groups which are numbered I to VIII group, each group is further subdivided into sub groups A and B. Horizontal rows are called **periods**.



Defects in Mendeleev's Table-

i. **Position of hydrogen**: Position of hydrogen was not justified.

ii. **Position of isotope**: Isotopes should be placed separately according to periodic law. But actually one place was given to all isotopes of an element.

iii. **Cause of periodicity**: Mendeleev could not explain why elements exhibit a periodicity in their properties when arranged in the order of increasing atomic weight.

iv. **Anomalous pairs of elements**: Some anomalous pairs were present in table. As Tellurium (128 u) comes in VI group before Iodine (127 u).

Moseley's Modern Periodic Table

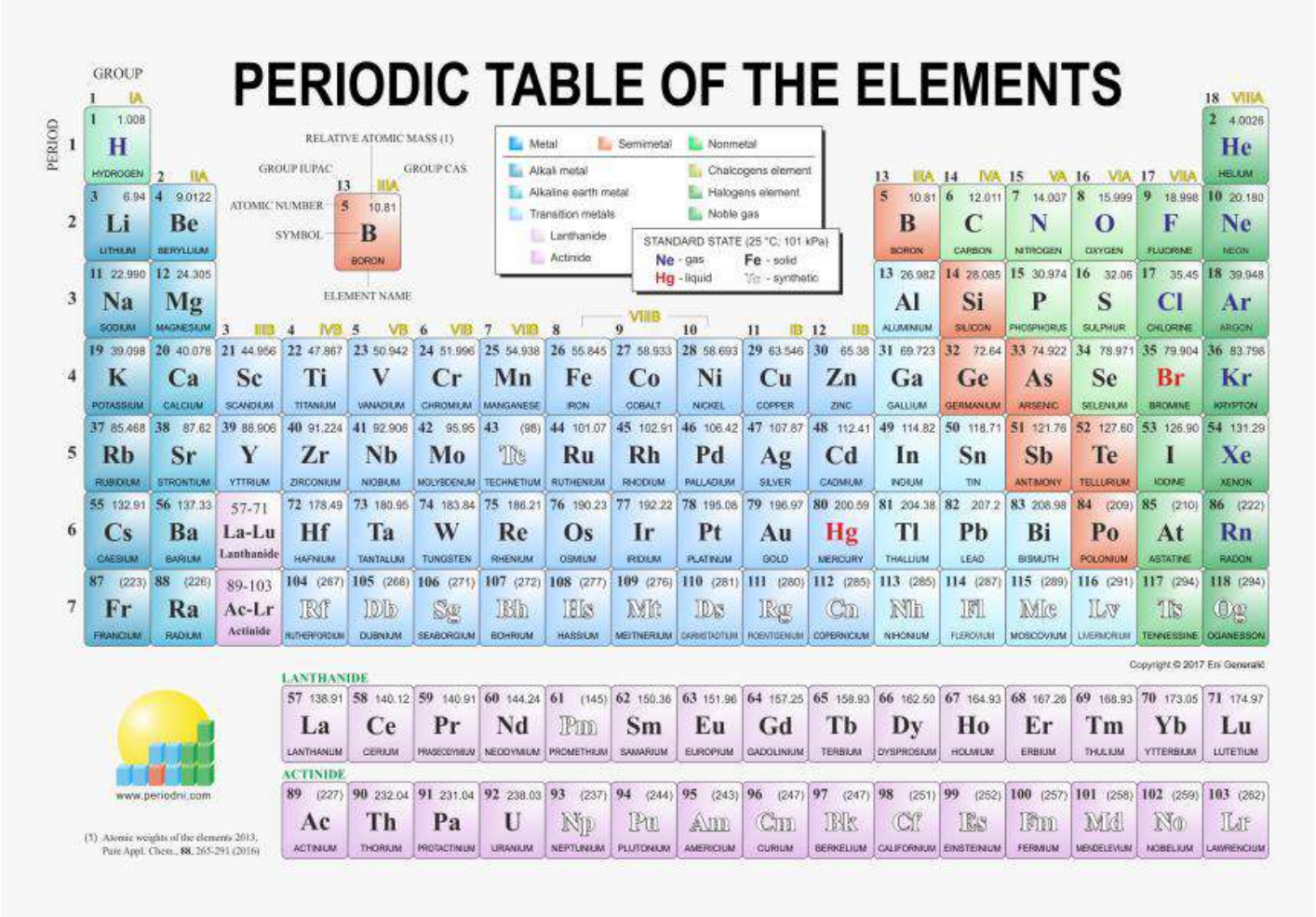
"The physical and chemical properties are the periodic function of their atomic numbers".

The long form of periodic table, also called Modem Periodic Table, is based on Modern periodic law. In this table, the elements have been arranged in order of increasing atomic numbers.

A modern version, the so-called "**long form**" of the **Periodic Table** of the elements, is the most convenient and widely used. The horizontal rows are called periods and the vertical columns, groups. Elements having similar outer electronic configurations in

their atoms are arranged in vertical columns, referred to as groups or families. According to the recommendation of International Union of Pure and Applied Chemistry (IUPAC), the groups are numbered from 1 to 18 replacing the older notation of groups IA … VIIA, VIII, IB … VIIB and 0.

There are altogether seven periods. The period number corresponds to the highest principal quantum number (n) of the elements in the period. The first period contains 2 elements. The subsequent periods consists of 8, 8, 18, 18 and 32 elements, respectively. The seventh period is incomplete and like the sixth period would have a theoretical maximum of 32 elements. In this form of the Periodic Table, 14 elements of both sixth and seventh periods (lanthanoids and actinoids, respectively) are placed in separate panels at the bottom.



The IUPAC names are derived by using roots for three digit atomic number of the elements.

Digit	Iupac Name	Symbol
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

A systematic nomenclature be derived directly from the atomic number of the element using the numerical roots for 0 and numbers 1-9. The roots are put together in order of digits which make up the atomic number and "ium" is added at the end. The IUPAC names for elements with Z above 100 are shown below:

Atomic Number	Name according to IUPAC nomenclature	Symbol	IUPAC Official Name	IUPAC Symbol
101	Unnilunium	Unu	Mendelevium	Md
102	Unnilbium	Unb	Nobelium	No
103	Unniltrium	Unt	Lawrencium	Lr
104	Unnilquadium	Unq	Rutherfordium	Rf
105	Unnilpentium	Unp	Dubnium	Db
106	Unnilhexium	Unh	Seaborgium	Sg
107	Unnilseptium	Uns	Bohrium	Bh
108	Unniloctium	Uno	Hassium	Hs
109	Unnilennium	Une	Meitnerium	Mt
110	Ununnillium	Uun	Darmstadtium	Ds
111	Unununnium	Uuu	Rontgenium	Rg
112	Ununbium	Uub	Copernicium	Cn
113	Ununtrium	Uut	Nihonium	Nh
114	Ununquadium	Uuq	Flerovium	Fl
115	Ununpentium	Uup	Moscovium	Mc
116	Ununhexium	Uuh	Livermorium	Lv
117	Ununseptium	Uus	Tennessine	Ts
118	Ununoctium	Uuo	Oganesson	Og

Division of Elements into Blocks

s-block: The elements of Group 1 (alkali metals) and Group 2 (alkaline earth metals) which have ns^1 and ns^2 outermost electronic configuration belong to the s-Block Elements.

Characteristics of s-Block elements,

i. Except Be and Mg, all impart characteristic colour to the flame.
ii. These have low ionisation energy.
iii. These are highly reactive.
iv. These are the highly electropositive elements.
v. All the elements are soft metals.
vi. They have low melting and boiling points.

p-block: The p-Block Elements comprise those belonging to Group 13 to 18 and these together with the s-Block Elements are called the Representative Elements or Main Group Elements. The outermost electronic configuration varies from ns^2np^1 to ns^2np^6 in each period.

Characteristics of p-Block elements,

1. The compounds of p-block elements are generally covalent although their ionic character increases down the group.
2. From left to right 13 to 18, reducing character decreases.
3. The p-block elements generally show more than one oxidation state.
4. The reactivity of elements in a group generally decreases downwards.
5. At the end of each period is a noble gas element with a closed valence shell $ns^2\ np^6$ configuration.

d-block: These are the elements of Group 3 to 12 in the centre of the Periodic Table. These are characterised by the filling of inner d orbitals by electrons and are therefore referred to as d-Block Elements. These elements have the general outer electronic configuration $(n-1)d^{1-10}ns^{0-2}$.

Characteristics of d-Block elements:

1. They are all metals with high melting and boiling points.
2. The compounds of the elements are generally paramagnetic in nature.
3. They mostly form coloured ions, exhibit variable valence (oxidation states).
4. They are of tenly used as catalysts.
5. These elements have high melting point.

f-block: The two rows of elements at the bottom of the Periodic Table, called the **Lanthanoids**, Ce(Z = 58) – Lu(Z = 71) and **Actinoids**, Th(Z=90) – Lr (Z=103) are characterised by the outer electronic configuration $(n-2)f^{1-14}(n-1)d^{0-1}ns^2$. The last electron added to each element is filled in f-orbital. These two series of elements are hence called the **Inner-Transition Elements** (f-Block Elements).

Characteristics of f-Block elements:

1. All actinoids are radioactive. Elements after uranium are known as transuranium element.
2. They form coloured compounds.
3. These two series of elements are called Inner Transition Elements (f-Block Elements).
4. They are all metals. Within each series, the properties of the elements are quite similar.
5. They generally have high melting and boiling points.

Periodic Properties

The properties which generally have a regular trend along a group or period are called periodic properties. These are as given below:

- Atomic size
- Ionisation energy
- Electron gain enthalpy
- Electronegativity

i. **Atomic Size**: Atomic Radius is the distance from the centre of the nucleus to the outermost shell containing electron.

Ionic Radius: The ionic radii can be estimated by measuring the distances between cations and anions in ionic crystals. In general, the ionic radii of elements exhibit the same trend as the atomic radii.

Cation: The removal of an electron from an atom results in the formation of a cation. The radius of cation is always smaller than that of the atom.

Anion: Gain of an electron leads to an anion. The radius of the anion is always larger than that of the atom.

ii. **Ionisation energy**: It is the amount of energy required to remove the outer most electron from an isolated atom in its gaseous state. It is the measured in the unit of kJ/mole. It is denoted by ($\Delta_i H$).

$$M(g) - e^- \longrightarrow M^+(g)$$

iii. **Electron gain enthalpy**: It is the enthalpy change when an electron is added to the gaseous neutral atom. Electron gain enthalpy provides a measure of the ease with which an atom adds an electron to form anion. It is the measured in the unit of

kJ/mole. It is denoted by ($\Delta_{eg}H$).

$$X(g) + e^- \longrightarrow X^-(g)$$

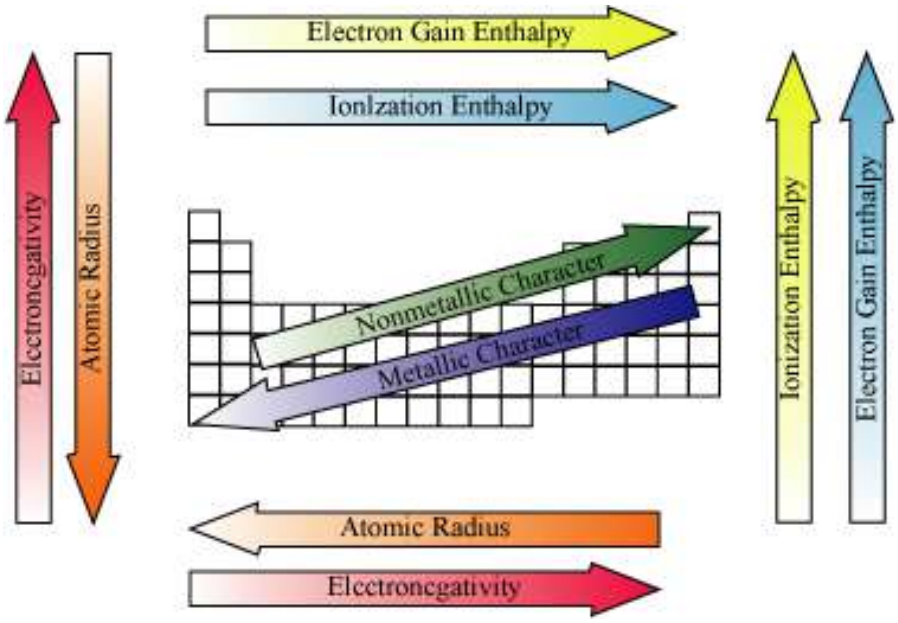
iv. **Electronegativity**: Electronegativity is a measure of the tendency of an element to attract bonded electron pair towards itself in a covalently bonded molecule.

Periodic Trends in Chemical Properties along a Period

1. **Metallic character**: It decreases across a period, maximum on the extreme left (alkali metals).
2. **Non-metallic character**: It increases along a period, from left to right.
3. **Atomic Size**: It decreases across a period.
4. **Ionisation energy**: It increases along a period.
5. **Electron gain enthalpy**: It increases along a period.
6. **Electronegativity**: It increases along a period.
7. **Basic nature of oxides**: It decreases from left to right in a period.
8. **Acidic nature of oxides**: It increases from left to right in a period.

Variation in Chemical Properties along a Group

1. **Metallic character**: Generally increases because increase in atomic size and hence decrease in the ionizatiorn energy of the elements in a group from top to bottom.
2. **Non-metallic character**: It generally decreases down a group. As electronegativity of elements decreases from top to bottom in a group.
3. **Atomic Size**: It increases along a group.
4. **Ionisation energy**: It decreases across a period.
5. **Electron gain enthalpy**: It decreases across a period.
6. **Electronegativity**: It decreases across a period.
7. **Basic nature of oxides**: Since metallic character or electropositivity of elements increases in going from top to bottom in a group basic nature of oxidise naturally increases.
8. **Acidic character of oxides**: It generally decreases as non-metallic character of elements decreases in going from top to bottom in a group.
9. **Reactivity of metals**: It generally increases down a group. Since tendency to lose electron increases.



Summary-

1. **Periodic table**: Arrangement of elements in the increasing order of atomic number such that elements with similar properties fall under same vertical column.
2. **Group**: A vertical column of elements in the periodic table.
3. **Period**: A horizontal row of elements in the periodic table.
4. **Long form of periodic table** has 18 groups and 7 periods. Sixth period is the longest and first period is the smallest.
5. **s-Block elements**: Elements of groups 1 and 2. Their general valence shell electronic configuration is ns^{1-2}.
6. **p-Block elements**: Elements of groups 13, 14, 15, 16, 17 and 18. Their general valence shell electronic configuration is ns^2np^{1-6}.
7. **d-Block elements**: Elements of groups 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12. Also known as transition elements. Their general valence shell electronic configuration is $(n-1)d^{1-10}$ ns^{1-2}. $_{46}Pd$ is exception ($4d^{10}$ $5s^0$).
8. **f-Block elements**: The two horizontal rows of elements at the bottom of the table. Also known as inner transition elements. Their general valence shell electronic configuration is $(n-2)f^{1-14}$ $(n-1)d^{0-1}$ ns^2.
9. **Covalent radius**: Half of the internuclear distance between two atoms of the element held by a single covalent bond.
10. **Van der Waal's radius**: Half of the internuclear distance between two nearest atoms belonging to two adjacent molecules in solid state.
11. **Metallic radius**: Half of the internuclear distance between two nearest atoms in the metallic lattice.
12. **Isoelectronic ions**: The ions having same number of electrons but different nuclear charge.

Example: (i) N^{3-}, O^{2-}, F^{-}, Na^{+}, Mg^{2+}, Al^{3+}; (ii) P^{3-}, S^{2-}, Cl^{-}, K^{+}, Ca^{2+}, Sc^{3+}

13. Among isoelectric ions, greater the nuclear charge smaller is the size.
14. **Ionization enthalpy**: The minimum amount energy required to remove the outermost electron from an isolated gaseous atom of the element.
15. Ionization enthalpy increases along the period and decreases down the group.
16. Be, Mg, N, P and noble gases have exceptionally high values of ionization enthalpies due to their stable electronic configurations.
17. **Electron gain enthalpy**: The enthalpy change taking place when an electron is added to an isolated gaseous atom of the element.
18. Electron gain enthalpy becomes more negative as we move along the period and becomes less negative down the group.
19. Successive electron gain enthalpies are always positive.
20. Helium has the highest value of ionization enthalpy in periodic table.
21. Chlorine has the highest negative electron gain enthalpy in periodic table.
22. **Electronegativity**: It is the tendency of an atom in a molecule to attract towards itself the shared pair of electrons.
23. Fluorine is the most electronegative element whereas Caesium is the least electronegative element in periodic table.
24. Unlike ionisation energy and electron affinity, electronegativity is the property of atom of an element in combined state.
25. Electropositive or metallic character is related to the ionisation energy of the element. The elements having low I.E. are more electropositive or more metallic in character.
26. **Valence** of an element belonging to s or p-block is either equal to the number of valence electrons or eight minus the number of valence electron.
27. The chemical reactivity is maximum at the two extreme ends of the periodic table and is least in the centre.
28. Among alkali metals reactivity increases on descending the group while among halogens the reactivity decreases on descending the group.
29. The basic character of oxides decreases while the acidic character increases on going from left to right in a period.
30. Oxides of metals are generally basic while that of non-metals are acidic in nature.
31. The similarity between a pair of elements in period second and third located diagonally in the periodic table is called the **diagonal relationship**.

NCERT LINE BY LINE QUESTIONS

(1.) **Assertion :** The elements beryllium, antimony, arsenic and tellurium have characteristics of both metals and non-metals.
Reason: The metallic character increases as we go from left to right across the periodic table. **[Page: 82]**

(a.) Both A and R are true and R is the correct explanation of A.
(b.) Both A and R are true but R is nor the correct explanation of A.
(c.) A is true but R is false.
(d.) Both A and R are false.

(2.) Which of the following elements has highest first ionization enthalpy? **[Page: 85]**

(a.) P
(b.) C

(c.) O (d.) Ne

(3.) If atomic weights of lithium and potassium are 7 and 39 respectively, then what is the atomic weight of sodium according to Dobereiner's law of triads? **[Page: 71]**

(a.) 25 (b.) 23

(c.) 14 (d.) 78

(4.) Select the correct order of size of the given species. **[Page: 84]**

(a.) $I^- > I > I^+$ (b.) $I > I^- > I^+$

(c.) $I > I^+ > I^-$ (d.) $I^+ > I^- > I$

(5.) The sixth period contains 32 elements and successive electrons enter in the orbitals of **[Page: 80]**

(a.) 5s, 4f, 5d and 4p. (b.) 6s, 3f, 4d and 5p.

(c.) 5s, 4f, 6d and 6p. (d.) 6s, 4f, 5d and 6p.

(6.) The size of an anion will be larger than that of the parent atom because **[Page: 84]**

(a.) The addition of one or more electrons would result in decreased repulsion among the electron anda increase in effective nuclear charge.

(b.) The removal of one or more electrons results in increased attraction among the electrons.

(c.) The addition of one or more electrons would result in increased repulsion among the electrons and a decrease in effective nuclear charge.

(d.) The addition of one or more electrons results in decreased attraction among the electrons.

(7.) Identify the oxide which is amphoteric in nature. **[Page: 91]**

(a.) Al_2O_3 (b.) NO

(c.) Cl_2O_7 (d.) Na_2O

(8.) Some properties of inner-transition elements are given below. Choose the incorrect statements. **[Page: 82]**

(I) They are all non-metals.
(II) Within each series, the properties of the elements are not similar.
(III) The chemistry of the early actinoids is more simple than the corresponding lanthanoids.

(a.) I and II (b.) II and III

(c.) I and III (d.) I, II and III

(9.) Seaborg was awarded the Nobel Prize in Chemistry for his work. What name has been given to an element in his honour? **[Page: 76]**

(a.) Tantalum (b.) Molybdenum

(c.) Iridium (d.) Seaborgium

(10.) Some order and their respective properties are given below. Choose the correct one. **[Page: 82]**

(a.) Na < Mg < Be: Metallic character
(b.) K < Rb < Cs: Reactivity
(c.) Cl < S < P: Non-metallic character
(d.) Br < Ser < As: Electron gain enthalpy

(11.) Some properties for the noble gases are given below. Choose the correct statements. **[Page: 78]**
(I) All the orbitals in the valence shell are completely filled by electrons.
(II) Very difficult to alter the electronic arrangement by the addition or removal of electron.
(III) Exhibit very high chemical reactivity.

(a.) I and III
(b.) II and III
(c.) I and II
(d.) I, II and III

(12.) The period number in the long form of the periodic table is equal to **[Page: 76]**

(a.) maximum principal quantum number of any element of the period.
(b.) magnetic quantum number of any element of the period.
(c.) maximum Azimuthal quantum number of any element of the period.
(d.) atomic number of any element of the period.

(13.) What are the oxidation state and covalency respectively of Al in $\left[AlCl(H_2O)_5\right]^{2+}$?**[Page: 89]**

(a.) 3 and 6
(b.) 6 and 3
(c.) 2 and 6
(d.) 6 and 2

(14.) What is the symbol of the element Meitnerium.**[Page: 76]**

(a.) Md
(b.) Mt
(c.) Mo
(d.) Mn

(15.) Match the oxide given in column I with its property given in column II. **(odisha, NEET-2019,Page: 85)**

	Column - I		Column - II
(P.)	Na_2O	(i.)	Neutral
(Q.)	Al_2O_3	(ii.)	Basic
(R.)	N_2O	(iii.)	Acidic
(S.)	Cl_2O_7	(iv.)	Amphoteric

Which of the following option has all correct pairs?

(a.) (i) – (B), (ii) – (D), (iii) – (A), (iv) – (C)
(b.) (i) – (B), (ii) – (A), (iii) – (D), (iv) – (C)
(c.) (i) – (C), (ii) – (B), (iii) – (A), (iv) – (D)
(d.) (i) – (A), (ii) – (D), (iii) – (B), (iv) – (C)

(16.) Which of the given periodic trends is correct?**[Page: 89]**

(a.) Electronegativity increases down the group.
(b.) Ionization enthalpy increases down the group.
(c.) Atomic radius increases down the group.
(d.) Electron gain enthalpy increases down the group.

(17.) A quantitative measure of the tendency of an element to lose electron is given by its **[Page: 85]**

(a.) electronegativity. (b.) electron gain enthalpy.
(c.) ionization enthalpy. (d.) electronegativity and ionization enthalpy.

(18.) **Assertion:** Mendeleev periodic table had left the gap under aluminium and a gap under silicon, and called these elements Eka-Aluminium and EkaSilicon.
Reason: The elements gallium and germanium were known at that time Mendeleev published his periodic table. **[Page: 72]**

(a.) Both A and R are true and R is the correct explanation of A. (b.) Both A and R are true but R is not the correct explanation of A.
(c.) A is true but R is false. (d.) Both A and R are false.

(19.) **Assertion:** The elements become more metallic as we go from left to right across the periodic table.
Reason: The elements become more non-metallic as we *go* down a group. **[Page: 82]**

(a.) Both A and R are true and R is the correct explanation of A. (b.) Both A and R are true but R is not the correct explanation of A.
(c.) A is true but R is false. (d.) Both A and R are false.

(20.) The ionic radii can be estimated by measuring the distances between **[Page: 84]**

(a.) anions and anions in ionic crystals. (b.) cations and cations in ionic crystals.
(c.) cations and anions in ionic crystals. (d.) None of these.

(21.) A qualitative measure of the ability of an atom in a chemical compound to attract shared electrons to itself is called **[Page: 87]**

(a.) electron gain enthalpy. (b.) ionization enthalpy.
(c.) electronegativity. (d.) stability.

(22.) Which of the following oxides is most acidic in nature? **[NEET-2018, Page: 85]**

(a.) MgO (b.) BeO
(c.) BaO (d.) CaO

(23.) The first and the last of lanthanoids elements are **[Page: 81]**

(a.) Th and Lr (b.) Ce and No
(c.) La and Lu (d.) Ce and Lu

(24.) What is the atomic number of the element which is considered as last element of the 3d series? **[Page: 81]**

(a.) 30 (b.) 40
(c.) 20 (d.) 25

(25.) **Assertion:** A qualitative measure of the ability of an atom in a chemical compound to attract shared electrons to itself is called electronegativity.
Reason: The ionization enthalpy, electron gain enthalpy and electronegativity are measurable quantity. **[Page: 89]**

(a.) Both A and R are true and R is the correct explanation of A. (b.) Both A and R are true but R is not the correct explanation of A.
(c.) A is true but R is false. (d.) Both A and R are false.

(26.) According to Mendeleev's periodic table, which of the following elements has formula of oxide as R_2O_3? **[QR code, Page: 72]**

(a.) B (b.) Be

(c.) Li (d.) C

(27.) Which of the following is the correct order with respect to first ionization enthalpies? **[Page: 84]**

(a.) $Li < Na < K < Rb$ (b.) $Rb > K > Na > Li$

(c.) $Na < Li < K < Rb$ (d.) $K > Rb > Na > Li$

(28.) Select the correct statement. **[Page: 91]**

(a.) Reactivity of the alkali metals decreases down the group. (b.) Reactivity of the halogens decreases down the group.

(c.) Reactivity of alkali metals and halogens decreases down the group. (d.) Reactivity of alkali metals and halogens increases down the group.

(29.) Combination of which two blocks elements are also called representative elements . **[Page: 79]**

(a.) *s*-block and *d*-block (b.) *s*-block and *d*-block

(c.) *s*-block and *p*-block (d.) *d*-block and *f*-block

(30.) **Assertion:** Energy is always required to remove electrons from an atom and hence ionization enthalpies are always negative.

Reason: The second ionization enthalpy will be lower than the first ionization enthalpy. **[Page: 84]**

(a.) Both A and R are true and R is the correct explanation of A. (b.) Both A and R are true but R is not the correct explanation of A.

(c.) A is true but R is false. (d.) Both A and R are false.

(31.) The maximum number of elements that can be accommodated in fifth period is **[Page: 78]**

(a.) 8 (b.) 18

(c.) 32 (d.) 20

(32.) Which among the following are the isoelectronic Species? **[Page: 84]**

(a.) Mg^{2+}, Cl^{-} and Na^{+} (b.) O^{2+}, P^{-} and Mg^{2+}

(c.) Na^{+}, O^{2-} and F^{-} (d.) Cl^{-}, F^{-} and O^{2+}

(33.) The electronic configurations of Eu (Atomic No. 63), Gd (Atomic No. 64) and Tb (Atomic No. 65) are **[AIPMT/NEET-2016, Page: 81]**

(a.) $[Xe]4f^{7}6s^{2}, [Xe]4f^{8}6s^{2}$ and $[Xe]4f^{8}5d^{1}6s^{2}$

(b.) $[Xe]4f^{7}5d^{1}6s^{2}, [Xe]4f^{7}5d^{1}6s^{2}$ and $[Xe]4f^{9}6s^{2}$

(c.) $[Xe]4f^{6}5d^{1}6s^{2}, [)\zeta e]4r^{7}5d^{1}6s^{2}$ and $[Xe]4f^{8}5d^{1}6s^{2}$

(d.) $[Xe]4f^{7}6s^{2}, [Xe]4f^{7}5d^{1}6s^{2}$ and $[Xe]4f\,6s^{2}$

(34.) The physical and chemical properties of the elements are periodic functions of their **[Page: 75]**

(a.) volume. (b.) densities.

(c.) atomic masses. (d.) atomic numbers.

(35.) The *d*-block elements in the periodic table lie in the group from **[Page: 81]**

(a.) 4 to 11 (b.) 3 to 12

(c.) 3 to 13 (d.) 4 to 14

(36.) The distribution of electrons into orbitals of an atom is called its **[Page: 79]**

(a.) shell.
(b.) electronic configuration.
(c.) series.
(d.) block.

(37.) Which of the following is correct with respect to electronegativity, metallic and non-metallic character of the elements? **[Page: 88]**

(a.) The increase in electronegativity across a period is accompanied by an increase in nonmetallic properties of elements.
(b.) The increase in electronegativity down a group is accompanied by a decrease in nonmetallic properties of elements.
(c.) Electronegativity is inversely related to the non-metallic properties of elements.
(d.) Electronegativity is directly related to the metallic properties of elements.

(38.)A plot of $\sqrt{\nu}$ against atomic number (Z) gave a straight line and not the plot of $\sqrt{\nu}$ against atomic mass. Which of the following scientist observed such regularities in the characteristics X-ray spectra of the element? **[page: 75]**

(a.) Dmitri Mendeleev
(b.) Henry Moseley
(c.) A. H. B. de Chancourtois
(d.) Alexander Newlands

(39.) Which of the following statements regarding ionization enthalpy is correct?. **[Page: s5]**

(a.) The first ionization enthalpy will be higher than the second ionization enthalpy.
(b.) The second ionization enthalpy will be higher than the first ionization enthalpy.
(c.) The second ionization enthalpy will be higher than the third ionization enthalpy.
(d.) The first ionization enthalpy will be higher than the third ionization enthalpy.

(40.) Fourth period ended with element of **[Page: 8i]**

(a.) xenon.
(b.) krypton.
(c.) silver.
(d.) copper.

(41.) Which of the following groups of elements has highly negative electron gain enthalpies **[Page: 79]**

(a.) Halogen group
(b.) Chalcogens group
(c.) Alkaline earth metal group
(d.) Alkali metal group

(42.) Which of the following is the correct statement.**[Page: 84]**

(a.) The cation with the greater positive charge will have a smaller radius.
(b.) The anion with the greater negative charge will have the smaller radius.
(c.) The cation with the lower positive charge will have a smaller radius.
(d.) The anion with the lower negative charge will have the larger radius.

(43.) Transition elements in the periodic table started from the atomic number **[Page: 81]**

(a.) 20
(b.) 21
(c.) 22
(d.) 24

(44.)Assertion: The atomic size generally decreases across a period.

Reason: Effective nuclear charge increases as the atomic number increases across a period.**[Page: 84]**

(a.) Both A and R are true and R is the correct explanation of A.
(b.) Both A and R are true but R is not the correct explanation of A.
(c.) A is true but R is false.
(d.) Both A and R are false.

(45.)Assertion: The two rows of elements at the bottom of the periodic table are called the lanthanoids and actinoids.

Reason: The elements after uranium are called trans-uranium elements. **[Page: 81]**

(a.) Both A and R are true and R is the correct explanation of A.
(b.) Both A and R are true but R is not the correct explanation of A.
(c.) A is true but R is false.
(d.) Both A and R are false.

(46.) Which of the following properties does not belong to the *d*-block elements ? **[Page: sl]**

(a.) They exhibit specific oxidation states.
(b.) They are all metals.
(c.) They are mostly formed of coloured ions.
(d.) They are often used as catalyst.

(47.) Consider the two oxygen containing compounds OF_2 and Na_2O. The order of electronegativity of the three elements involved in these compounds is**[Page: 88]**

(a.) $F > Na > O$
(b.) $F > O > Na$
(c.) $Na > F > O$
(d.) $O > F > Na$

(48.) Which of the given element has highest electronegativity value as per Pauling scale?**[Page: 89]**

(a.) Si
(b.) S
(c.) Be
(d.) Mg

(49.) Gadolinium belongs to 4f series. Its atomic number is 64. Which of the following is the correct electronic configuration of gadolinium **[Re-AIPMT-2015, Page: 81]**

(a.) $[Xe]4f^{7}5d^{1}6s^{2}$
(b.) $[Xe]4f^{6}5d^{2}6s^{2}$
(c.) $[Xe]4f^{8}6d^{2}$
(d.) $[Xe]4f\,5d^{1}$

(50.)Assertion: Henry Moseley observed regularities in the characteristic X-ray spectra of element. A plot of $\sqrt{v}$ (v is frequency.) against atomic number (Z) gave a straight line.

Reason: Henry Moseley showed thar the atomic number is a more fundamental property of an element than its atomic mass. **[Page: 75]**

(a.) Both A and R are true and R is the correct explanation of A.
(b.) Both A and R are true but R is not the correct explanation of A.
(c.) A is true but R is false.
(d.) Both A and R are false.

TOPIC 1: Mendeleev and Modern Periodic Table

1. The molecular formula of chloride of Eka-Aluminium and Eka-Silicon respectively are
   1) GaCl3 and SiO4 2) GaCl3 and AlCl3 3) AlCl3 and SiCl4 4) GaCl3 and GeCl4
2. Representative elements belong to
   1) *s*- and *p*-blocks 2) *p*- and *d*-blocks 3) *f*-block only 4) *d*- and *f*-blocks
3. The tenth element in the periodic table resembles the element with atomic number
   1) 2 and 30 2) 8 and 18 3) 2 and 54 4) 8 and 54
4. The elements with atomic numbers 9, 17, 35, 53 and 85 belong to
   1) alkali metals 2) alkaline earth metals
   3) halogens 4) noble gases
5. The element Z = 114 has been discovered recently. It will belong to which of the following family group and electronic configuration?
   1) Halogen family [Rn] 5*f*14 6*d*10 7*s*2 *7p*5 2) Carbon family [Rn] 5*f*14 6*d*10 7*s*2 *7p2*
   3) Oxygen family [Rn] 5*f*14 6*d*10 7*s*2 *7p4* 4) Nitrogen family [Rn] 5*f*14 6*d*10 7*s*2 *7p3*
6. The most abundant element in the universe is thought to be
   1) carbon 2) oxygen 3) hydrogen 4) nitrogen
7. Element with atomic number 47 belongs to the period .....and the group .....
   1) 4th, 12th 2) 4th, 11th 3) 5th, 12th 4) 5th, 11th
8. Which of the following is the atomic number of a metal–
   1) 32 2) 34 3) 36 4) 38
9. What is the IUPAC name of the element with atomic number 114 ?
   1) Unununnium 2) Unnilquadium 3) Ununquadium 4) Unnilennium.
10. The element with atomic number 118, will be
    1) alkali 2) noble gas 3) lanthanide 4) transition element
11. If the atomic number of an element is 33, it will be placed in the periodic table in the
    1) first group 2) third group 3) fifth group 4) seventh group.
12. The long form of periodic table consists of
    1) Seven periods and eight groups 2) seven periods and eighteen groups
    3) Eight periods and eighteen groups 4) eighteen periods and eight groups
13. Elements of which group form anions most readily?
    1) Oxygen family 2) Nitrogen family 3) Halogens 4) Alkali metals
14. Element with electronic configuration 1*s*2 2*s*2 2*p*6 3*s*2 3*p*6 3*d*10 4*s*2 4*p*6 4*d*10 5*s*2 5*p*3 belongs to the following group of the periodic table
    1) 2nd 2) 5^{th} 3) 3rd 4) 7th
15. Element having atomic no. of 56 belongs to which of the following block of periodic table?
    1) *p*- block 2) *d*-block 3) *f*- block 4) *s*-block
16. Which of the following pairs has both members from the same period of the periodic table.
    1) Na – Ca 2) Na – Cl 3) Ca – Cl 4) Cl – Br
17. Which group of the periodic table contains coinage metal ?
    1) IIA 2) IB 3) IA 4) None of these
18. Which of the following period contain most of the manmade radioactive elements?
    1) Seventh 2) Fifth 3) Sixth 4) Both 1) and 3)
19. Element X forms a chloride with the formula XCl2, which is a solid with a high melting point. X would most likely be in the same group of the periodic table as –
    1) Na 2) Mg 3) Al 4) Si
20. An element has electronic configuration 1*s*22*s*22*p*63*s*23*p*4.
    1) Period = 3rd, block = *p*, group = 16 2) Period = 5th, block = *s*, group = 1

3) Period = 3rd, block = *p*, group = 10 4) Period = 4th, block = *d*, group = 12

21. Which of the following is the artificial element in the periodic table ?
1) Tc 2) Te 3) Ru 4) Os

TOPIC 2: Atomic Radii, Ionic Radii and Ionization Energy

22. The correct order of radii is
1) N < Be < B 2) F- < O2- < N3- 3) N < Li < K 4) Fe3+ < Fe2+ < Fe4+

23. When an electron is removed from an atom, its energy
1) increases 2) decreases 3) remains the same 4) none of these

24. In the ions P^{3-}, S^{2-} and Cl^{-}, the increasing order of size is
1) Cl^{-}, S^{2-}, P^{3-} 2) P^{3-}, S^{2-}, Cl^{-} 3) S^{2-}, Cl^{-}, P^{3-} 4) S^{2-}, P^{3-}, Cl^{-}

25. Ionisation energy decreases down the group due to
1) increase in charge 2) increase in atomic size
3) decrease in size 4) decrease in shielding effect

26. Which one has least ionisation potential?
1) Ne 2) N 3) O 4) F

27. Covalent radii of atoms varies in range of 72 pm to 133 pm from F to I while that of noble gases He to Xe varies from 120pm to 220pm. This is because in case of noble gases
1) covalent radius is very large 2) van der Waal radius is considered
3) metallic radii is considered 4) None of these

28. Ionic radii are
1) inversely proportional to effective nuclear charge
2) inversely proportional to square of effective nuclear charge
3) directly proportional to effective nuclear charge
4) directly proportional to square of effective nuclear charge

29. Which one of the following ions has the highest value of ionic radius ?
1) O^{2-} 2) B^{3+} 3) Li^{+} 4) F^{-}

30. Atomic radii of fluorine and neon in Angstorm units are respectively given by
1) 0.72, 1.60 2) 1.60, 1.60 3) 0.72, 0.72 4) None of these values

31. The screening effect of inner electrons of the nucleus causes
1) decrease in the ionization energy 2) increase in the ionization energy
3) no effect on the ionization energy 4) increases the attraction of the nucleus for the electrons

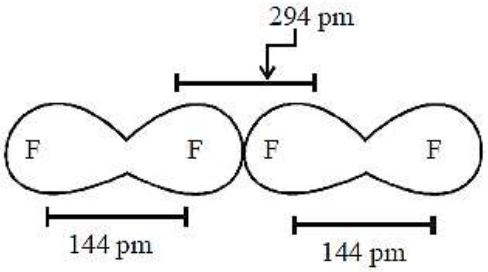
32. The second ionization potential is
1) less than the first ionization potential. 2) equal to the first ionization potential.
3) greater than the first ionization potential. 4) none of these

33. The pair of elements having approximately equal ionisation potential is
1) Al, Ga 2) Al, Si 3) Al, Mg 4) Al, B

34. Which of the following option is incorrect with respect to ionic radii ?
1) $Ti^{4+} < Mn^{2+}$ 2) $^{35}Cl^{-} < {}^{37}Cl^{-}$ 3) $K^{+} > Cl^{-}$ 4) $P^{3+} > P^{5+}$

35. Which of the following element has maximum, first ionisation potential –
1) V 2) Ti 3) Cr 4) Mn

36. The van der Waal and covalent radii of fluorine atom respectively from the following figure are.



1) 219 pm, 72 pm 2) 75 pm, 72 pm 3) 147 pm, 72 pm 4) 147 pm, 144 pm

37. Which of the following has same size?
1) Fe^{2+} , Ni^{2+} 2) Zr^{4+}, Ti^{4+} 3) Zr^{4+}, Hf^{4+} 4) Zn^{2+}, Hf^{4+}

38. The correct decreasing order of first ionisation enthalpies of five elements of the second period is
1) Be > B > C > N > F 2) N > F > C > B > Be 3) F > N > C > Be > B 4) N > F > B > C > Be

39. Which is the correct order of second ionization potential of C, N, O and F in the following ?
1) O > N > F > C 2) O > F > N > C 3) F > O > N > C 4) C > N > O > F

40. Which of the following statements is wrong ?
1) van der Waal's radius of iodine is more than its covalent radius
2) All isoelectronic ions belong to same period of the periodic table
3) I.E.1 of N is higher than that of O while I.E.2 of O is higher than that of N
4) The electron gain enthalpy of N is almost zero while that of P is 74.3 kJ mol^{-1}

41. The atomic sizes are not significantly different for the series of elements
1) Bi, Na, K, Rb 2) Na, Mg, Al, Si 3) O, S, Sc, Te 4) Cr, Mn,Fe,Co

42. The correct sequence of the ionic radii of the following is
1) $Br^- > Cl^- > S^{2-} > O^{2-} > F^-$ 2) $Br^- > S^{2-} > Cl^- > O^{2-} > F^-$
3) $Br^- > S^{2-} > Cl^- > F^- > O^{2-}$ 4) none of these

43. Ionization potentials of the following elements are in the order
1) Al > Ga > In > Tl 2) Al > Ga > Tl > In 3) Al » Ga > In > Tl 4) Al » Ga > Tl > In

44. Electron affinity is maximum for
1) Cl 2) F 3) Br 4) I

45. Consider the following four elements, which are represented according to long form of periodic table

	Y	
W	X	Z

Here W, Y and Z are left, up and right elements with respect to the element 'X' and 'X' belongs to 16th group and 3rd period. Then according to given information the incorrect statement regarding given elements is:
1) Maximum electronegativity : Y 2) Maximum catenation property : X
3) Maximum electron affinity : Z 4) Y exhibits variable covalency

46. The electron affinity for the inert gases is
1) zero 2) high 3) negative 4) positive

47. An atom with high electronegativity has
1) large size 2) high ionisation potential
3) low electron affinity 4) low ionisation potential

48. The stability of + 1 oxidation state increases in the sequence:
1) Tl < In < Ga < Al 2) In < Tl < Ga < Al
3) Ga < In < Al < Tl 4) Al < Ga < In < Tl

49. Halogens and chalcogens family have highly ...P.. electron gain enthalpy. Here, P refers to
1) negative 2) positive 3) zero 4) infinity

50. Which one of these is basic ?
1) SiO2 2) SO2 3) CO2 4) Na2O

51. Which of the following sequence correctly represents the decreasing acidic nature of oxides?
1) $Li_2O > BeO > B_2O_3 > CO_2 > N_2O_3$ 2) $N_2O_3 > CO_2 > B_2O_3 > BeO > Li_2O$

3) $CO_2 > N_2O_3 > B_2O_3 > BeO > Li_2O$ 4) $B_2O_3 > CO_2 > N_2O_3 > Li_2O > BeO$

52. Which one of the following is an amphoteric oxide ?
1) Na_2O 2) SO_2 3) B_2O_3 4) ZnO

53. An element X occurs in short period having configuration $ns^2\ np^1$. The formula and nature of its oxide is
1) XO_3, basic 2) XO_3 acidic
3) X_2O_3, amphoteric 4) X_2O_3 basic

54. Which is chemically most active non-metal ?
1) S 2) O 3) F 4) N

55. Which is not the correct order for the stated property.
1) Ba > Sr > Mg ; atomic radius 2) F > O > N ; first ionization enthalpy
3) Cl > F > I ; electron affinity 4) O > Se > Te ; electronegativity

56. The correct order of acidic strength :
1) $Cl_2O_7 > SO_2 > P_4O_{10}$ 2) $K_2O > CaO > MgO$
3) $CO_2 > N_2O_5 > SO_3$ 4) $Na_2O > MgO > Al_2O_3$

57. The elements with zero electron affinity are
1) Boron and Carbon 2) Beryllium and Helium
3) Lithium and Sodium 4) Fluorine and Chlorine

58. Which is true about the electronegativity order of the following elements?
1) P > Si 2) C > N 3) Br > Cl 4) Sr > Ca

59. The element having very high ionization energy but zero electron affinity is
1) H 2) F 3) He 4) B

60. In the process, $C\ell(g) + e^- \xrightarrow{\Delta H} C\ell^{-1}(g); \Delta H$ is
1) positive 2) negative 3) zero 4) unpredictable

NEET PREVIOUS YEARS QUESTIONS

1. Magnesium reacts with an element (X) to form an ionic compound. If the ground state electronic configuration of (X) is 1*s*2 2*s*2 2*p*3, the simplest formula for this compound is (2018)
1) Mg_2X_3 2) MgX_2 3) Mg_3X_2 4) Mg_2X

2. The element Z = 114 has been discovered recently. It will belong to which of the following family/group and electronic configuration ? [2017]
1) Carbon family, [Rn] $5f^{14}6d^{10}7s^27p^2$ 2) Oxygen family, [Rn] $5f^{14}6d^{10}7s^27p^4$
3) Nitrogen family, [Rn] $5f^{14}6d^{10}7s^27p^6$ 4) Halogen family, [Rn] $5f^{14}6d^{10}7s^27p^5$

3. In which of the following options the order of arrangement does not agree with the variation of property indicated against it? [2016]
1) Al3+ < Mg2+ < Na+ < F– (increasing ionic size)
2) B < C < N < O (increasing first ionisation enthalpy)
3) I < Br < Cl < F (increasing electron gain enthalpy)
4) Li < Na < K < Rb (increasing metallic radius)

4. The formation of the oxide ion O2–(g), from oxygen atom requires first an exothermic and then an endothermic step as shown below : [2015]

$O(g) + e^- \rightarrow O^-(g); \Delta_f H^\Theta = -141 kJ\ mol^{-1}$

$O^-(g) + e^- \rightarrow O^{2-}(g); \Delta_f H^\Theta = +780 kJ\ mol^{-1}$

Thus process of formation of O2– in gas phase is unfavourable even though O2– is isoelectronic with neon. It is due to the fact that
1) Electron repulsion outweighs the stability gained by achieving noble gas configuration

2) O– ion has comparatively smaller size than oxygen atom
3) Oxygen is more electronegative
4) Addition of electron in oxygen results in larger size of the ion.

5. The species Ar, K+ and Ca2+ contain the same number of electrons. In which order do their radii increase? [2015]
1) Ca 2+ < Ar < K+ 2) Ca 2+ < K + < Ar 3) K + < Ar < Ca2+ 4) Ar < K + < Ca2+

6. Which of the following orders of ionic radii is correctly represented? [2014]
1) H– > H+ > H 2) Na+ > F– > O2– 3) F– > O2– > Na+ 4) Al3+ > Mg2+ > N3–

7. For the second period elements the correct increasing order of first ionisation enthalpy is :- [2019]
(1) Li < Be < B < C < N < O < F < Ne (2) Li < B < Be < C < O < N < F < Ne
(3) Li < B < Be < C < N < O < F < Ne (4) Li < Be < B < C < O < N < F < Ne

8. Match the oxide given in column A with its property given in column B: [NEET-2019-ODISSA]

Column-A	Column-B
(i) Na_2O	(a) Neutral
(ii) Al_2O_3	(b) Basic
(iii) N_2O	(c) Acidic
(iv) Cl_2O_7	(d) Amphoteric

Which of the following options has all correct pairs?
(1) (i)-(b), (ii)-(a), (iii)-(d), (iv)-(c) (2) (i)-(c), (ii)-(b), (iii)-(a), (iv)-(d)
(3) (i)-(a), (ii)-(d), (iii)-(b), (iv)-(c) (4) (i)-(b), (ii)-(d), (iii)-(a), (iv)-(c)

9. Match the element in column I with that in column II. [NEET-2020-COVID-19]

Column-I	Column-II
(a) Copper	(i) Non-metal
(b) Fluorine	(ii) Transition metal
(c) Silicon	(iii) Lanthanoid
(d) Cerium	(iv) Metalloid

Identify the correct match :
(1) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii) (2) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)
(3) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii) (4) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

10. Identify the incorrect match [**NEET** - 2020]

Named	**IUPAC official Name**
a) Urnilunium	i) Mendelevium
b) Unnibrium	ii) Lawrencium
c) Unnihexium	iii) Seaborgium
d) Unununnium	iv) Darmstadtium

1) d, iv 2) a, i 3) b, ii 4) c, iii

11. Zr (Z=40) and Hf(Z=72) have similar atomic and ionic radii because of **[NEET-2021]**
1) diagonal relationship 2) lanthanoid contraction
3) having similar chemical properties 4) belonging to same group

12. The IUPAC name of an element with atomic number 119 is **[NEET-2022]**
1) Ununennium 2) Unnilennium
3) Unununnium 4) ununoctium

NCERT LINE BY LINE QUESTIONS – ANSWERS

(1.)	d	**(2.)**	d	**(3.)**	b	**(4.)**	a	**(5.)**	d
(6.)	c	**(7.)**	a	**(8.)**	d	**(9.)**	d	**(10.)**	b
(11.)	c	**(12.)**	a	**(13.)**	a	**(14.)**	b	**(15.)**	a
(16.)	c	**(17.)**	c	**(18.)**	c	**(19.)**	d	**(20.)**	c
(21.)	c	**(22.)**	b	**(23.)**	d	**(24.)**	a	**(25.)**	c
(26.)	a	**(27.)**	b	**(28.)**	b	**(29.)**	c	**(30.)**	d
(31.)	b	**(32.)**	c	**(33.)**	d	**(34.)**	d	**(35.)**	b
(36.)	b	**(37.)**	a	**(38.)**	b	**(39.)**	b	**(40.)**	b
(41.)	a	**(42.)**	a	**(43.)**	b	**(44.)**	a	**(45.)**	b
(46.)	a	**(47.)**	b	**(48.)**	b	**(49.)**	a	**(50.)**	a

TOPIC WISE PRACTICE QUESTIONS - ANSWERS

1) 4	**2)** 1	**3)** 3	**4)** 3	**5)** 2	**6)** 3	**7)** 4	**8)** 4	**9)** 3	**10)** 2
11) 3	**12)** 2	**13)** 3	**14)** 2	**15)** 4	**16)** 2	**17)** 2	**18)** 1	**19)** 2	**20)** 1
21) 1	**22)** 2	**23)** 1	**24)** 1	**25)** 2	**26)** 3	**27)** 2	**28)** 1	**29)** 1	**30)** 1
31) 1	**32)** 3	**33)** 1	**34)** 4	**35)** 4	**36)** 3	**37)** 3	**38)** 3	**39)** 2	**40)** 2
41) 4	**42)** 2	**43)** 4	**44)** 1	**45)** 4	**46)** 1	**47)** 2	**48)** 4	**49)** 1	**50)** 4
51) 2	**52)** 4	**53)** 3	**54)** 3	**55)** 2	**56)** 1	**57)** 2	**58)** 1	**59)** 3	**60)** 2

NEET PREVIOUS YEARS QUESTIONS-ANSWERS

1) 3	**2)** 1	**3)** 3	**4)** 1	**5)** 2	**6)** 2	**7)** 2	**8)** 4	**9)** 2	**10)** 1
11) 2	**12)** 1								

NCERT LINE BY LINE QUESTIONS – SOLUTIONS

(1.) (d) Beryllium is a metal, while silicon, germanium, arsenic, antimony and Tellurium are considered metalloids and they have characteristics of both metals and non-metals. The elements become more metallic as we go down a group, the nonmetallic character increases as one goes from left to right across the periodic table.

(2.) (d) Among the given elements from period 2 of the periodic table, Ne has maximum first ionization enthalpy because of closed electron shells and very stable electron configurations.

(3.) (b) According to Dobereiner's law of triads, the atomic weight of sodium is 23.

Assertion-Reason Type questions

(4.) (a) The correct order of size of the given species is

$I^- > I > I^+$

(5.) (d) The sixth period $(n = 6)$ contains 32 elements and successive electrons enter $6s, 4f, 5d$ and $6p$ orbitals, in the order of filling up of the $4f$ orbitals, it begins with cerium $(z = 58)$ and ends at lutetium $(z = 71)$ to give the 4*f*- inner transition series which is called the lanthanoid series.

(6.) (c) The size of an anion will be larger than that of the parent atom because the addition of one or more electrons would result in increased repulsion among the electrons and a decrease in effective nuclear charge.

(7.) (a) Al_2O_3 is amphoteric oxide. Amphoteric oxides behave as acidic with bases and as basic with acidic.

(8.) (d) The inner transition elements are all metals within each series, the properties of the elements are quite similar. The chemistry of the early actinoids is more complicated than the corresponding lanthanoids, due to the large number of oxidation states possible for these actinoid elements.

(9.) (d) Element 106 has been named seaborgium (S*g*) in his honour.

(10.) (b) Reactivity of the group 1 elements increases down the group.

(11.) (c) All the orbitals in the valence shell of the noble gases are completely filled by electrons and it is very difficult to alter this stable arrangement by the addition or removal of electrons. The noble gases thus exhibit very low chemical reactivity.

(12.) (a) The period number in the long form of the periodic table is equal to maximum principal quantum number of any element of the period.

Assertion-Reason Type Questions

(13.) 43.(a) The oxidation state of Al is $+3$ and the covalency is 6.

(14.) (b) IUPAC official name and symbol of the element atomic number $\log$ is Meitnerium (Mt).

(15.) (a) $Na_2O - Basic$

$Al_2O_3 - Amphoteric$

$N_2O - Neutral$

$Cl_2O_7 - Acidic$

Assertion-Reason Type questions

(16.) (c) Among the given periodic trends, atomic radius increases down the group. Remaining other trends, electronegativity, ionization enthalpy, electron gain enthalpy, decrease down the group.

(17.) 20.(c) A quantitative measure of the tendency of an element to lose electron is given by its ionization enthalpy. It represents the energy required to remove an electron from an isolated gaseous atom in its ground state.

(18.) (c) The elements gallium and germanium were unknown at the time Mendeleev published his periodic table.

(19.) (d) The elements become more metallic as we *go* down a group, the non-metallic character increases as one goes from left to right across the periodic table.

(20.) (c) The radii can be estimated by measuring the distance between cations and anions in ionic crystals.

(21.) (c) A qualitative measure of the ability of an atom in a chemical compound to attract shared electrons to itself is called electronegativity.

(22.) (b) In metal moving down the group metallic character increases so basic nature increases, hence most acidic will be BeO.

(23.) (d) The order of filling up of the 4f orbitals begins with cerium (*Ce*) $(z = 58)$ and ends at lutetium (Lu) $(z = 71)$ to give the 4f - inner transition series which is called the lanthanoid series.

(24.) (a) 3d series elements started from scandium $(z = 21)$ which has electronic configuration $3d^1 2s^2$. The 3d orbitals are filled at zinc $(z = 30)$ with electronic configuration $3d^{10} 2s^2$.

(25.) (c) Electronegativity is not a measurable quantity, while ionization enthalpy and electron gain enthalpies are measurable quantity. However, a number of numerical scales of electronegativity of elements like Pauling scale, Mulliken-Jaffe scale, Allred-Rochow scale have been developed.

(26.) (a) According to Mendeleev's periodic table, boron has formula B_2O_3 or R_2O_3.

(27.) (b) In general, ionization enthalpies decrease as we descend in a group.

(28.) (b) Within a group, the reactivity increases down the group, whereas within group of non-metals, halogens, reactivity decreases down the group.

(29.) (c) The p-block elements comprise with s-block elements are called the representative elements or main group elements.

(30.) (d) Energy is always required to remove electrons from an atom and hence ionization enthalpies are always positive. The second ionization enthalpy will be higher than the first ionizarion enthalpy because it is more difficult to remove an electron from a positively charged ion than from a neutral atom.

(31.) (b) Maximum 18 elements can be accommodated in the fifth period of the periodic table.

(32.) (c) Na^+, F^- and O^{2-} are isoelectronic species because it consists of same number of electrons.

(33.) (d)

Eu :	$[Xe]4f^7 6s^2$
Gd :	$[Xe]4f^7 5d^1 6s^2$
Tb :	$[Xe]4f^9 6s^2$

(34.) (d) The physical and chemical properties of the elements are periodic functions of their atomic numbers.

(35.) (b) The d-block elements in the periodic table lie in the group from 3 to 12.

(36.) (b) The distribution of electrons into orbitals of an atom is called its electronic configuration.

(37.) (a) Among the given statements option (a) is correct with respect to electronegativity, metallic and non-metallic character of the elements.

(38.) (b) In 1913 the English physicist Henry Moseley observed regularities in the characteristic X-ray spectra of the element. A plot of $\sqrt{\nu}$ (where ν is frequency of X-rays emitted) against atomic number (z) gave a straight line and not the plot of $\sqrt{\nu}$ vs atomic mass.

(39.) (b) The second ionization enthalpy will be higher than the first ionizaoon enthalpy because it is more difficult to remove an electron from a positively charged ion than from a neutral atom.

(40.) (b) Fourth period ended with element of Krypton.

(41.) (a) Among the given groups, halogen group of elements has highly negative electron gain enthalpies and readily add one electron to attain the stable noble gas configuration.

(42.) (a) The cation with the greater positive charge will have a smaller radius because of the greater attraction of the electrons to the nucleus. Whereas the anion with the greater negative charge will have the larger radius.

(43.) (b) Transition elements in the periodic table started from the atomic number $(z = 21)$, scandium.

(44.) (a) The atomic size generally decreases across a period. It is because within the period the outer electrons are in the same valence shell and the effective nuclear charge increases as the atomic number increases, resulting in the increased attraction of electrons to the nucleus.

(45.) (b) The two rows of elements at the bottom of the periodic table, called the lanthanoids Ce (Z = 58) - Lu (Z = 7l) and actinoids, Th (Z=90)-Lr (Z= 103) are characterized by the outer electronic configuration $(n-2)f^{1-14}(n-1)d^{0-1}ns^2$. The elements after uranium are called trans-uranium elements.

(46.) (a) The d-block, transition, elements exhibit variable oxidation states.

(47.) (b) Correct order of electronegativity of the given elements is $F > O > Na$.

(48.) (b)

Element	Electronegativity value
Si	1.8
S	2.5
Be	1.5
Mg	1.2

(49.) (a) Electronic configuration of gadolinium (Gd) is [Xe] $4f^7 5d^1 6s^2$.

(50.) (a) Henry Moseley observed regularities in the characteristic x-ray spectra of the elements. A plot of $\sqrt{\nu}$ (where ν is frequency of x-rays emitted) against atomic number (Z) gave a straight line and not the plot of $\sqrt{\nu}$ vs atomic mass. He thereby showed that the atomic number is a more fundamental property of an element than its atomic mass.

TOPIC WISE PRACTICE QUESTIONS - SOLUTIONS

1. (4) Chloride formulas

   (i) Eka-Aluminium = $GaCl_3 (ECl_3)$

   (ii) Eka-Silicon = $GeCl_4 (ECl_4)$

   Mendeleev arranged elements in horizontal rows and vertical columns of a table in order to their increasing atomic weights.

2. (1) The s and p–block elements are collectively known as representative elements.

3. (3) The magic number is 2, 8, 8, 18, 18, 32 according to which the elements are arranged in the periodic table. As the atomic number of the element is 10, so, it will resemble the elements with atomic number = 10 – 8 = 2,
   10 + 8 = 18, 18 + 18 = 36, 36 + 18 = 54. This element resembles the element with atomic number 2, 54.

4. (3) atomic number 9 is for F so its halogen series.

5. (2) Z = 114 belong to group 14, carbon family electronic configuration $[Rn]5f^{14}6d^{10}7s^2 7p^2$

6. (3) Hydrogen is the most abundant element in the universe. The order of abundance of given elements in the universe is H > O > C > N

7. (4) Electronic configuration : $[Kr]4d^{10}5s^1$; period = 5^{th} ;group = 10 + 1 = 11^{th}

8. (4) 38 is the atomic no. of stronium (Sr) which is s-block element and all the elements of s-block are metals.

9. (3)

Digit	Name
1	un
4	quad

   Using above notation IUPAC name of element 114 is Ununquadium.

10. (2) Electronic configuration of element with atomic number 118 will be $[Rn]5f^{14}6d^{10}7s^{2}7p^{6}$. Since its electronic configuration in the outer most orbit $(ns^{2}np^{6})$ resemble with that of inert or noble gases, therefore it will be noble gas element.
11. (3) Element with Z = 33
$(1s^{2}2s^{2}p^{6}3s^{2}p^{6}d^{10}4s^{2}p^{3})$ lies in fifth (or 15^{th}) group.
12. (2)
13. (3) Halogens are most electronegative elements i.e., they are likely to form anions most readily.
14. (2) Its valence shell has 5 electrons (ns^{2}, np^{3}). It belongs to 5th group of the periodic table.
15. (4) Barium has atomic number 56. It is an alkaline earth metal i.e., found in *s*-block.
16. (2) Na and Cl both belongs to III period.
17. (2) Cu, Ag and Au are coinage metals. They belong to group IB (*d*-block) of periodic table
18. (1) Seventh period includes most of the man-made radioactive elements.
19. (2)
20. (1) By observing principal quantum number (n). Orbital (*s*, *p*, *d*, *f*) and equating no. of e–'s we are able to find the period, block and group of element in periodic table.
21. (1) Tc^{43} is the first artificial element.
22. (2) $F^{-} < O^{2-} < N^{3-}$
23. (1) Energy is supplied in order to remove electron from atoms. So energy of atom increases when electron is removed from atom.
24. (1)
25. (2) When we move down the group, atomic size increases, distance between nucleus and valence shell electron increases and ionisation energy decreases.
26. (3) Ionisation potential increases while moving in a period.

Group	V	VI	VII	VIII
Element	N	O	F	Ne

Oxygen (group 6) has low ionisation potential than N (group 5) because of stable configuration of nitrogen (half-filled p-orbital)
27. (2) In case of halogens covalent radius is considered this bond is formed by overlapping of electron clouds; while noble gases remain monoatomic, in this case only way to obtain radius is through van der Waal radii.
28. (1) Ionic radii are inversely proportional to effective nuclear charge.
Ionic radii in the nth orbit is given as

$$r_n = \frac{n^2 a_0}{Z} \text{ or } r_n \propto \frac{1}{Z}$$

when n = principal quantum number
Z-effective nuclear change.
29. (1) O^{--} and F^{-} are isoelectronic. Hence have same number of shells, therefore greater the nuclear charge smaller will be the size i.e., $O^{--} > F^{-}$
further Li^{+} and B^{3+} are isoelectronic. therefore
$Li^{+} > B^{3+}$
Hence the correct order of atomic size is.
$O^{--} > F^{-} > Li^{+} > B^{3+}$
30. (1) (i) Noble gases do not have covalent radii. They have only van der Waal's radii.
(ii) Covalent radii is always smaller than
corresponding van der Waal's radii
Atomic radius of neon being van der Waal's radius is larger than that of fluorine which is in fact is its covalent radius.
31. (1) Higher the screening effect, lower is the I.E.

32. (3) Greater than the first ionization energy because after removal of one e^-, effective nuclear charge increases.

33. (1) In case of Ga there are 10d-electrons in the penultimate energy shell which shield the nuclear charge less effectively, the outer electron is held firmly by nucleus. As a result, the ionisation energy remains nearly the same as that of aluminium inspite of the fact that atomic size increases.

34. (4) P^{5+} has more effective nuclear charge and smaller size than P^{3+}.

35. (4) $[Ar]3d^5 4s^2$ due to half-filled configuration (d^5), higher energy is required to removal of electron compared to other elements.

36. (3) Covalent radius is radius of an atom in its bound state i.e., in fluorine it is half of distance between two covalently bonded fluorine atoms; van der Waal radii is one-half of the distance between the nuclei of two identical non-bonded isolated atoms. These atoms are attracted toward each other through weak van der Waal's force hence van der Waal radii are very large.

37. (3) In general, the atomic and ionic radii increases on moving down in a group. But the element of second transition series (eg., Zr, Nb, Mo etc.,) have the almost same radii as the elements of third transition series (eg. Hf, Ta, W etc.). This is because of lanthanide contraction.

38. (3) As we move along the period, the atomic size decreases due to increase in nuclear charge. Therefore, it is more difficult to remove electron from an atom. Hence the sequence of first ionization enthalpy in decreasing order is
F > N > C > B > Be
But ionization enthalpy of boron is less as compared to beryllium because first electron in boron is to be removed from p-orbital while in beryllium, is to be removed from s-orbital. As s-orbital is closer to nucleus in comparison to p-orbital thus energy required to remove an electron from s-orbital is greater.

39. (2) The second ionization potential means removal of electron from cation
$C^+ = 1s^2 2s^2 2p^1, N^+ = 1s^2 2s^2 2p^2$
$O^+ = 1s^2 2s^2 2p^3, F^+ = 1s^2 2s^2 2p^4$
Therefore O > F > N > C

40. (2) In the isoelectronic species, all isoelectronic anions belong to the same period and cations to the next period.

41. (4) The decrease in size of inner d-subshell due to added electrons and their shielding effect on the outer most electrons from the nuclear charge almost compensate for Cr, Mn, Fe and Co.

42. (2) Radii of anions carrying same charge decrease from left to right in a period and increase down the group.

43. (4) Barring few exceptions, ionization potential decreases down the group.

44. (1) Electron affinity is energy released when electron is added to isolated gaseous atom. Its value decreases down the group. So electron affinity of F should be highest among halogens but due to its smaller size electron affinity of Cl is more than F.
$\therefore$ Cl has highest electron affinity.

45. (4)

W : Phosphorus	Y : Oxygen	X : Sulphur	Z : Chlorine
Electronegativity	O > Cl > S > P	Catenation :	S > P > O > Cl
Electron Affinity :	Cl > O > S > P	Oxygen exhibits covalency of two only	

46. (1) Zero, because of the stable electronic configuration the noble gases do not show any force of attraction towards the incoming electron.

47. (2) An atom with high electronegativity has high IP.

48. (4) The stability of +1 oxidation state increases from aluminium to thallium i.e.
Al < Ga < In < Tl

49. (1) The halogen (group-17) and the chalcogens (group-16) are two groups of elements having highly negative electron gain enthalpies.

50. (4) Basicity of oxides decreases in a period from left to right. Na_2O is basic oxide, CO_2, SiO_2 and SO_2 are acidic oxides. Alternatively, oxides of metals (e.g., Na_2O) are basic, while oxides of non-metals (SO_2, SiO_2 and CO_2) are acidic.
51. (2) On passing from left to right in a period acidic character of the normal oxides of the elements increases with increase in electronegativity.
52. (4) Na_2O (basic), SO_2 and B_2O_3 (acidic) and ZnO is amphoteric.
53. (3) n*s*2 *p*1 is the electronic configuration of III A period.
Al2O3 is amphoteric oxide.
54. (3) F_2 has highest electronegativity, so it is chemically most active non metal.
55. (2) On moving along the period, ionization enthalpy increases. In second period, the order of ionization enthalpy should be as follows :
F > O > N.
But N has half-filled structure, therefore, it is more stable than O. That is why its ionization enthalpy is higher than O. Thus, the correct order of IE is
F > N > O.
56. (1) Acidic character of oxide μ Non-metallic nature of element. Non-metallic character increases along the period. Hence order of acidic character is
$Cl_2O_7 > SO_2 > P_4O_{10}$.
57. (2) Fully filled electronic configuration
58. (1) P > Si electronegativity increases along the period.
59. (3) He has zero EA because of its completely filled subshells ($1s^2$).
60. (2) The process represents the first electron affinity which is always exothermic. Hence ΔH is negative.

NEET PREVIOUS YEARS QUESTIONS-EXPLANATIONS

1. (3) Element (X) electronic configuration
$1s^2 2s^2 2p^3$
So, valency of X will be 3.
Valency of Mg is 2.
Formula of compound formed by Mg and X will be Mg_3X_2.
2. (1) Z = 114 belong to Group 14, carbon family
Electronic configuration
$=[Rn]5f^{14}6d^{10}7s^2 7p^2$
3. (2, 3)The correct order is
B < C < O < N
Generaly ionisation energy increases across a period. But here first I.E. of O is less than the first I.E. of N. This is due to the half-filled 2*p* orbital in N $(1s^2 2s^2 2p^3)$ which is more stable than the 2*p* orbital in O $(1s^2 2s^2 2p^4)$
(3) The correct order of electron affinity is I < Br < F < Cl
Halogens have high electron affinities which decreases on moving down the group. However, fluorine has lower value than chlorine which is due to its small size and repulsion between the electron added and electrons already present.
4. (1) Incoming electrons occupies the smaller n = 2 shell, also negative charge on oxygen (O^-) is another factor due to which incoming electron feel repulsion. Hence electron repulsion outweigh the stability gained by achieving noble gas configuration.
5. (2) In isoelectronic species the radius decrease with increase in nuclear charge
hence increasing order of radius is $Ca^{+2} < K^+ < Ar$
6. (N) All answers are incorrect.
7. 2)For same shell

$[s^1 < p^1 < s^2 < p^2 < p^4 < p^3 < p^5 < p^6]$

Li < B < Be < C < O < N < F < Ne

8. 4) $Na_2O \rightarrow$ Basic

$Al_2O_3 \rightarrow$ Amphoteric

$N_2O \rightarrow$ Neutral

$Cl_2O_7 \rightarrow$ Acidic

9. 2) Copper – Transition metal

Fluorine – Non metal

Silicon – Metalloids

erium – Lanthanoid

10. 1)Ununnium (Z= 111) is officially name as Roentgenium

11. 2)The cumulative effect of the contraction of the lanthanoid series, known as lanthanoid contraction, causes the radii of the members of the third transition series to be very similar to those of the corresponding members of the second series.

The almost identical radii of Zr (160 pm) and Hf (159 pm) is a consequence of the lanthanoid

12: 119- Ununennium