

Chapter = 03

Periodic Table and Periodicity of Properties

Q1) State Dobereiner's triad with two examples.

DOBEREINER'S TRIAD



Dobereiner's arranged the element in increasing order of atomic masses. He found that the atomic mass of the middle element was approximately equal to the arithmetic mean (average) of the atomic masses of the other two elements of that triad when they are arranged in their increasing order of atomic mass,

EXAMPLE

Lithium	7		Calcium	40	
Sodium	23	$\frac{7+39}{2} = 23$	Strontium	87	$\frac{40+137}{2} = 88$
Potassium	39		Barium	137	

Q2) State Newland law of octaves with example.

NEWLAND LAW OF OCTAVES

In 1864 British chemist Newland put forward Law of Octaves in order of increasing atomic masses.

STATEMENT

According to him eighth element has similar properties as first element in group of eight elements.

FOR EXAMPLE:

Li=7	Be=94	B=11	C=12	N=14	O=16	F=19
Na=23	Mg 24	Al=27.3	Si=28	P=32	C=35.5	

In the above arrangement Li and Na, Be and Mg, B and Al, C and Si, N and P, O and S, F and Cl shows same chemical properties.

Q3) State Mendeleev periodic law.

MENDELEEV PERIODIC LAW.

In 1869 Mendeleev published eight vertical columns(groups) and horizontal rows(periods)on the basis of physical and chemical properties of elements. In 1869 German scientist Luther Meyer published a periodic table in which 56 elements were arranged in 9 vertical columns or groups on the basis of atomic masses.

STATEMENT

He state that

“Physical and chemical properties are the periodic function of the atomic masses or atomic weight”

Q4) When and by whom modern periodic able was proposed. Also state the law.



MODERN PERIODIC LAW

In 1913 Moseley discovered that Atomic number is the basic property of an atom. He proposed a modern periodic law.

STATEMENT The Moseley states that

“The Physical and chemical properties of elements are the periodic function of their atomic numbers”

Q5) Define Periods in Periodic Table. Also discuss the period in modern periodic table.

PERIODS IN PERIODIC TABLE:

There are seven horizontal lines in periodic table known as periods. In periods physical and chemical properties changes from left to right.

FIRST PERIOD (SHORTEST PERIOD)

- This period contains only two elements Hydrogen (H) and Helium (He).
- K-shell is filled in this period.

SECOND AND THIRD PERIOD(SHORT PERIOD)

- Each period contains eight elements.
- In these Periods L and M shells are being filled by electrons.
- Second period contains Li, Be, B, C, N, O, F and Ne.
- Third period contains Na, Mg, Al, Si, P, S, Cl, and Ar.

FOURTH AND FIFTH PERIOD(LONG PERIOD)

- Each period contain 18 elements.
- In these periods M and N shells are being filled by electrons.
- Fourth period starts from Potassium (K) and ends on Krypton (Kr).
- Fifth period starts from Rubidium (Rb) and ends on Xenon (Xe).

SIXTH PERIOD(LONGEST PERIOD)

- This period contains 32 elements.
- The 14 elements in the bottom are named as Lanthanides.
- Sixth period starts from Cesium (Cs) and ends with Radon (Rn).

SEVENTH PERIOD (INCOMPLETE PERIOD)

- This period starts from Francium (Fr)
- This period is considering as incomplete.
- This period contains a group of 14 elements known as Actinides

Q6) Define Groups in Periodic Table. Give properties of each group of modern periodic table

GROUPS IN PERIODIC TABLE:



- There are Eight vertical columns in periodic table known as groups.
- The sub groups are divided on the basis of their similar properties as A and B and placed together in periodic table.
- The elements of sub group A are called Main or Representative Elements.
- The elements of sub group B are called Transition Elements.
- The group number indicate total number of electrons in valence shell of the element.

GROUP I A (ALKALI METAL) OR LITHIUM FAMILY:

- This Group include Lithium (Li), Sodium (Na), Potassium (K), Rubidium (Rb), Cesium (Cs) and Francium (Fr).
- Their Valence shell contain one electron.
- On reaction they lose one electron and form univalent positive ion.
- They are highly reactive metals.
- They have low melting point.

GROUP II ALKALINE EARTH METALS OR BERYLIUM FAMILY:

- This Group include Beryllium (Be), Magnesium (Mg), Calcium (Ca), Strontium (Sr), Barium (Ba) and Radium (Ra)
- Their Valence shell contain two electrons.
- On reaction they lose two electrons and form divalent positive ion.
- They show irregular Densities, Melting and Boiling point.

GROUP III A (BORON FAMILY):

- This Group include Boron (B), Aluminum (Al) Boron (B) Gallium (Ga), Indium (In) And Thallium (Ti).
- Their valence shell contains three electrons.
- On reaction they lose three electrons and form trivalent positive ion except Boron.

GROUP IV A (CARBON FAMILY)

- This Group include carbon (C), silicon (Si), Germanium (Ge), Tin (Sn) and Lead (Pb).
- Their valence shell contains four electrons.
- C, Si and Ge form covalent bond, whereas Sn and Pb exhibit variable Valence 2 and 4.

- Carbon is nonmetal, Silicon, Germanium are metalloids and Tin and Lead are metals.

GROUP V A(NITROGEN FAMILY) :

- This Group include Nitrogen (N), Phosphorus (P), Arsenic (As), Antimony (Sb) and Bismuth (Bi).
- Their valence shell contains five electrons.
- They show large variations in their properties as we go down the group.
- Except Nitrogen all exist in allotropic form.



GROUP VI A(OXYGEN FAMILY)

- This Group include Oxygen(O), Sulphur (S), Selenium (Se), Tellurium (Te) and Polonium (Po).
- Their valence shell contains six elements.
- All of these elements exist in allotropic forms.
- Oxygen and sulphur are nonmetals, polonium is metal and all other are metalloids.

GROUP VII A(HALOGEN FAMILY):

- This Group include Fluorine (F), Chlorine (Cl), Bromine (Br), Iodine (I) and Astatine (At).
- Their valence shell contains seven electrons.
- Except arsenic(metal) all are nonmetals,
- Fluorine and chlorine are gases, bromine is liquid and iodine is solid at room temperature.

GROUP VILLA(INERT OR NOBEL GASES):

- This Group include Helium(He), Neon(Ne), Argon[Ar], Krypton (Kr) Xenon(Xe) and Radon(Rn).
- Their valence shell contain eight electrons except Helium which contain two electrons.

GROUP 1B TO VILL B(TRANSITION ELEMENTS):

- These Groups are metals.
- In chemical reactions they show Variable valences.
- Their valence shells are incomplete.

Q7) Distinguish between periods and groups

<u>Period</u>	<u>Group</u>
Horizontal agreement in periodic table is known as period	Vertical agreement in periodic table is known as group
There are seven horizontal columns in periodic table known as periods	There are Eight vertical columns in periodic table known as groups
In periods physical and chemical properties changes from left to right	In periods physical and chemical properties changes from top to bottom

Period number indicate the number of shells in an element

Group number indicate the valance shell electronic configuration

Q8) Discuss in detail the long form of periodic table.

LONG FORM OF PERIODIC TABLE

The periodic table has been divided into four blocks s, p, d, and f based on electronic configuration.

NOBEL GASES:



- They are colorless, unreactive and diamagnetic,
- They are placed in zero group.
- Their electronic configuration is ns^2, np^6 and are exceptionally stable.

REPRESENTATIVE ELEMENTS

- Elements of s block and d block are known as representative elements.
- It includes metals and nonmetals. Some are diamagnetic and some are paramagnetic and marked as S block and P block elements.

(A) S-BLOCK ELEMENTS:

- In s block elements electrons occupy in ns orbital.
- The elements of group I A and II A are s block elements.
- Their electronic configuration varies ns^1 to ns^2

(B) P-BLOCK ELEMENTS:

- In p block elements electrons begin to fill np^1 to np^6
- Elements of group III A to VII A and zero group are p block elements.

(C) D-BLOCK ELEMENT (OUTER TRANSITION ELEMENTS):

- The Elements exhibit common oxidation state.
- In these elements electron fills in (n-1)d-orbital.
- Elements of B sub groups are d-block elements
- They exhibit electronic configuration $ns^2, (n-1) d^1$ to $ns^2, (n-1) d^{10}$

(D) F-BLOCK ELEMENTS (INNER TRANSITION ELEMENTS):

- The elements in which inner f-orbital filled, are called f block elements.
- They exhibit electronic configuration: $ns^2, (n-1) d^{10}, (n-2) f^1$ to $ns^2, (n-1) d^{10}, (n-2) f^{14}$.
- There are two series called Lanthanides and Actinides
- Elements of Group III B are considered to be f-block elements.

Q9) Define Atomic Radius. How it increases and decrease. Also give example

ATOMIC RADIUS

The distance between the centers of two bonded atoms of any elements. Half of this distance is considered to be the radius of the atom. It is measured in Angstrom unit (\AA)

EXAMPLE Atomic radii decrease in period

2nd Periods elements	Li	Be	B	C	N	O	F	Ne
Atomic radii (pm)	152	113	88	77	75	73	71	69

ATOMIC RADII INCREASES IN GROUP

1st group elements	Atomic radii (pm)
${}^3\text{Li}$	152
${}^{11}\text{Na}$	186
${}^{19}\text{K}$	227
${}^{37}\text{Rb}$	248
${}^{55}\text{Cs}$	265

Q10) Define Ionization energy. How it increases and decrease. Also give example

IONIZATION ENERGY

The ionization energy is amount or energy required to remove an electron from a gaseous state and measured in joule mole.

The ionization energy depends upon atomic size and nuclear charge. The higher ionization energy means removal of electron is more difficult.

EXAMPLE

IONIZATION ENERGY INCREASES IN PERIOD

Elements of 2 nd periods	${}^3\text{Li}$	${}^4\text{Be}$	${}^5\text{B}$	${}^6\text{C}$	${}^7\text{N}$	${}^8\text{O}$	${}^9\text{F}$	${}^{10}\text{Ne}$
i.E in KJ/mol	520	899	801	1086	1402	1314	1681	2081

IONIZATION ENERGY DECREASES IN GROUP

1ST GROUP ELEMENTS	ATOMIC RADII (PM)
${}^3\text{Li}$	520
${}^{11}\text{Na}$	496
${}^{19}\text{K}$	416
${}^{37}\text{Rb}$	403
${}^{55}\text{Cs}$	377

Q11) Define electron affinity. How it increases and decrease. Also give example

ELECTRON AFFINITY

The electron affinity is amount of energy released when an electron is added in the outermost shell of a gaseous atom. It is also calculated in K J/mol.

EXAMPLE

ELECTRON AFFINITY INCREASES IN PERIOD

Elements of 2 nd periods	³ Li	⁴ Be	⁵ B	⁶ C	⁷ N	⁸ O	⁹ F	¹⁰ Ne
E.A (kJ/mol)	60	241	29	123	0	141	322	-29

ELECTRON AFFINITY DECREASES IN GROUPS

Elements of 17 th group	Electron Affinity(KJ/mol)
F	-328
Cl	-349
Br	-325
I	-295

Q12) Define shielding effect. How it increases and decrease. Also give example

SHIELDING EFFECT:

“Electrons present in the inner shells Shield the force of attraction of nucleus felt by the valence shell electrons is called Shielding effect.”

The Shielding effect increases down the group in periodic table and remain same in period from left to right.

EXAMPLE

Shielding effect in potassium atom is more than sodium atom.

Q13) Define electronegativity. How it increases and decrease. Also give example

ELECTRONEGATIVITY:

The ability of an atom to attract the shared pair of electrons towards itself in a molecule is called electronegativity. The trend of electronegativity is same as ionization energy and electron affinity.

Electronegativity Increases in periods

EXAMPLE

ELECTRONEGATIVITY INCREASES IN PERIOD

Elements of 2 nd periods	³ Li	⁴ Be	⁵ B	⁶ C	⁷ N	⁸ O	⁹ F
Electronegativity	1.0	1.6	2.0	2.6	3.0	3.4	4.0

ELECTRONEGATIVITY DECREASES IN GROUP

Elements of 17 th group	Electronegativity
F	4.0
Cl	3.2
Br	3.0
I	2.7

Q1. Give valence shell Electronic of:

I-A	
II-A	
III-A	
IV-A	
V-A	
VI-A	
VII-A	
VIII-A	
Nobel gas	
s-block	
p-block	
d-block	
f-block	

Q2. Identify the electronic configuration of the following elements.

- | | | | |
|-------|------|------|-------|
| 1. Na | 3. F | 5. C | 7. Cl |
| 2. Ca | 4. H | 6. O | 8. Mg |

Periodic Table of the Elements

Number		Symbol		Name		Mass				
1	H	Hydrogen	1.008	2	He	Helium	4.003			
3	Li	Lithium	6.941	4	Be	Beryllium	9.012			
11	Na	Sodium	22.990	12	Mg	Magnesium	24.305			
13	B	Boron	10.811	14	C	Carbon	12.011			
15	N	Nitrogen	14.007	16	O	Oxygen	15.999			
17	F	Fluorine	18.998	18	Ne	Neon	20.180			
19	K	Potassium	39.098	20	Ca	Calcium	40.078			
21	Sc	Scandium	44.956	22	Ti	Titanium	47.867			
23	V	Vanadium	50.942	24	Cr	Chromium	51.995			
25	Mn	Manganese	54.938	26	Fe	Iron	55.845			
27	Co	Cobalt	58.933	28	Ni	Nickel	58.693			
29	Cu	Copper	63.546	30	Zn	Zinc	65.38			
31	Ga	Gallium	69.723	32	Ge	Germanium	72.631			
33	As	Arsenic	74.922	34	Se	Selenium	78.971			
35	Br	Bromine	79.904	36	Kr	Krypton	83.798			
37	Rb	Rubidium	85.468	38	Sr	Strontium	87.62			
39	Y	Yttrium	88.906	40	Zr	Zirconium	91.224			
41	Nb	Niobium	92.906	42	Mo	Molybdenum	95.95			
43	Tc	Technetium	98.907	44	Ru	Ruthenium	101.07			
45	Rh	Rhodium	102.906	46	Pd	Palladium	106.42			
47	Ag	Silver	107.868	48	Cd	Cadmium	112.414			
49	In	Indium	114.818	50	Sn	Tin	118.710			
51	Sb	Antimony	121.760	52	Te	Tellurium	127.6			
53	I	Iodine	126.904	54	Xe	Xenon	131.293			
55	Cs	Cesium	132.905	56	Ba	Barium	137.328			
57-71	Lanthanide Series						72	Hf	Hafnium	178.49
73	Ta	Tantalum	180.948	74	W	Tungsten	183.84			
75	Re	Rhenium	186.207	76	Os	Osmium	190.23			
77	Ir	Iridium	192.217	78	Pt	Platinum	195.085			
79	Au	Gold	196.967	80	Hg	Mercury	200.592			
81	Tl	Thallium	204.383	82	Pb	Lead	207.2			
83	Bi	Bismuth	208.980	84	Po	Polonium	[209]			
85	At	Astatine	[209]	86	Rn	Radon	[222]			
87	Fr	Francium	[223]	88	Ra	Radium	[226]			
89-103	Actinide Series						104	Rf	Rutherfordium	[261]
105	Db	Dubnium	[262]	106	Sg	Seaborgium	[266]			
107	Bh	Bohrium	[264]	108	Hs	Hassium	[269]			
109	Mt	Mendelevium	[278]	110	Ds	Darmstadtium	[281]			
111	Rg	Roentgenium	[280]	112	Cn	Copernicium	[285]			
113	Nh	Nihonium	[286]	114	Fl	Flerovium	[289]			
115	Mc	Moscovium	[289]	116	Lv	Livermorium	[293]			
117	Ts	Tennesine	[294]	118	Og	Oganesson	[294]			

Alkali Metal Alkaline Earth Transition Metal Basic Metal Metalloid Nonmetal Halogen Noble Gas Lanthanide Actinide

- Identify and list down the solid, liquid and gases at room temperature from the given periodic table.
- Identify and name the artificial elements from the periodic table gives above.
- Identify and list down the radioactive elements.
- Identify alkali, alkaline, transition metals.
- Identify and list down metalloids, lanthanide and actinide.

MULTIPLE CHOICE QUESTIONS

Tick Mark the correct answer

1. In 1869 Mendeleev put forward his periodic law about:

- (a) Atomic Number (b). Chemical properties (c) Physical properties (d). Atomic Mass

2. The periodic table divided into S, P, d, and f block based on.

- (a) Atomic Radius (b). Electronic Configuration
(c) Ionization Energy (d). Electron Affinity

3. 4th and 5th period in periodic table are known as:

- (a) Short period (b). Long period (c) Normal period (d). Very long period

4. Which one of the following decreases along the period?

- (a) Ionization Energy (b). Atomic Radius (c) Electronegativity (d). Electron Affinity

5. The elements of VIIA group are known as:

- (a) Lanthanides (b). Actinides (c) Halogens (d). Nobel Gases

6. According to Mosely the chemical properties of elements are the periodic function of their :

- (a) Atomic Size (b). Atomic Mass (c) Atomic Radius (d). Atomic Number

7. The shielding effect across the period.

- (a) Increases (b). Decrease (c) Moderate (d). Same

8. The ability to attract shared pair of electrons is called:

- (a) Electron Affinity (b). Electronegativity (c) Ionization Energy (d) Shielding Effect

9. In group electron affinity values decreases from top to bottom because:

- (a) Atomic size normal (b) Atomic size increases (c) Atomic size decreases (d) Atomic size same

10. All Transition Elements are:

- (a) Gases (b) Metals (c) Nonmetals (d) Metalloids

