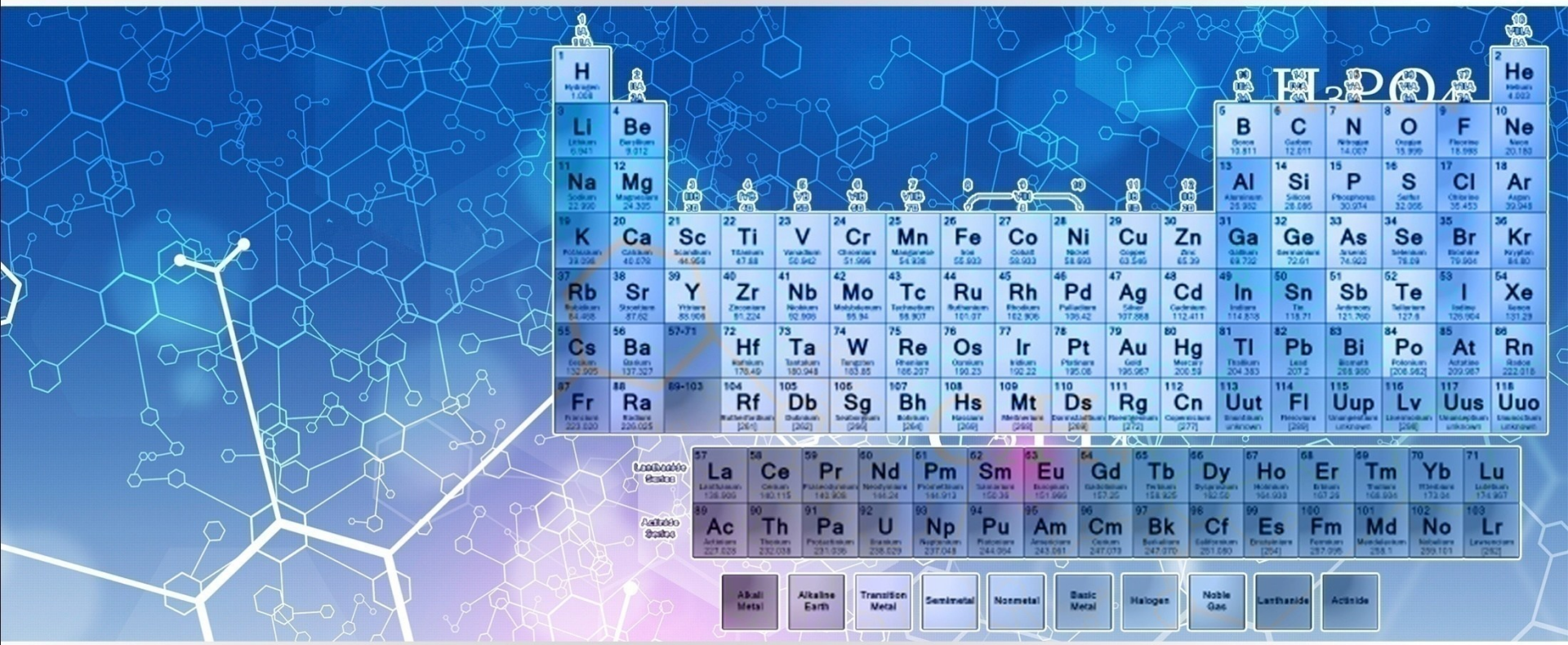
SUBJECT-CHEMISTRY

CLASS-X | CHAPTER 1



PERIODIC TABLE AND ELECTRONIC CONFIGURATION

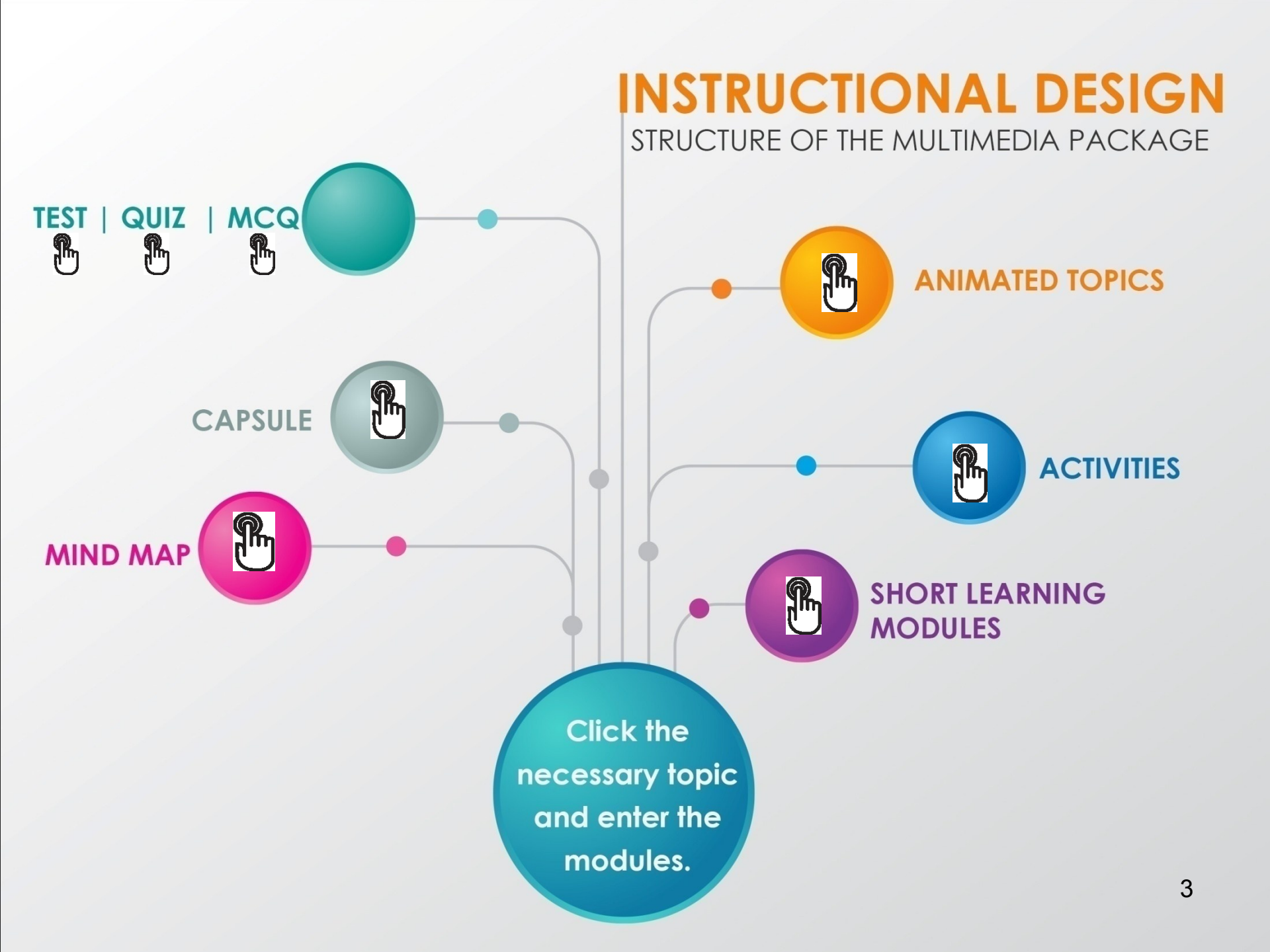
INSTRUCTIONS TO THE STUDENTS

Dear students,

This package is specially designed for **class X students** to help them understand the topic "PERIODIC TABLE" effectively. The instructional design for the package is presented in the next page.

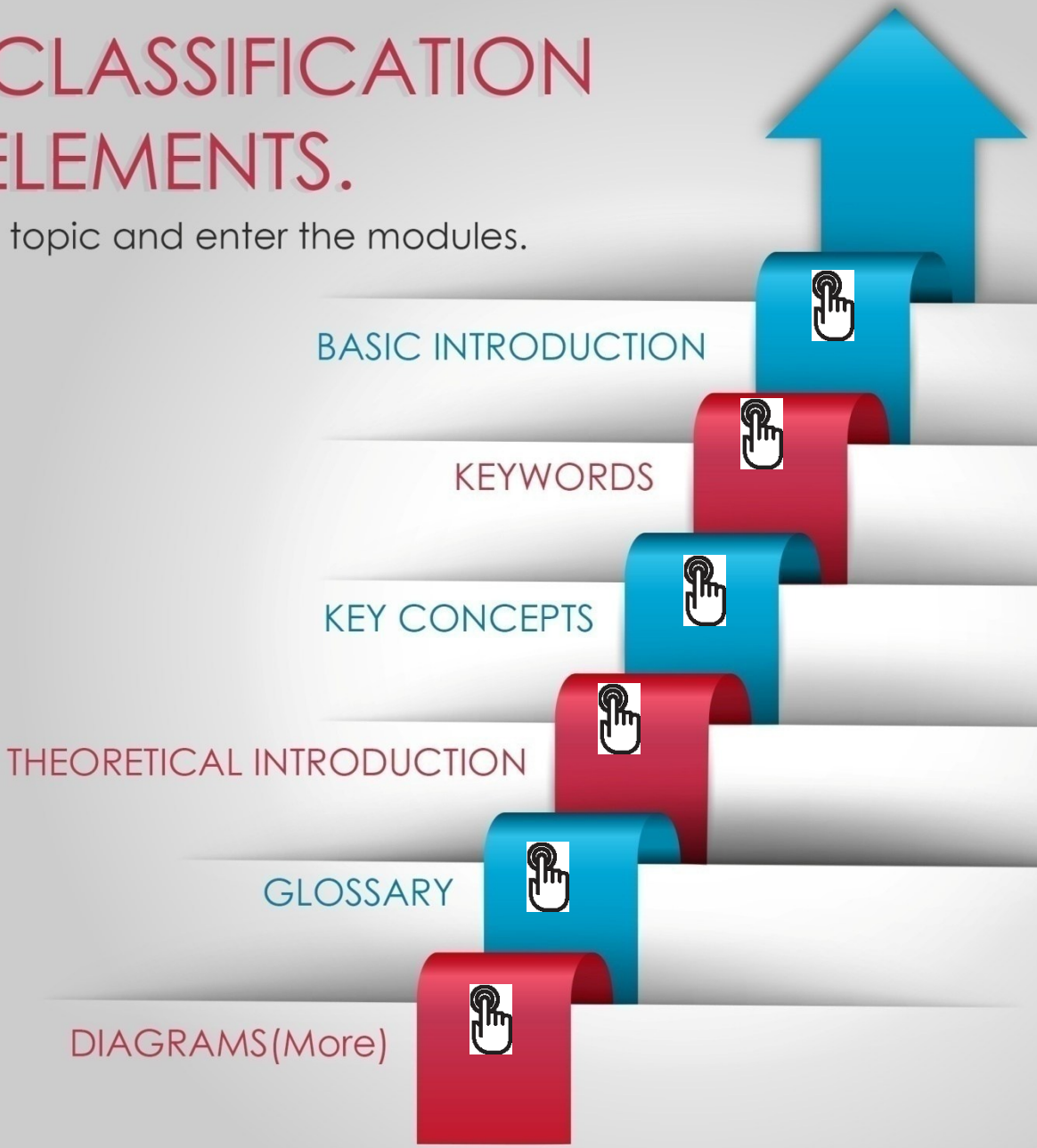
INSTRUCTIONAL DESIGN

STRUCTURE OF THE MULTIMEDIA PACKAGE



PERIODIC CLASSIFICATION OF ELEMENTS.

Click the necessary topic and enter the modules.



PERIODIC TABLE

Groups

Periods

1 H 1 Hydrogen																2 He 4 Helium 2
3 Li 7 Lithium 2,1	4 Be 9 Berilium 2,2											5 B 11 Boron 2,3	6 C 12 Carbon 2,4	7 N 14 Nitrogen 2,5	8 O 16 Oxygen 2,6	9 F 19 Fluorine 2,7	10 Ne 20 Neon 2,8
11 Na 23 Sodium (natrium) 2,8,1	12 Mg 24 Magnesium 2,8,2											13 Al 27 Aluminium 2,8,3	14 Si 28 Silicon 2,8,4	15 P 31 Phosphorus 2,8,5	16 S 32 2,8,6	17 Cl 35 Chlorine 2,8,7	18 Ar 40 Argon 2,8,8
19 K 39 Potassium 2,8,8,1	20 Ca 40 Calcium 2,8,8,2	21 Sc 45 Scandium 2,8,9,2	22 Ti 48 Titanium 2,8,10,2	23 V 51 Vanadium 2,8,11,2	24 Cr 52 Chromium 2,8,13,1	25 Mn 55 Manganese 2,8,13,2	26 Fe 56 Iron(Ferrum) 2,8,14,2	27 Co 59 Cobalt 2,8,15,2	28 Ni 59 Nickel 2,8,16,2	29 Cu 64 Copper (cuprum) 2,8,18,1	30 Zn 65 Zinc 2,8,18,2	31 Ga 70 Gallium 2,8,18,3	32 Ge 73 Germanium 2,8,18,4	33 As 75 Arsenic 2,8,18,5	34 Se 79 Selenium 2,8,18,6	35 Br 80 Bromine 2,8,18,7	36 Kr 84 Krypton 2,8,18,8
37 Rb 85 Rubidium 2,8,18,8,1	38 Sr 88 Strontium 2,8,18,8,2	39 Y 89 Yttrium 2,8,18,9,2	40 Zr 91 Zirconium 2,8,18,10,2	41 Nb 93 Niobium 2,8,18,12,1	42 Mo 96 Molybdenum 2,8,18,13,1	43 Tc 98 Technetium 2,8,18,14,1	44 Ru 101 Rutherium 2,8,18,15,1	45 Rh 103 Rhodium 2,8,18,16,1	46 Pd 106 Palladium 2,8,18,18,	47 Ag 108 Silver (Argentum) 2,8,18,18,1	48 Cd 112 Cadmium 2,8,18,18,2	49 In 115 Indium 2,8,18,18,3	50 Sn 119 Tin (stanum) 2,8,18,18,4	51 Sb 122 Antimony (stibium) 2,8,18,18,5	52 Te 128 Tellurium 2,8,18,18,6	53 I 127 Iodine 2,8,18,18,7	54 Xe 131 Xeon 2,8,18,18,8
55 Cs 133 Caesium 2,8,18,18,8,1	56 Ba 137 Barium 2,8,18,18,8,2	57 La 139 Lanthanum 2,8,18,18,9,2	72 Hf 178 Halfnium 2,8,18,32,10,2	73 Ta 181 Tantalum 2,8,18,32,11,2	74 W 184 Tungsten (wolfram) 2,8,18,32,12,2	75 Re 186 Rhenium 2,8,18,32,13,2	76 Os 190 Osmium 2,8,18,32,32,14,2	77 Ir 192 Iridium 2,8,18,32,15,2	78 Pt 195 Platinum 2,8,18,32,17,1	79 Au 197 Gold(Aurum) 2,8,18,32,18,1	80 Hg 201 Mercury (hydrarygyrum) 2,8,18,32,18,2	81 Tl 204 Thalium 2,8,18,32,18,3	82 Pb 207 Lead (plumbum) 2,8,18,32,18,4	83 Bi 209 Bismuth 2,8,18,32,18,5	84 209 Polonium 2,8,18,32,18,6	85 At 210 Astatine 2,8,18,32,18,7	86 Rn 222 Radon 2,8,18,32,18,8
87 Fr 223 Francium 2,8,18,32,18,8,1	88 Ra 226 Radium 2,8,18,32,18,8,2	89 Ac 89 Actinium 2,8,18,32,18,9,2	104 Rf 263 Rutherfordium 2,8,18,32,32,10,2	105 Db 268 Dubmium 2,8,18,32,32,11,2	106 Sg 266 Seaborgium 2,8,18,32,32,12,2	107 Bh 272 Bohrium 2,8,18,32,32,13,2	108 Hs 277 Hassium 2,8,18,32,32,14,2	109 Mt 276 Meitnarium 2,8,18,32,32,15,2	110 Ds 281 Dormstadium 2,8,18,32,32,16,1	111 Rg 280 Roentgenium 2,8,18,32,32,18,1	112 Cn 285 Copernicium 2,8,18,32,32,18,2	113 Uut 284 Ununtrium 2,8,18,32,32,18,3	114 Fl 289 Florovium 2,8,18,32,32,18,4	115 Uup 288 Ununpentium 2,8,18,32,32,18,5	116 Lv 292 Livemonium 2,8,18,32,32,18,6	117 Uus 293 Ununseptium 2,8,18,32,32,18,7	118 Uuo 294 Ununoctium 2,8,18,32,32,18,8

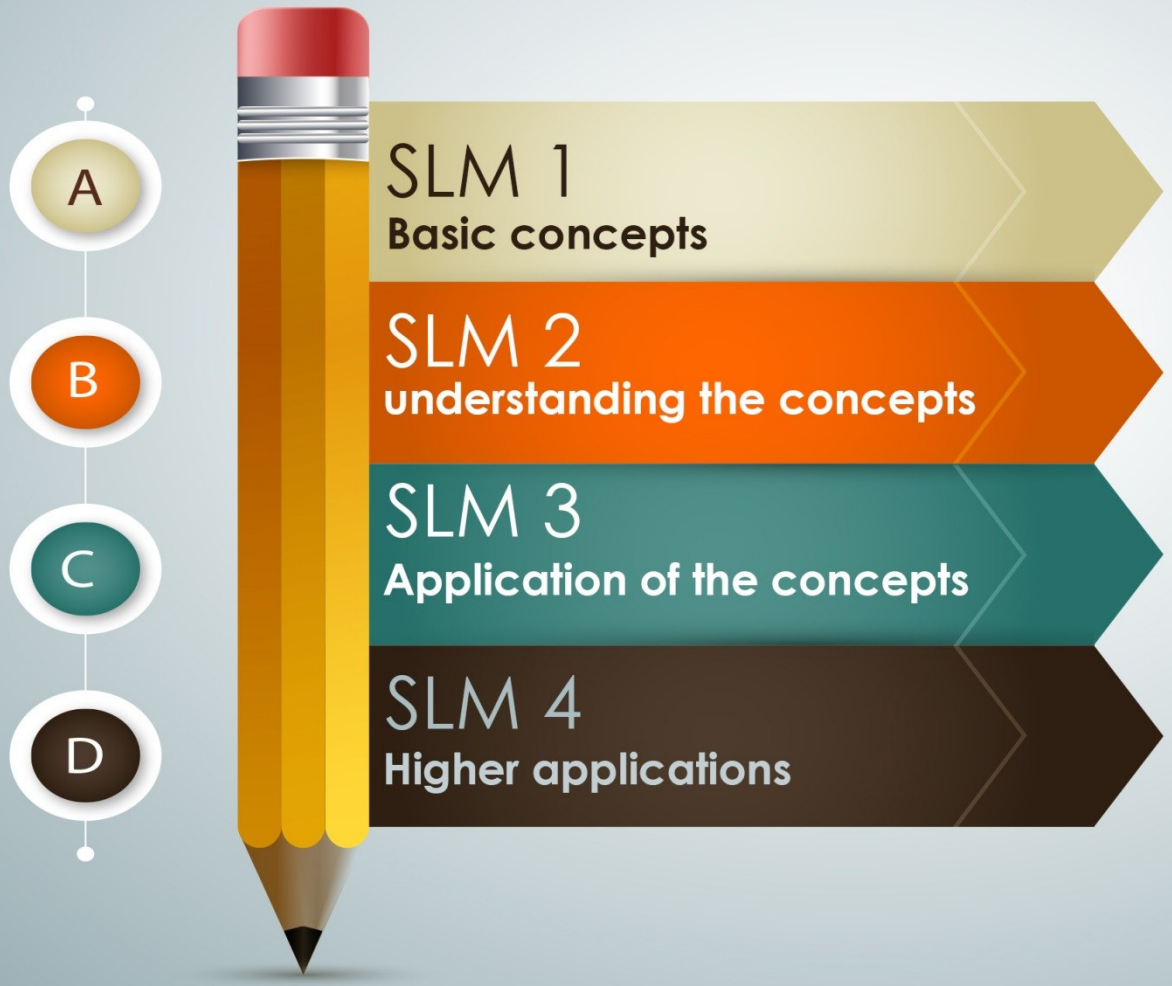
58 Ce 140 Cerium 2,8,18,19,9,2	59 Pr 141 Praseodymium 2,8,18,21,8,2	60 Nd 144 Neodymium 2,8,18,22,8,2	61 Pm 145 Promethium 2,8,18,23,8,2	62 Sm 150 Samarium 2,8,18,24,8,2	63 Eu 152 Europium 2,8,18,25,8,2	64 Gd 157 Gadolinium 2,8,18,25,9,2	65 Tb 159 Terbium 2,8,18,27,8,2	66 Dy 163 Dysprosium 2,8,18,28,8,2	67 Ho 165 Holmium 2,8,18,29,8,2	68 Er 167 Erbium 2,8,18,30,8,2	69 Tm 169 Thulium 2,8,18,31,8,2	70 Yb 173 Ytterbium 2,8,18,32,8,2	71 Lu 175 lutetium 2,8,18,32,9,2
90 Th 232 Thorium 2,8,18,32,18,10,2	91 Pa 231 Prolactinium 2,8,18,32,20,9,2	92 U 238 Uranium 2,8,18,32,21,9,2	93 Np 237 Neptunium 2,8,18,32,22,9,2	94 Pu 244 Plutonium 2,8,18,32,24,8,2	95 Am 243 Americium 2,8,18,32,25,8,2	96 Cm 247 Curium 2,8,18,32,25,9,2	97 Bk 247 Berkelium 2,8,18,32,27,8,2	98 Cf 251 Californium 2,8,18,32,28,8,2	99 Es 252 Einsteinium 2,8,18,32,29,8,2	100 Fm 257 Fermium 2,8,18,32,30,8,2	101 Md 258 Mendelevium 2,8,18,32,31,8,2	102 No 259 Nobelium 2,8,18,32,32,8,2	103 Lr 262 Lawrencium 2,8,18,32,32,9,2

ELECTRONIC CONFIGURATION

SIGNIFICANT LEARNING OUTCOMES OF THE TOPIC

- The learner identifies that electrons in an atom are arranged in the various shells around the nucleus and that each shell has subshells.
- The learner identifies that shells have subshells which differ in their energy levels and writes the subshell electronic configuration of the elements.
- The learner identifies the group, period and block of elements based on filling of electrons in subshells and writes them down.
- The learner identifies the characteristics of s,p,d and f block elements and lists them.

SHORT LEARNING MODULES



KEY POINTS OF THE TOPIC

S.NO	KEY POINTS	SLM NUMBERS
1	Introduction	
2	ELECTRONIC CONFIGURATION OF AN ELEMENT AND VALENCY	
3	SHELLS, SUBSHELLS AND SUBSHELL ELECTRONIC CONFIGURATION OF ELEMENTS	
4	IDENTIFYING GROUP,PERIOD AND BLOCK OF ELEMENTS FROM SUBSHELL ELECTRONIC CONFIGURATION	
4	CHARACTERISTICS OF s,p,d and f BLOCK ELEMENTS	
5	ELECTRONIC CONFIGURATION OF IONS	

Further references:

www.info please.com/periodic table.ph.p

www.periodic table.org.uk/

BASIC INRODUCTION

TIMELINE OF SCIENTISTS

ANTOINE LAVOISIER-1789

JOHN DALTON -1808

PROUT-1816

DOBEREINER-1829

JOHN NEWLANDS-1864

LOTHER MAYER-1869

DIMITRI EVANOVICH MENDELEEV-1869

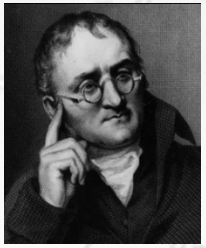
HENRY MOSELEY-1913

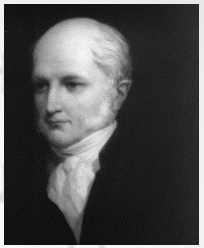
JJ THOMSON

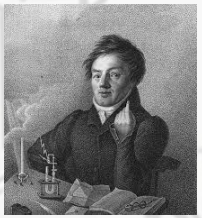
CHADWICK

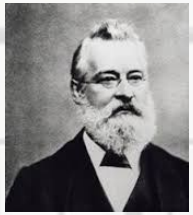
RUTHERFORD


ANTOINE LAVOISIER

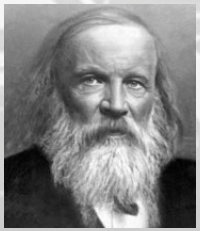

JOHN DALTON


PROUT


DOBEREINER


JOHN NEWLANDS


LOTHER MAYER


MENDELEEV


HENRY MOSELEY


JJ THOMSON


CHADWICK


RUTHERFORD

PERIODICITY

When elements are arranged in increasing order of their atomic masses, elements with similar properties appear at definite periods.

ELECTRO-NEGATIVITY

The tendency of an element to accept electrons in the outermost shell of its atom

IONISATION ENERGY

The amount of energy required to liberate the most loosely bound electron from the outermost shell of an isolated gaseous atom of an element is called its ionization energy.

- KEY WORDS
- Group
- Period
- Representative elements
- S,p,d,f
- Transition elements
- Inner transition elements

KEY CONCEPTS

VALENCY

OXIDATION STATE

METHOD OF CALCULATING OXIDATION STATE

EXAMPLES FOR CALCULATION

Calculation of oxidation state of **Mn** in **Mncl2**

Mn – 25

$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^5\ 4S^2$

Let the oxidation state of **Mn** in **$MnCl_2$** be **X**
Oxidation state of **Cl** is -1
X+[2x(-1)] = 0
X-2=0
X=2
Hence the oxidation state of **Mn** in **$MnCl_2$** is 2 and its electronic configuration is $1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^5$

So the electronic configuration of **MnO_2** will be
$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^3$

MnO_2
Oxidation state of O is -2
X+[2x(-2)] = 0
X-4=0
X=4

Calculate the oxidation state of **Mn** in **Mn_2O_3** and write the electronic configuration of **Mn_2O_3**

Calculate the oxidation state of **Mn** in **Mn_2O_7** and write the electronic configuration **Mn_2O_7**

Calculation of oxidation state of **Fe** in **$FeCl_2$**

Fe – 26

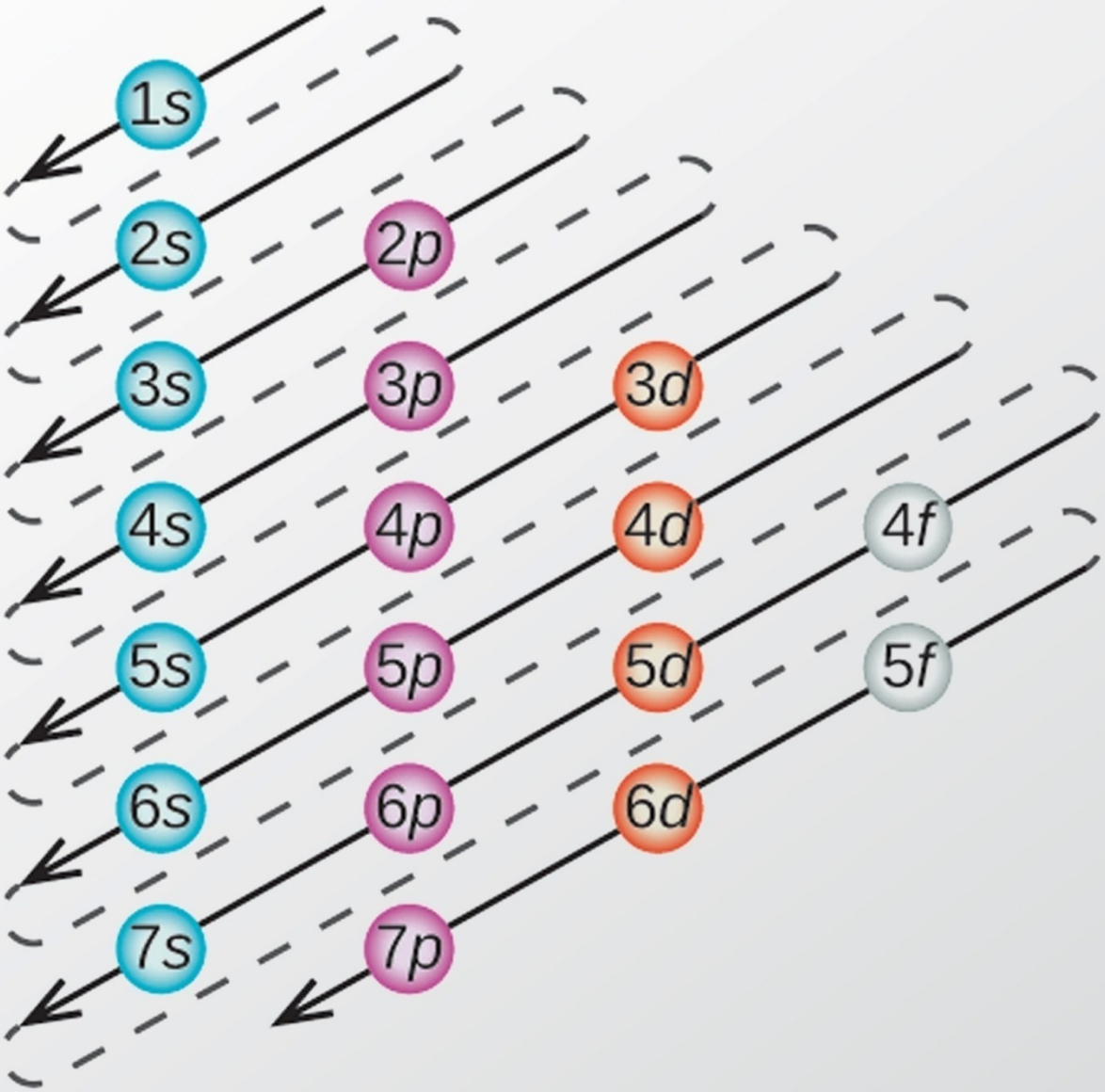
$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^6\ 4S^2$

Let the oxidation state of **Fe** in **$FeCl_2$** be X
Oxidation state of **Cl** is -1
X+[2x(-1)] = 0
X-2=0
X=2

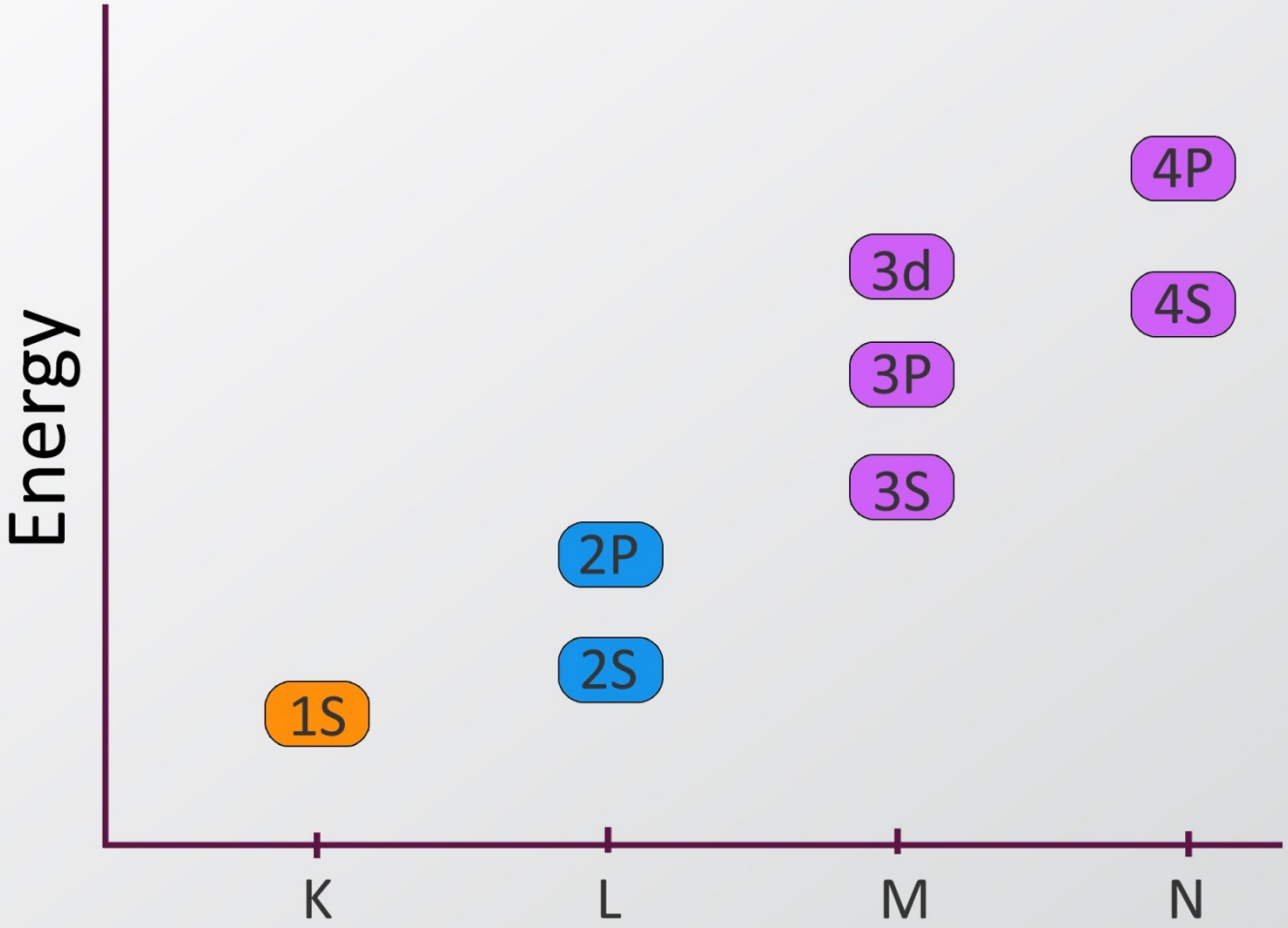
Hence the oxidation state of **Fe** in **$FeCl_2$** is 2
So the electronic configuration of **$FeCl_2$** will be
$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^6$

$FeCl_3$
Oxidation state of **Cl** is -1
X+[3x(-1)] = 0
X-3=0
X=3
Hence the oxidation state of **Fe** in **$FeCl_3$** is +3 and its electronic configuration is **:**
$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^5$

1s						
	2s					
	2p	3s				
		3p	4s			
		3d	4p	5s		
			4d	5p	6s	
			4f	5d	6p	7s


1s
2s
2p
3s
3p
3d
4s
4p
4d
4f
5s
5p
5d
5f
6s
6p
6d
7s
7p

RELATIONSHIP OF SUBSHELLS WITH ENERGIES



INTRODUCTION

- In 1913 Henry Moseley showed that atomic number of an element is a more fundamental property than its atomic mass. The modern periodic law can be stated as "properties of elements are a periodic function of their atomic number".

- The atomic number gives us the number of protons in the nucleus of an atom and this number increases by one in going from one element to the next. Elements when arranged in order of increasing atomic number Z, lead to the classification of elements known as 'The modern periodic table".

INTRODUCTION

- The discovery of periodic table is an important turning point in the development of chemistry. The elements are arranged in the periodic table in such a way that their chemical and physical properties can be predicted. Mendeleev gave shape to the modern periodic table. In this chapter we can study about electronic configuration of atoms in an element, their respective blocks and the characteristics of elements such as electronegativity, ionization energy and chemical reactivity.

s-Block

H	
Li	Be
Na	Mg
K	Ca
Rb	Sr
Cs	Ba
Fr	Ra

d-Block

Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd
* La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg
** Ac	Rf	Db	Sg	Bh	Hs	Mt	Uun	Uuu	Uub

p-Block

					He
B	C	N	O	F	Ne
Al	Si	P	S	Cl	Ar
Ga	Ge	As	Se	Br	Kr
In	Sn	Sb	Te	I	Xe
Tl	Pb	Bi	Po	At	Rn
	Uuq				

f-Block

*	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
**	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

ELECTRONIC CONFIGURATION

The arrangement of electrons in the various orbits of an atom of the element is called its electronic configuration.

The basic reason for the periodicity in the properties of elements in the periodic table is their electronic configuration. The properties of elements are influenced by the electronic arrangement in their atoms.

SHELLS AND SUBSHELLS

According to Bohr scheme of arrangement of electrons in an atom, the electrons that move around the nucleus have definite paths. Electrons revolve in a three dimensional region around the nucleus. The name of such a fixed path is called an orbital. The paths of electrons around the nucleus of atom are shells. Electrons present in each such shell or orbit have a definite energy. Therefore shells are also known as energy levels. . The shells are numbered 1,2,3,4…or K,L,M,N starting from the centre to the outside.

• Only after filling the inner shells with electrons outer shells are filled. As the distance from nucleus increases the energy of the electrons in the shells increases and the attractive force between the nucleus and the electrons decreases.

Bohr model of atom has shells K,L,M,N……considered as principal energy levels and each principal energy level contains sub energy levels. These sub energy levels are subshells. In these subshells, there are regions where there is a high probability of finding electrons. These are known as orbitals. The maximum number of electrons that can be accommodated in an orbital is 2.

The names s,p,d,f are given to the subshells based on words indicating certain properties related to atomic structure of elements. S for sharp, p for principal, d for diffuse , f for fundamental. The s subshell has only one orbital with a spherical shape. The p subshell has 3 orbitals which are dumb-bell shaped, the d subshell has 5 orbitals and the f subshell has 7 orbitals.

FILLING OF ELECTRONS IN TO VARIOUS SHELLS

The maximum number of electrons that can be accommodated in each shell depends on the formula $2n^2$, where n is the number of the given shell from the nucleus. K is the first shell.

K shell = 2x1 = 2

L shell = $2x2^2$ = 8

M shell = $2x3^2$ = 18

N shell = $2x4^2$ = 32

K shell have only one subshell. All other shells have more than one subshell named as s,p,d,f. each of the main energy level contains the same number of subshells as its serial number. Thus the K shell, which is the first has 1 subshell. L shell has 2 subshells, M shell has 3 subshells and n shell has 4 subshells as given below:

Shell	K(1^{st} shell)	L(2^{nd} shell)	M(third shell)	N(fourth shell)
Subshells	s	s,p	s,p,d	s,p,d,f
Representation of subshell	1s	2s 2p	3s 3p 3d	4s 4p 4d 4f

ELECTRONIC CONFIGURATION OF ELEMENTS

The Electronic configuration of Lithium Li with atomic no 3 is 2,1. The electronic configuration of Na and Ar and the number of electrons in the K,L,M shells are as follows:

Element	Electronic configuration	K	L	M
Na	2,8,1	2	8	1
Ar	2,8,8	2	8	8

- Since the outermost shell can have only 18 electrons, 4th period to 7th period has 18 elements.
- Now it is clear, 3rd period has only 8 elements.

CHARACTERISTIC FEATURES OF PERIOD

The elements of same period will differ in their valency

The period number can be identified from the electronic configuration of an element. There are 7 periods in a periodic table

VISUALIZING PERIODIC TABLE

Group 1 elements are called alkali metals

Group 2 elements are called alkaline earth metals

Group 3-12 elements are called d block elements

Group 13-18 elements are called p block elements

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H 1 Hydrogen																	2 He 4 Helium 2
3 Li 7 Lithium 2,1	4 Be 9 Berilium 2,2											5 B 11 Boron 2,3	6 C 12 Carbon 2,4	7 N 14 Nitrogen 2,5	8 O 16 Oxygen 2,6	9 F 19 Fluorine 2,7	10 Ne 20 Neon 2,8
11 Na 23 Sodium (natrium) 2,8,1	12 Mg 24 Magnesium 2,8,2											13 Al 27 Aluminium 2,8,3	14 Si 28 Silicon 2,8,4	15 P 31 Phosphorus 2,8,5	16 S 32 2,8,6	17 Cl 35 Chlorine 2,8,7	18 Ar 40 Argon 2,8,8
19 K 39 Potassium 2,8,8,1	20 Ca 40 Calcium 2,8,8,2	21 Sc 45 Scandium 2,8,9,2	22 Ti 48 Titanium 2,8,10,2	23 V 51 Vanadium 2,8,11,2	24 Cr 52 Chromium 2,8,13,1	25 Mn 55 Manganese 2,8,13,2	26 Fe 56 Iron(Ferrum) 2,8,14,2	27 Co 59 Cobalt 2,8,15,2	28 Ni 59 Nickel 2,8,16,2	29 Cu 64 Copper (cuprum) 2,8,18,1	30 Zn 65 Zinc 2,8,18,2	31 Ga 70 Gallium 2,8,18,3	32 Ge 73 Germanium 2,8,18,4	33 As 75 Arsenic 2,8,18,5	34 Se 79 Selenium 2,8,18,6	35 Br 80 Bromine 2,8,18,7	36 Kr 84 Krypton 2,8,18,8
37 Rb 85 Rubidium 2,8,18,8,1	38 Sr 88 Strontium 2,8,18,8,2	39 Y 89 Yttrium 2,8,18,9,2	40 Zr 91 Zirconium 2,8,18,10,2	41 Nb 93 Niobium 2,8,18,12,1	42 Mo 96 Molybdenum 2,8,18,13,1	43 Tc 98 Technetium 2,8,18,14,1	44 Ru 101 Rutherium 2,8,18,15,1	45 Rh 103 Rhodium 2,8,18,16,1	46 Pd 106 Palladium 2,8,18,18,	47 Ag 108 Silver (Argentum) 2,8,18,18,1	48 Cd 112 Cadmium 2,8,18,18,2	49 In 115 Indium 2,8,18,18,3	50 Sn 119 Tin (stanum) 2,8,18,18,4	51 Sb 122 Antimony (stibium) 2,8,18,18,5	52 Te 128 Tellurium 2,8,18,18,6	53 I 127 Iodine 2,8,18,18,7	54 Xe 131 Xeon 2,8,18,18,8
55 Cs 133 Caesium 2,8,18,18,8,1	56 Ba 137 Barium 2,8,18,18,8,2	57 La 139 Lanthanum 2,8,18,18,9,2	72 Hf 178 Halfnium 2,8,18,32,10,2	73 Ta 181 Tantalum 2,8,18,32,11,2	74 W 184 Tungsten (wolfram) 2,8,18,32,12,2	75 Re 186 Rhenium 2,8,18,32,13,2	76 Os 190 Osmium 2,8,18,32,32,14,2	77 Ir 192 Iridium 2,8,18,32,15,2	78 Pt 195 Platinum 2,8,18,32,17,1	79 Au 197 Gold(Aurum) 2,8,18,32,18,1	80 Hg 201 Mercury (hydrarygyrum) 2,8,18,32,18,2	81 Tl 204 Thalium 2,8,18,32,18,3	82 Pb 207 Lead (plumbum) 2,8,18,32,18,4	83 Bi 209 Bismuth 2,8,18,32,18,5	84 209 Polonium 2,8,18,32,18,6	85 At 210 Astatine 2,8,18,32,18,7	86 Rn 222 Radon 2,8,18,32,18,8
87 Fr 223 Francium 2,8,18,32,18,8,1	88 Ra 226 Radium 2,8,18,32,18,8,2	89 Ac 89 Actinium 2,8,18,32,18,9,2	104 Rf 263 Rutherfordium 2,8,18,32,32,10,2	105 Db 268 Dubmium 2,8,18,32,32,11,2	106 Sg 266 Seaborgium 2,8,18,32,32,12,2	107 Bh 272 Bohrium 2,8,18,32,32,13,2	108 Hs 277 Hassium 2,8,18,32,32,14,2	109 Mt 276 Meitnarium 2,8,18,32,32,15,2	110 Ds 281 Dormstadium 2,8,18,32,32,16,1	111 Rg 280 Roentgenium 2,8,18,32,32,18,1	112 Cn 285 Copernicium 2,8,18,32,32,18,2	113 Uut 284 Ununtrium 2,8,18,32,32,18,3	114 Fl 289 Florovium 2,8,18,32,32,18,4	115 Uup 288 Ununpentium 2,8,18,32,32,18,5	116 Lv 292 Livemonium 2,8,18,32,32,18,6	117 Uus 293 Ununseptium 2,8,18,32,32,18,7	118 Uuo 294 Ununoctium 2,8,18,32,32,18,8

Elements 58-103 are placed separately and they are called f block elements.

58 Ce 140 Cerium 2,8,18,19,9,2	59 Pr 141 Praseodymium 2,8,18,21,8,2	60 Nd 144 Neodymium 2,8,18,22,8,2	61 Pm 145 Promethium 2,8,18,23,8,2	62 Sm 150 Samarium 2,8,18,24,8,2	63 Eu 152 Europium 2,8,18,25,8,2	64 Gd 157 Gadolinium 2,8,18,25,9,2	65 Tb 159 Terbium 2,8,18,27,8,2	66 Dy 163 Dysprosium 2,8,18,28,8,2	67 Ho 165 Holmium 2,8,18,29,8,2	68 Er 167 Erbium 2,8,18,30,8,2	69 Tm 169 Thulium 2,8,18,31,8,2	70 Yb 173 Ytterbium 2,8,18,32,8,2	71 Lu 175 lutetium 2,8,18,32,9,2
90 Th 232 Thorium 2,8,18,32,18,10,2	91 Pa 231 Prolactinium 2,8,18,32,20,9,2	92 U 238 Uranium 2,8,18,32,21,9,2	93 Np 237 Neptunium 2,8,18,32,22,9,2	94 Pu 244 Plutonium 2,8,18,32,24,8,2	95 Am 243 Americium 2,8,18,32,25,8,2	96 Cm 247 Curium 2,8,18,32,25,9,2	97 Bk 247 Berkelium 2,8,18,32,27,8,2	98 Cf 251 Californium 2,8,18,32,28,8,2	99 Es 252 Einsteinium 2,8,18,32,29,8,2	100 Fm 257 Fermium 2,8,18,32,30,8,2	101 Md 258 Mendelevium 2,8,18,32,31,8,2	102 No 259 Nobelium 2,8,18,32,32,8,2	103 Lr 262 Lawrencium 2,8,18,32,32,9,2

POSITION OF ELEMENTS IN A PERIODIC TABLE

About 78% of elements are metals and are placed at the left side of the periodic table

Non-metals are placed at the right side of the periodic table

Elements which show some properties of metals and some properties of non-metals are called metalloids and are present on zig-zag border line which run diagonally across periodic table.

- The elements are classified into 4 blocks s,p,d and f.
- The elements present at extreme left side of the periodic table are called s block elements.
- The elements present at extreme right side of the periodic table are called p block elements.
- s and p block elements obey the periodicity completely and represent all the elements in the periodic table and are called representative elements.
- The elements between s and p block elements represents Transition Elements and are called d block elements
- The elements placed in separate panels at the bottom of the periodic table represents lanthanides and actinides and are called f block elements.

METHOD OF REPRESENTING SUBSHELL ELECTRONIC CONFIGURATION

FILLING OF ELECTRONS IN THE SUBSHELL:

When electrons are added to the subshells of atoms, they are filled in the order from lower energy subshell to higher energy. This is called the subshell electronic configuration of atoms. The maximum number of electrons that can be accommodated in each subshell is given in the table below:

Subshell	Maximum number of electrons
s	2
p	6
d	10
f	14

The subshells in the increasing order of their energies are given below:

1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p < 5s < 4d < 5s < 4d < 5p < 6s < 4f<.....

The number of electrons filled in the subshell is written as a superscript above the symbol on the right side. If there are 2 electrons in 1s it is written as $1s^2$ and in 2p if there are 5 electrons it is written as $2p^5$.

The maximum number of electrons in each of the first 4 subshells and the maximum number of electrons in each shell is shown above.

While writing the subshell electronic configuration of elements with higher atomic number, the symbol of the noble gas preceding that element may be written in square brackets followed by the electronic configuration of the remaining subshells.

For eg, potassium(K) has the electronic configuration
$1S^2$ $2S^2$ $2P^6$ $3S^2$ $3P^6$ $4S^1$

The preceding noble gas Argon has the electronic configuration
$1S^2$ $2S^2$ $2P^6$ $3S^2$ $3P^6$

So we can write the configuration of potassium using the symbol argon as [Ar]$4S^1$

For sodium it will be [Ne] $3S^1$

ELECTRONIC CONFIGURATION OF

CHROMIUM (Cr) AND COPPER (Cu)

When elements in the 4th period are considered, the newly added electrons are filled in d subshell by adding one electron each from Sc to Zn. But the electronic configuration of chromium and copper are different from the expected configurations as given below:

Element	Expected electronic configuration	Real electronic configuration
Cr	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^4\ 4S^2$	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^5\ 4S^1$
Cu	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^9\ 4S^2$	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^{10}\ 4S^1$

The configurations with half filled d subshell or completely filled d subshell show greater stability

Similarly in f subshell f^7,f^{14} arrangements show greater stability.

Electronic Configuration of Elements

Atomic No.	Element	Electronic Configuration
19	K	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 4S^1$
20	Ca	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 4S^2$
21	Sc	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^1\ 4S^2$
22	Ti	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^2\ 4S^2$
23	V	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^3\ 4S^2$
24	Cr	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^5\ 4S^1$
25	Mn	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^5\ 4S^2$
26	Fe	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^6\ 4S^2$
27	Co	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^7\ 4S^2$
28	Ni	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^8\ 4S^2$
29	Cu	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^{10}\ 4S^1$
30	Zn	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^{10}\ 4S^2$

IDENTIFYING BLOCK, GROUP AND PERIOD FROM SUBSHELL ELECTRONIC CONFIGURATION

The subshell in which the last electron of the element is filled up is the block of the element. Therefore from the subshell electronic configuration ,the block, group number and period number can be found out. But the method to be adopted is different in the case of group number of s,p,d blocks.

In the s block elements, the number of electrons in the outermost s subshell will be the group number.

The group number of p block elements can be obtained by adding 10 to the total number of electrons in the s and p subshells of the outermost shell or by adding 12 to the number of p shell electrons in the outermost shell.

Group number of d block element is found out by adding s-subshell electrons of the outermost shell and electrons in the preceding inner d subshell together.

CHARACTERISTICS OF

S BLOCK ELEMENTS

- Low ionization energy
- Low electronegativity
- Metallic nature
- Lose electrons in chemical reactions
- Compounds are mostly ionic
- Greater reactivity down the group
- Oxides and hydroxides are basic in nature
- Highest atomic radius in the respective periods

CHARACTERISTICS OF

P BLOCK ELEMENTS

- The outermost p subshell of the p block elements contain 1 to 6 electrons
- Elements in the solid, liquid and gaseous states are present in p block
- There are metals and non metals in this block
- There are most reactive elements, less reactive elements and noble elements in this block
- Ionization energy increases along a period
- Electronegativity increases along a period
- Metallic nature decreases along a period

CHARACTERISTICS OF

d BLOCK ELEMENTS

- d block elements are also called as transition elements and are metals
- Last electron enters the d subshell preceding the outermost shell
- They show similarities of properties not only in group but also in period
- Show different oxidation states
- Components are mostly coloured. E.g. copper sulphate – blue, cobalt nitrate – light pink , potassium permanganate – violet , ferrous sulphate – light green, ammonium dichromate- orange
- Transition elements and their compounds are widely used as catalysts as they are capable of showing different oxidation states and hence act as oxidizing agents or reducing agents at the sametime. For e.g. V in contact process, spongy iron in haber process and Ni in hydrogenation of vegetable oils.

CHARACTERISTICS OF

F BLOCK ELEMENTS

- Elements are arranged below the main body of periodic table in two rows. They belong to 6 and 7 periods.
- The first row elements in the f block are elements between La and Hf ,including Ce-Lu are named as Lanthanoids.
- The second row elements in f block are Ac to Rf including Th to Lr are named as Actinoids.
- The filling of electrons takes place in the 4f subshell for the f block elements of the 6th period and 5f subshell for the f block elements of the 7th period.
- Show variable oxidation states
- Most of the actinoids are radioactive and are artificial elements.
- Uranium(U), Thorium (Th), Plutonium (Pu) etc. are used as fuels in nuclear reactors
- Many of them are used as catalysts in the petroleum industry.

ELECTRONIC CONFIGURATION OF **IONS**

THE CONCEPT OF OXIDATION STATE

The number of electrons lost or gained or shared by atoms during chemical bond formation decides the valency of an element. Similarly the oxidation state of an element is obtained by the number of electrons it can gain or loose to form an octet configuration.

The electronic configuration of an element helps to find out the oxidation state of that element to form a particular ion of that element.

When s block elements react chemically they donate electron and show positive oxidation states . When alkali metals undergo chemical reactions, they show +1 oxidation state and alkaline earth metals show +2 oxidation state. These elements show definite oxidation states only.

P block elements show positive oxidation state and negative oxidation state.

Oxidation state remains constant in each group. For e.g. group 13 = +3, group 14= +4, group 15 = -3, etc.

When d block elements undergo chemical reactions along with the electrons in the outermost shell, the electrons in the penultimate d subshell also take part. In the d block elements, electrons are not lost in the same order as they are filled up i.e. Electrons are first lost from the outermost s subshell.

The difference in energy between the outer most s subshell and the penultimate d subshell is very small. Hence under suitable conditions the electrons in d subshell also take part in chemical reactions and show variable oxidation states.

Most of the coloured salts are compounds of transition elements. The colour is due to the presence of transition element ions in these compounds.

The subshell electronic configuration of Fe is $1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^6\ 4S^2$

The oxidation state of Iron(Fe) in $FeCl_2$ and $FeCl_3$ are given below:

compound	Oxidation state of Fe	Subshell electronic configuration of the ions of Fe
$FeCl_2$	+2	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^6$
$FeCl_3$	+3	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^5$

Manganese (Mn), atomic no 25 subshell electronic configuration:

$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^5\ 4S^2$

The oxidation state of Mn in $MnCl_2$, MnO_2, $Mn2O_3$, Mn_2O_7 are given below:

compound	Oxidation state of Mn	Subshell electronic configuration
$MnCl_2$	+2	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^5$
MnO_2	+4	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^3$
Mn_2O_3	+3	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^4$
Mn_2O_7	+7	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6$

Electronic Configuration Of
f block elements

Element	Subshell electronic configuration	Period number	Shell in which last electron enters	Subshell in which last electron enters
Ce	$[Xe]4f^1\ 5d^1\ 6s^2$	6	4	f
Th	$[Rn]5f^1\ 6d^1\ 7s^2$	7	5	f

ACTIVITIES

Form a table showing block, period and group of the elements having the electronic configuration given below.

- A. $1S^2\ 2S^2\ 2P^6\ 3S^1$
- B. $1S^2\ 2S^2\ 2P^6\ 3S^2\ 3p^2$
- C. $1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^5\ 4S^1$
- Hint: focus on outermost electrons
- Identify the highest shell

Answer:

element	block	period	group
A	S	3	1
B	P	3	14
C	d	4	6

Questions

?

1. The law that was used by Mendeleev to classify the elements.
2. The basis of the modern periodic table
3. The group in the periodic table that contains elements with the largest atoms
4. The 100th element
5. The number of groups in the modern periodic table

Answers:

Answers

1. Periodic law
2. Atomic number
3. Group one
4. Fermium
5. 18

Questions

?

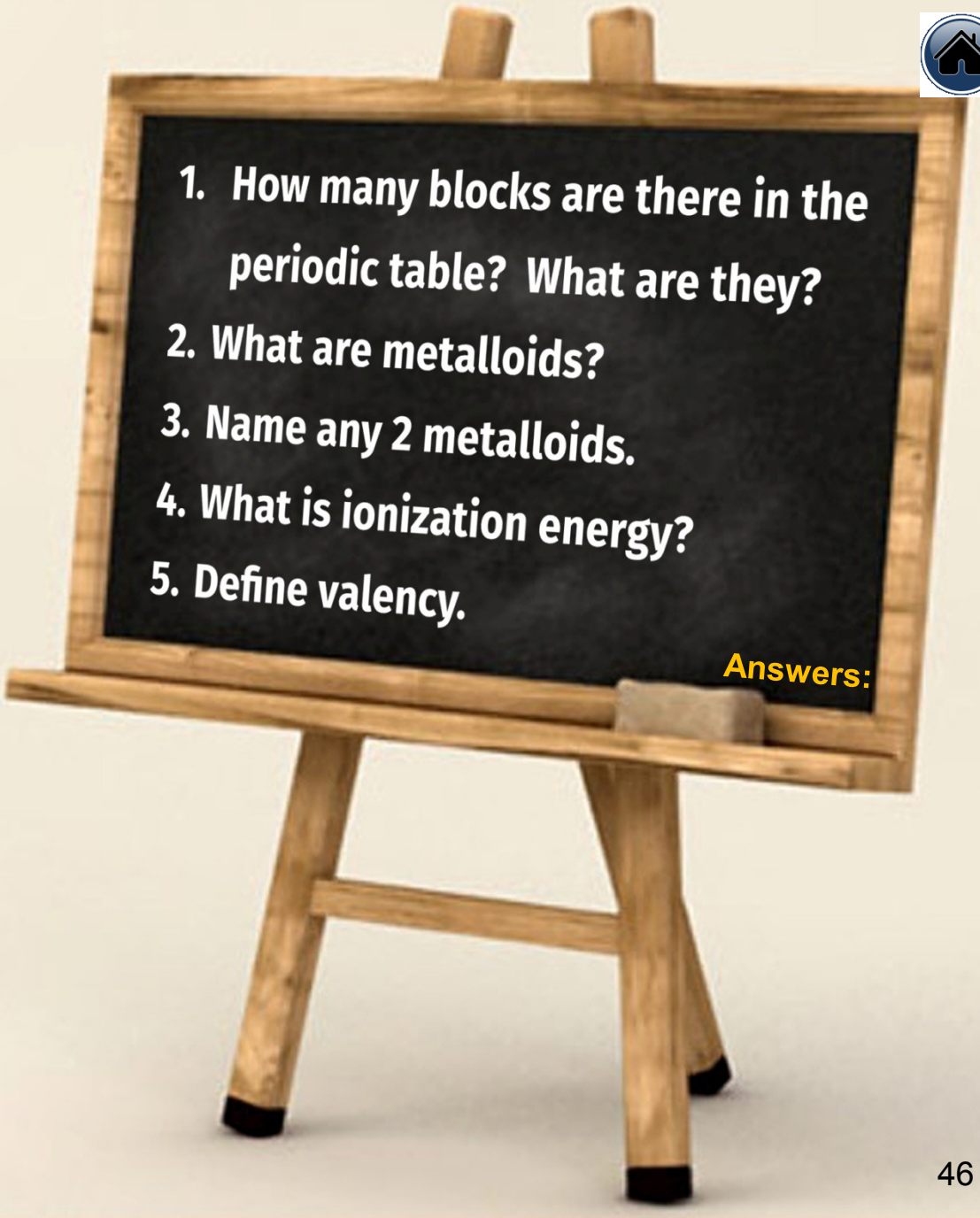
1. Who proposed modern periodic table?
2. How many groups are there in modern periodic table?
3. How many periods are there in modern periodic table?
4. Name any 5 metals of s block elements.
5. Name any 5 metals of d block elements.

Answers:

Answers

1. Henry Moseley
2. 18
3. 7
4. Li, Na, K, Mg, Ca
5. Cu, Fe, Zn, Ni, Co

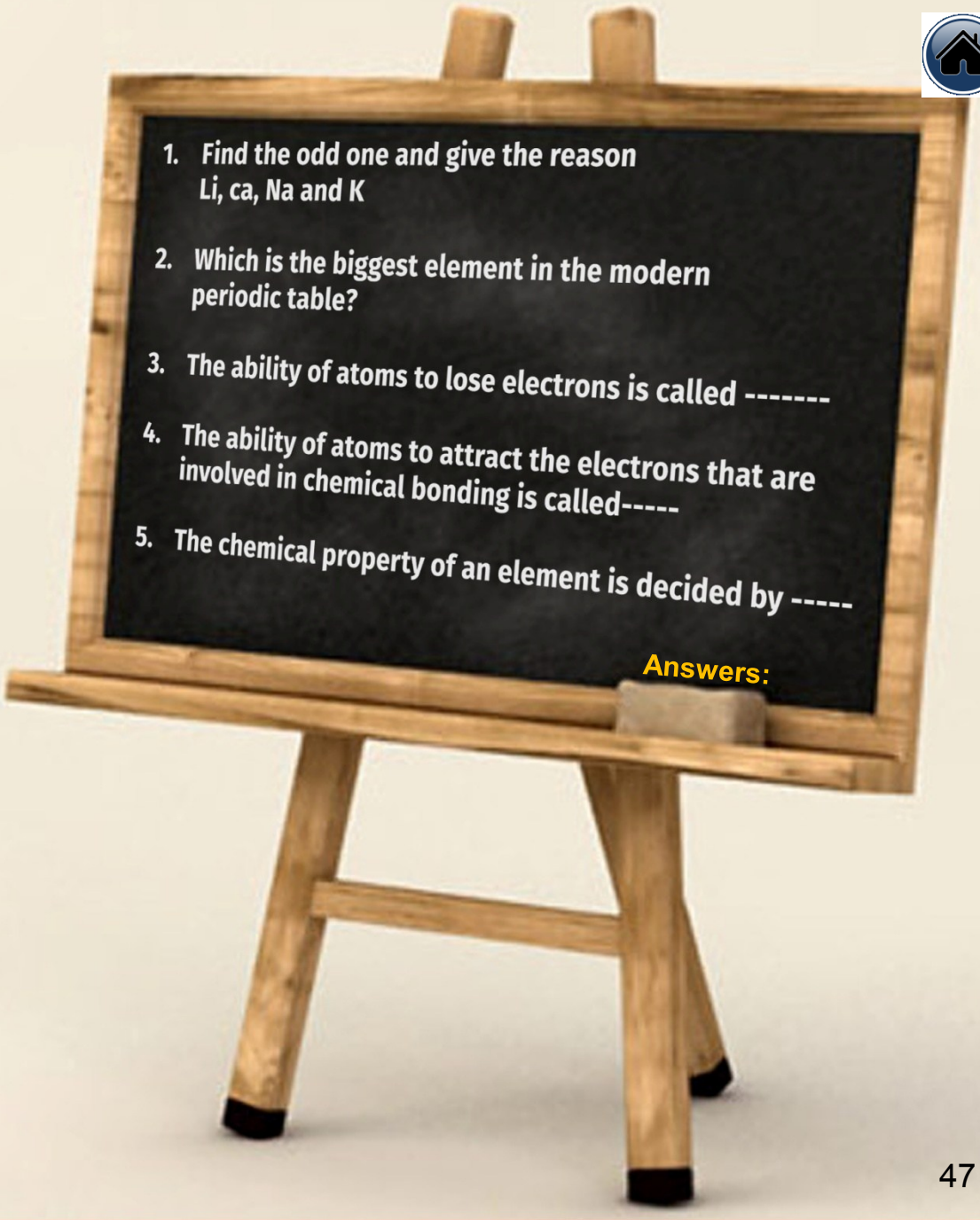
Questions



Answers

1. There are 4 blocks in the periodic table namely s,p,d and f.
2. Elements lying between metals and nonmetals in the periodic table are metalloids.
3. Si, Ge
4. The amount of energy required to liberate the most loosely bound electron from the outermost shell of an isolated gaseous atom of an element is called its ionizationenergy.
5. The combining capacity of an element is called valency.

Questions



Answers

1. Ca is an element of group 2
2. Francium
3. Electropositivity
4. Electronegativity
5. Valence electrons

QUESTIONS

Complete the table.

ELEMENT	*ATOMIC NUMBER*	*SUBSHELL ELECTRONIC CONFIGURATION*	*THE SUBSHELL TO WHICH THE LAST ELECTRON IS ADDED*	*BLOCK*
$_{3}Li$				
$_{12}Mg$				
$_{7}N$				
$_{21}Sc$				

ANSWER.....

ELEMENT	ATOMIC NUMBER	SUBSHELL ELECTRONIC CONFIGURATION	THE SUBSHELL TO WHICH THE LAST ELECTRON IS ADDED	BLOCK
$_{3}Li$	3	$1S^2\ 2S^1$	s	S
$_{12}Mg$	12	$1S^2\ 2S^2\ 2P^6\ 3S^2$	s	s
$_{7}N$	7	$1S^2\ 2S^2\ 2P^3$	p	P
$_{21}Sc$	21	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 3d^1\ 4S^2$	d	d

Test Questions - 1

1. Write the subshell wise electronic configuration of **Ca, K** and **Zn**
2. **Cr** and **Cu** has a slight change in their electronic configurations. Why?
3. Write the electronic configurations of **Mn** ion in MnO_2, $MnCl_2$, Mn_2O_3 and Mn_2O_7.
4. Why do iron form compounds with two different valencies?
5. Write the increasing order of filling electrons in the subshells.

Ca - $1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 4S^2$

K - $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$

Zn - $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2$

valences.

<5s <4d <5s <4d <5p <6s <4f <.....

n electrons from both these sub

forms compounds with two different

ns.

Test Questions - 2

1. How can the subshell configuration of **Mg** be written in short form?

✔ [Ne] $3s^2$

2. What is the relation between the sub shell to which the last electron was added and the block to which the element belongs?

✔ The name of the block is the same as the sub-shell in which last electron was added.

3. Identify the correct electronic configuration of **Cu 29** from those given below:

$1S^2$ $2S^2$ $2P^6$ $3S^2$ $3P^6$ $3d^{10}$ $4S^1$

$1S^2$ $2S^2$ $2P^6$ $3S^2$ $3P^6$ $3d^9$ $4S^2$

✔ $1S^2$ $2S^2$ $2P^6$ $3S^2$ $3P^6$ $3d^{10}$ $4S^1$

4. Write the electronic configuration of **Cr**

✔ $1S^2$ $2S^2$ $2P^6$ $3S^2$ $3P^6$ $3d^5$ $4S^1$

5. Elements are arranged below the main body of the periodic table in two rows. To which block they belong to?

✔ f block

1. Write the relation between the subshell electronic configuration of element in each block and the group number.

2. An element exhibits only +2 oxidation state, predict the block and group of this element.

3. The electronic configuration of an element is $1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 4s^2\ 3d^3$. Predict the block, period and group of the element.

4. It is found that a metallic element forms two chloride salts with different colors. What is the assumption about the block of the element?

5. Why do d block elements show variable oxidation states?

- 1.S- block: groupnumber is the number of last s electron
- p-block: group number is obtained when 10 is added to the number of last (s+p) electrons
- d-block : group number is the sum of the

Block s , group 2 e d electron in the penultimate shell

Block-d , group 5, period 4

d block

Due to slight energy difference between s sub shell electrons and d sub shell electrons, during compound formation electrons from s and d may be transferred or shared. Hence the element shows variable valency.

Matter around us is present in the form of

Elements, Compounds and Mixtures

Helium balloons (He)

Calcium (Ca)

Sand (Si, C)

Water (H, O)

Washing soda (Na, C, O

Silicon (Si)

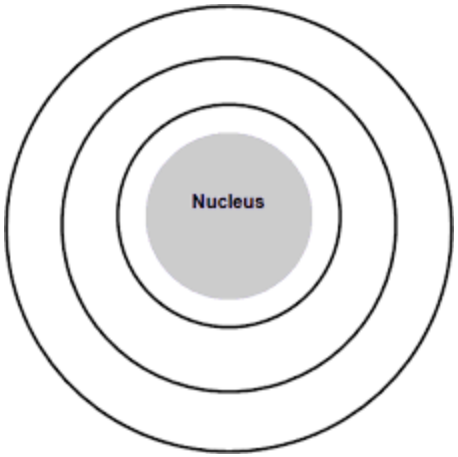
Charcoal (C)

Oxygen (O)

Marble (Ca, C, O)

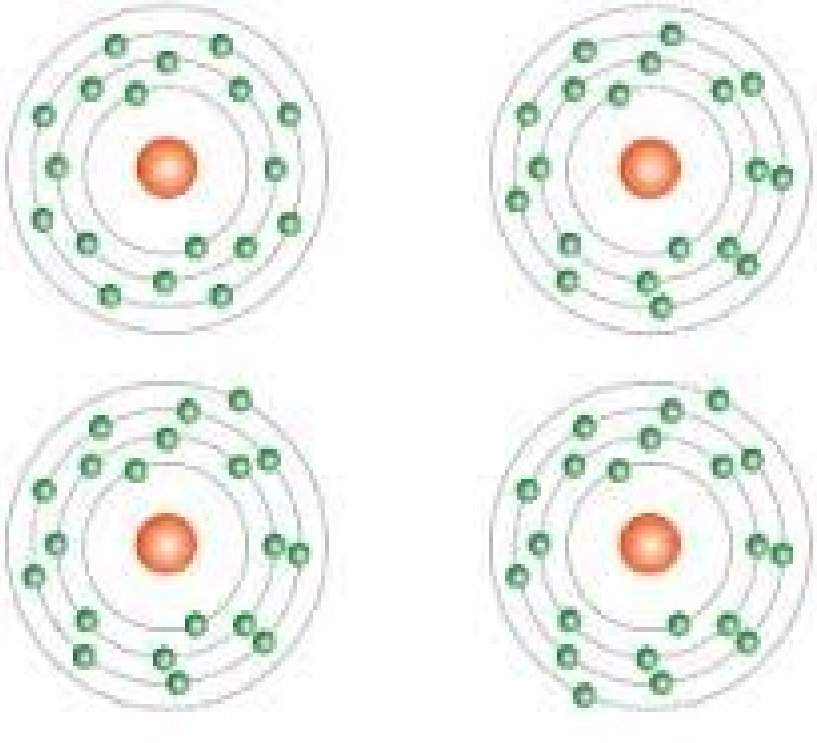
Nitrogen (N)

SHELLS


Nucleus


4
3
2
1
K
L
M
N
N Shell
M Shell
L Shell
K Shell
Positvely charged
Nucleus

ORBIT AND ORBITALS



CONCEPT OF

ATOMIC NUMBER AND MASS NUMBER

Atomic number:

The atomic number of an element is defined as the total number of protons present in the nucleus of an atom. It is equal to the number of electrons present in the atom. It is represented by the letter Z.

Mass Number:

It is defined as the total number of protons and neutrons present in the nucleus of an atom of an element. It is represented by the letter A.

Thus Atomic Number Z= Number of protons = Number of electrons

Mass Number A = Number of protons + Number of Neutrons

- **REPRESENTING AN ELEMENT**
- An Element for e.g. X can be represented in terms of atomic number(Z) and mass number (A) as
- $^{A}_{Z}X$
- Eg Berylium
- Atomic number : 4 Mass number: 9
-

$$^{9}_{4}\mathrm{Be}$$

Number of protons = 4

Number of electrons = 4

Number of neutrons = 5

Now it is understood, how the number of neutrons is5 .

Mcq

1. Which element shows variable valency?	A. Ca B. Ne C. F D. Fe	D
2. How many electrons are released by Fe in FeCl2?	A.3 B. 2 C.1 D. 4	B
3. How many electrons are present in the s subshell of the outermost shell in the elements of group 1?	A.1 B 2. C. 3. D. 4	A
4. The principal energy levels are represented by the letters	A. A,B,C,D B. P,Q,R,S C. K,L,M,N D. s,p,d,f	C
5. The maximum number of electrons present in a 'p' subshell is	A.2 B. 6 C. 10 D. 14	B
6. Which is not possible?	A.2d B. 2s C. 2p D. 3d	A
7. the element with atomic number 100 is	A. Fermium B. Rutherfordium C. Bohrium D. Mendelinium	A
8. The most reactive element in group 17 is	A.F B. Cl. C. Br D. I	A
9. The element that is used as fuels in nuclear reactors	A. Uranium B. Thorium C. Plutonium D. All the above	D
10. The block elements which shows variable oxidation states	A. s block B. d block C. d block and f block D. p block	C

Answer

MEMORY TECHNIQUES TO LEARN PERIODICTABLE

First group	- Li Na K Rb Cs Fr
Key word	- ‘LiNa k road cross fear’
Second group	- Be Mg Ca Sr Ba RA
Key word	- ‘Beemji kesar bara’
Second period	- Li Be B C N O F Ne
Key word	- ‘LiBe Bc No Fc Ne’
Third period	- Na Mg Al Si P S Cl Ar
Key word	-‘NaMasteji Al Students please study chemistry Alert’
Fourth period	– K Ca Sc Ti V Cr Mn Fe Co Ni Cu Zn
Key word	– ‘KeCa sent Vicramen FeCO NiCu Zinc ’
Metalloids	- Si Ge As Se Sb Te Po
Key word	- ‘SirGe Asst commissioner of police’


THANK
YOU