

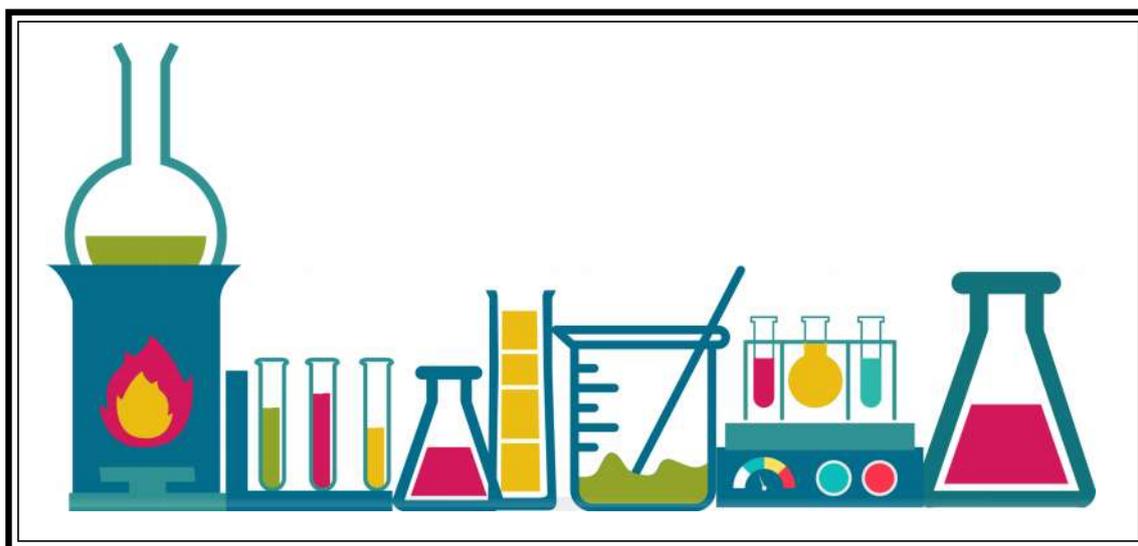


MATRIX

FOUNDATION PROGRAM

AJM CHEMISTRY

*PERIODIC CLASSIFICATION OF
ELEMENTS AND PERIODICITY IN
PROPERTIES*



Office : Piprali Road, Sikar (Raj.) | Ph. 01572-242911
Website : www.mhsworldschool.org; Email : smd@matrixacademy.co.in

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Periodic Table of the Elements

Atomic Number	Symbol	Name	Atomic Mass
1	H	Hydrogen	1.008
2	He	Helium	4.003
3	Li	Lithium	6.941
4	Be	Beryllium	9.012
5	B	Boron	10.811
6	C	Carbon	12.011
7	N	Nitrogen	14.007
8	O	Oxygen	15.999
9	F	Fluorine	18.998
10	Ne	Neon	20.180
11	Na	Sodium	22.990
12	Mg	Magnesium	24.305
13	Al	Aluminum	26.982
14	Si	Silicon	28.086
15	P	Phosphorus	30.974
16	S	Sulfur	32.066
17	Cl	Chlorine	35.453
18	Ar	Argon	39.948
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	51.996
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	78.972
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	112.411
49	In	Indium	114.818
50	Sn	Tin	118.711
51	Sb	Antimony	121.760
52	Te	Tellurium	127.5
53	I	Iodine	126.904
54	Xe	Xenon	131.294
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	[208.982]
85	At	Astatine	209.987
86	Rn	Radon	222.018
87	Fr	Francium	223.020
88	Ra	Radium	226.025
89-103	Actinide Series		
104	Rf	Rutherfordium	[261]
105	Db	Dubnium	[262]
106	Sg	Seaborgium	[266]
107	Bh	Bohrium	[264]
108	Hs	Hassium	[266]
109	Mt	Mitnerium	[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	Tennesseine	[294]
118	Og	Oganesson	[294]
119	Uue	Ununennium	[295]
120	Uuo	Unbinilium	[296]
121	Uuq	Untrium	[297]
122	Uub	Unquadrium	[298]
123	Uut	Unpentium	[299]
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322	Uuq	Untridecium	[498]
323	Uuq	Untridecium	[499]
324	Uuq	Untridecium	[500]

Table – 9

(1) Law of Triads (Dobereiner)

$$\text{Atomic Mass of Na} = \frac{\text{Atomic mass of Li} + \text{Atomic mass of K}}{2}$$

(Atomic Mass)

Li	7
Na	23
K	39

Other example of Dobereiner Triads :

- | | |
|-----------------------------|------------------------------|
| (1) Ca(40), Sr(88), Ba(137) | (2) P(31), As(75), Sb(120) |
| (3) S(32), Se(79), Te(127) | (4) Cl(35.5), Br(80), I(127) |

(2) Newland's law of Octaves

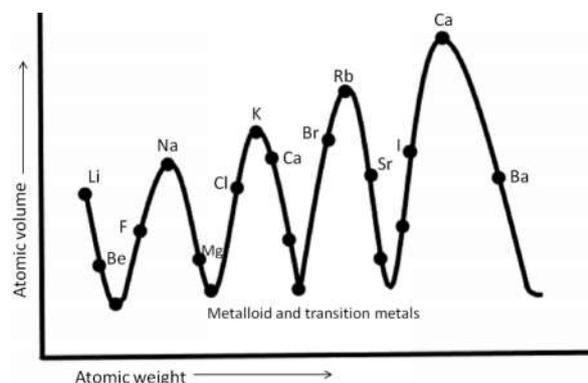
Sa	Re	Ga	Ma	Pa	DA	Ni
Sa						
Li	Be	B	C	N	O	F
Na	Mg	Al	Si	P	S	Cl
K	Ca	Sc				

×

(3) Lothar Mayer's atomic volume Curves

Lothar Mayer plotted a graph between volume of atoms & their atomic masses. He found that elements with similar properties occupy similar positions in the curve.

Elements like Li, Na, K (alkali metals) lie at the peak position of the curve, elements like Be, Mg, Ca (alkaline earth metals) lie at the descending position of curve, halogens like F, Cl, Br lie at the ascending position of the curve & transition metals lie at the lower part.



(4) Mendeleev's Periodic Table

According to Mendeleev's periodic law, "physical & chemical properties of the elements are periodic function of their atomic masses".

He arranged the known elements in increasing order of their atomic mass considering the fact that the elements with similar properties should fall in the same particular group.

Mendeleev's Periodic Table consists of 8 vertical columns & 7 horizontal lines.

Advantages

- (1) Arrangement of elements in groups was done for 1st time.
- (2) It led to discovery of new elements like germanium (aka silicon) & gallium (aka aluminium).

Drawbacks

- (1) Did not explain the reason of periodicity.
- (2) Order of increasing atomic mass was not strictly followed.

(5) Modern Periodic Table

Modern Periodic Law

Physical & chemical properties of elements are periodic function of their atomic numbers.

According to Moseley, frequency of x-ray emitted by heavy elements

$$\sqrt{\nu} \propto z$$

$$\sqrt{\nu} = a(z - b)$$

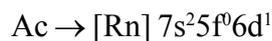
a, b = constant, ν = frequency, z = atomic number

In modern periodic table, elements are arranged in their increasing order of atomic number in such a way so that elements having same outermost shell electronic configuration comes out together.

Exception of $n + \ell$ rule

They are considered as in d-block




(6) IUPAC Naming of elements having atomic number greater than 100

Digit	Symbol	Abbreviation
0	nil	n
1	un	u
2	bi	b
3	tri	t
4	quada	q
5	penta	p
6	hexa	h
7	septa	s
8	octa	o
9	enna	e

→ 'ium' is added in the end of the name of element.

Ex. 101 unilunium unu

102 unilbium unb

(7) Classification of elements into blocks
(a) s-block

General Electronic configuration → ns^{1-2}

ns^1 → alkali metals

ns^2 → alkaline earth metals

(b) p-block

General Electronic configuration → $ns^2 np^{1-6}$

(c) d-block

Last electron enters into d-subshell of penultimate shell.

($n-2$ → anti penultimate, $n-1$ → penultimate, n → outermost)

General Electronic Configuration → $(n-1)d^{1-10} ns^{0 \text{ or } 1 \text{ or } 2}$

EXERCISE-I
ONLY ONE CORRECT TYPE

- In Lothar Meyer's curve most electronegative elements or halogens occupy –
 - Peaks
 - Ascending positions
 - Descending positions
 - Halogens were not shown
- In Lothar Meyer's plot, the peaks were occupied by –
 - Alkali metals
 - Alkaline earth metals
 - Halogens
 - Noble gases
- The plot given by Lothar Meyer, for then known elements, was between their atomic volume and –
 - Atomic number
 - Atomic mass
 - Density
 - Ionisation energy
- (X), (Y) and (Z) are elements in the third period. Oxide of (X) is ionic, that of (Y) is amphoteric and of (Z) a giant molecule. (X), (Y) and (Z) have atomic number in the order :
 - (X) < (Y) < (Z)
 - (Z) < (Y) < (X)
 - (X) < (Z) < (Y)
 - (Y) < (X) < (Z)
- Metals are included in the long form of periodic table in –
 - s-block only
 - p-block only
 - s & p blocks both
 - s, p, d and f blocks
- One important merit of modern periodic table is –
 - It explains why element in the same group have the same chemical properties.
 - Hydrogen has been placed accurately.
 - Isobars have not been placed separately.
 - It is based on classifying elements according to their atomic masses.
- In the long form of periodic table, all the non-metals are placed in –
 - s-block
 - p-block
 - d-block
 - f-block
- Which of the following is not a representative element ?
 - Fe
 - K
 - Ba
 - N
- Which of the following statements is not true for noble gases ?
 - They have stable configuration.
 - All of them contain eight electrons in their outermost shell.
 - They are the zero group elements.
 - They are colourless.
- The element with atomic number 35 belongs to –
 - s-block
 - p-block
 - d-block
 - f-block
- Elements in the same vertical column of the periodic table have same –
 - Number of electrons
 - Atomic number
 - Number of valence electrons
 - Electronic configurations

12. Which pair of atomic numbers represents s-block elements ?
 (A) 7, 15 (B) 6, 12
 (C) 9, 17 (D) 3, 12
13. Which of the following represents the electronic configuration of d-block elements ?
 (A) $(n-1)s^2 nd^{1-10}$ (B) $(n-1)d^{1-10} ns^{0-2}$
 (C) $(n-1)d^{1-10} ns^2 p^4$ (D) $(n-1)p^4 ns^2$
14. Elements of which group form anions most readily ?
 (A) Oxygen family (B) Nitrogen family
 (C) Halogens (D) Alkali metals
15. Which of the following atoms has a valency equal to zero ?
 (A) Hydrogen (B) Lithium
 (C) Neon (D) Oxygen
16. Which of the following electronic configurations represents most electropositive element ?
 (A) $[\text{He}]2s^1$ (B) $[\text{He}]2s^2$
 (C) $[\text{Xe}]6s^1$ (D) $[\text{Xe}]6s^2$
17. The electronic configuration of the element which is just above the element with atomic number 43 in the same periodic group is –
 (A) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^5, 4s^2$
 (B) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^2 4p^5$
 (C) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^6, 4s^1$
 (D) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^2 4p^6$
18. The number of periods in the long form of the periodic table is –
 (A) 6 (B) 7
 (C) 10 (D) 18
19. Which of the following pairs of elements does not belong to same group ?
 (A) Cl, Br (B) N, P
 (C) Mg, Ca (D) Al, Si
20. The group number of element in periodic table indicates –
 (A) Valency with respect to hydrogen.
 (B) The atomicity.
 (C) The number of electrons in the outermost shell.
 (D) None of these
21. Diagonal relationship is not shown by –
 (A) Li and Mg (B) C and N
 (C) B and Si (D) Be and Al
22. Modern Periodic table is based on –
 (A) Atomic number
 (B) Atomic masses
 (C) Both A and B
 (D) None of these
23. Which block of the periodic table contains maximum number of metals ?
 (A) s-block (B) p-block
 (C) d-block (D) f-block
24. In the third period of the periodic table, the element having smallest size is –
 (A) Na (B) Ar
 (C) Cl (D) Si
25. Which of the following is the most non-metallic element ?
 (A) Br (B) Cl
 (C) P (D) S

26. With the increase in atomic number in a period –
 (A) Metallic character decreases
 (B) Non-metallic character decreases
 (C) Ionisation energy decreases
 (D) None of these
27. Largest in size out of Na^+ , O^{2-} and K^+ is –
 (A) Na^+ (B) O^{2-}
 (C) K^+ (D) All are equal
28. Which of the following properties does not depend on periodicity?
 (A) Atomic weight (B) Electron affinity
 (C) Ionisation energy (D) Electronegativity
29. Which of the following have isoelectronic structures?
 (i) CH_3^+ (ii) H_3O^+
 (iii) CH_3^- (iv) NH_3
 (A) (i), (ii) and (iii) (B) (i) and (iii)
 (C) (i) and (iv) (D) (ii), (iii) and (iv)
30. Which of the following ions has smallest radius?
 (A) Cl^- (B) S^{2-}
 (C) K^+ (D) Ca^{2+}
31. The radii of F, F^- , O and O^{2-} are in the order –
 (A) $\text{O}^{2-} > \text{F}^- > \text{O} > \text{F}$
 (B) $\text{O}^{2-} > \text{F}^- > \text{F} > \text{O}$
 (C) $\text{F}^- > \text{O}^{2-} > \text{F} > \text{O}$
 (D) $\text{O}^{2-} > \text{O} > \text{F}^- > \text{F}$
32. Correct increasing order of density is –
 (A) $\text{Li} < \text{K} < \text{Na} < \text{Rb} < \text{Cs}$
 (B) $\text{Li} < \text{Na} < \text{K} < \text{Rb} < \text{Cs}$
 (C) $\text{Cs} < \text{Rb} < \text{K} < \text{Na} < \text{Li}$
 (D) $\text{K} < \text{Li} < \text{Na} < \text{Rb} < \text{Cs}$
33. Ionic radius of –
 (i) $\text{Ti}^{4+} < \text{Mn}^{7+}$ (ii) $^{35}\text{Cl}^- < ^{37}\text{Cl}^-$
 (iii) $\text{K}^+ > \text{Cl}^-$ (iv) $\text{P}^{3+} > \text{P}^{5+}$
 Which of the above is/are correct?
 (A) Only (iv) (B) (i) and (ii)
 (C) (ii) and (iv) (D) (ii) and (iii)
34. The ionisation energy of isotopes of an element will be –
 (A) Same
 (B) Different
 (C) Dependent on atomic masses
 (D) Dependent on the number of neutrons present in the nucleus
35. The correct order of second I.E. of C, N, O and F is –
 (A) $\text{F} > \text{O} > \text{N} > \text{C}$ (B) $\text{C} > \text{N} > \text{O} > \text{F}$
 (C) $\text{O} > \text{N} > \text{F} > \text{C}$ (D) $\text{O} > \text{F} > \text{N} > \text{C}$
36. I.E increases with –
 (A) Decrease in atomic size.
 (B) Increase in nuclear charge.
 (C) Increase in penetration effect of electrons.
 (D) All of the above
37. Which of the following has zero electron affinity?
 (A) Radon (B) Nitrogen
 (C) Oxygen (D) Radium
38. Which of the following has highest electron affinity?
 (A) Br (B) Cl
 (C) I (D) F

39. The amount of energy released on the addition of an electron in the outermost shell of an isolated gaseous atom is called –
 (A) Ionisation energy (B) Hydration energy
 (C) Electron affinity (D) Electronegativity
40. The formation of the oxide ion $O^{2-}(g)$ requires first an exothermic and then an endothermic step as shown below –
 $O(g) + e^- \longrightarrow O^-(g); \Delta H^\circ = -15.2 \text{ KJ/mol}$
 $O^-(g) + e^- \longrightarrow O^{2-}(g); \Delta H^\circ = 844 \text{ KJ/mol}$
 What does it show ?
 (A) O^- ion will tend to resist the addition of another electron.
 (B) Oxygen is more electronegative.
 (C) Oxygen has high electron affinity.
 (D) O^- ion has comparatively larger size than oxygen atom.
41. Which of the following is the increasing order of electron affinity of halogens ?
 (A) $Cl < Br < I < F$ (B) $I < Br < F < Cl$
 (C) $F < Cl < Br < I$ (D) $Br < F < I < Cl$
42. Electron affinity of X would be equal to –
 (A) Electron affinity of X^-
 (B) Ionisation potential of X^-
 (C) Ionisation potential of X
 (D) None of these
43. Among elements A, B, C and D having atomic numbers 7, 8, 9 and 12 respectively, the element with smallest size and highest I.E. is –
 (A) A (B) B
 (C) C (D) D
44. Which of the following transitions involve maximum amount of energy ?
 (A) $M(g) \longrightarrow M(g)$
 (B) $M(g) \longrightarrow M^-(g)$
 (C) $M^+(g) \longrightarrow M^{2+}(g)$
 (D) $M^{2+}(g) \longrightarrow M^{3+}(g)$
45. Ionisation energy of F^- is 320 KJ mol^{-1} . The electron affinity of fluorine would be –
 (A) -320 KJ mol^{-1} (B) -160 KJ mol^{-1}
 (C) 320 KJ mol^{-1} (D) 160 KJ mol^{-1}
46. A sudden large jump between the values of second and third ionisation energies of an element would be associated with the electronic configuration –
 (A) $1s^2, 2s^2 2p^6, 3s^1$
 (B) $1s^2, 2s^2 2p^6, 3s^2 3p^1$
 (C) $1s^2, 2s^2 2p^6, 3s^2 3p^2$
 (D) $1s^2, 2s^2 2p^6, 3s^2$
47. In which of the following arrangements, the order is not according to the property indicated against it ?
 (A) $Al^{3+} < Mg^{2+} < Na^+ < F^-$ – Increasing ionic size.
 (B) $B < C < N < O$ – Increasing first ionisation energy.
 (C) $I < Br < F < Cl$ – Increasing electron affinity.
 (D) $Li < Na < K < Rb$ – Increasing metallic radius.
48. Which of the following species has the highest electron affinity ?
 (A) F^- (B) O
 (C) O^- (D) Na^+

49. The first (IE_1) and second (IE_2) ionisation energies ($KJmol^{-1}$) of a few elements are shown below :

IE_1	IE_2
(i) 2372	5251
(ii) 520	7300
(iii) 900	1760
(iv) 1680	3380

Which of the above elements is likely to be a noble gas ?

- (A) (i) (B) (ii)
 (C) (iii) (D) (iv)

50. The electron affinities of halogens are –
 $F = -332 KJ mol^{-1}$, $Cl = -349 KJ mol^{-1}$,
 $Br = -324 KJ mol^{-1}$, $I = -295 KJ mol^{-1}$

The higher value of Cl as compared to that of F is due to –

- (A) Higher atomic radius of F
 (B) Smaller electronegativity of F
 (C) Weaker electron repulsion in Cl
 (D) More vacant p-subshell in Cl

EXERCISE-II

1. What is the basic theme of organisation in the periodic table ?
2. What is the basic difference in approach between the Mendeleev's Periodic Law and the Modern Periodic Law ?
3. Why is the law proposed by Newlands called the Law of Octaves ?
4. A, B, C are the elements of a Dobereiner's triad. If the atomic mass of 'A' is 9 and that of 'C' is 39, what is the atomic mass of element 'B' ?
5. What is common in the musical notes and the elements arranged by Newlands ?
6. Among the halogens F, Cl, Br, and I which does not fit in the Dobereiner's triad ? Why.
7. Explain Dobereiner's basis for classifying elements.
8. X, Y and Z are the elements of a Dobereiner's triad. If the atomic mass of X is 32 and that of Z is 127, what should be the atomic mass of Y ?
9. Why did Mendeleev leave gaps in the periodic table ?
10. What were the major defects of Mendeleev's classification ?
11. Use Mendeleev's periodic table to predict the formulae for the oxides of the following elements K, C, Al, Si, Ba :
12. Write the atomic number of the element present in the fourth period and eighth group of the Modern periodic table.
13. "Hydrogen occupies a unique position in Modern Periodic Table". Justify the statement.
14. State the modern periodic law.
15. Name three elements with single electron in their valence shell.
16. Name the metals among first ten elements in the modern periodic table.
17. Why are 18th group elements called inert gases ?
18. What is the similarity in the electronic configurations of Mg, Ca and Sr ?
19. On the basis of the periodic classification, identify each set belonging to either a group or a period.

(a) Na, Mg, Al	(b) K, Rb, Cs
(c) N, O, F	(d) Ne, Ar, Kr
20. Name the following along with their symbol.

(i) Alkali metal present in fourth	(ii) Halogen present in fourth period
------------------------------------	---------------------------------------
21. Why do elements in the same period have different physical and chemical properties? What about elements in the same group ?
22. In terms of block, period and group, where would you locate the element with $Z = 114$ in Modern periodic table ?
23. Write the general outer electronic configuration of s-, p-, d- and f-block elements.
24. How could the modern periodic table remove various anomalies of Mendeleev's periodic table ?
25. Why the third period of Modern periodic table contains 8 elements and not 18 ?
26. Considering the atomic number and position in the Modern periodic table, arrange the following elements in the increasing order of metallic character : P, Mg, Ca, K, Si.

27. Give the name and the electronic configuration of the second alkali metal.
28. Which of the following species are isoelectronic in nature ?
 (i) Ca^{2+} (ii) K
 (iii) Mg^{2+} (iv) S^{2-}
 (v) Cl^-
29. Name three elements which behave as metalloids.
30. Why does the atomic size decreases from Na to Cl when we move in the third period of the periodic table ?
31. Show the variation of valency with respect to hydrogen in the 2nd period.
32. What happens to the metallic character on moving down a group and moving across the period respectively ?
33. (a) What is meant by periodicity in properties of elements with reference to the periodic table ?
 (b) Why do all the elements of the same group have similar properties ?
 (c) How will the tendency to gain electrons change as we go from left to right across a period ? Explain.
34. Explain the following :
 (i) Why argon (atomic mass = 39.94) has been placed before potassium (atomic mass = 39.10) in the Modern periodic table ?
 (ii) There are only 14 lanthanides and only 14 actinides in Modern periodic table.
35. Why does alkali metals are largest in size while halogens are smallest in size in the whole periodic table ?
36. The first ionization enthalpy of carbon is greater than that of boron, whereas the reverse is true for second ionization enthalpy. Explain.
37. Among the elements B, Al, C and Si, (i) which element has the highest first ionisation enthalpy ? (ii) Which element has the most metallic character? Justify your answer in each case.
38. Arrange the following in increasing atomic radii
 (i) Cr, Mn, Fe (ii) Ge, As, Se
 (iii) Tl, Zr, Hf
39. Explain the following, giving appropriate reasons for your answer :
 (i) The atomic radius decreases with the increasing atomic number in a period.
 (ii) Na-atom is larger than both Li and Mg.
40. Which of the following elements has the largest value of electron affinity ?
 (i) N, P, As (ii) B, C, N
 (iii) Na, Cl, Si, Ar (iv) O, O⁻
 (v) F, Cl, Br, I, At (vi) F, Cl, Al, I, Ne
41. Explain the following, giving appropriate reasons :
 (i) The electron affinity values of Be, Mg and noble gases are zero and those of N (= 0.02 eV) and P (= 0.80 eV) are very low.
 (ii) EA value of Cl is higher than that of F although the electronegativity value of these elements is in the reverse order.
 (iii) Electron affinity of an atom increases in the 3rd period as we move from Na to Cl. Mg (Z = 12) and P(Z = 15) are, however, exceptions.
 (iv) The formation of F^- (g) from $\text{F}(\text{g})$ is exothermic while that of O^{2-} (g) from $\text{O}(\text{g})$ is endothermic.
 (v) Electron affinity value increases from N to F in the periodic table.

EXERCISE-III

1. In general, the properties that decrease and increase down a group in the periodic table, respectively, are:
 - (A) Electronegativity and electron gain enthalpy
 - (B) Electron gain enthalpy and electronegativity
 - (C) Electronegativity and atomic radius.
 - (D) Atomic radius and electronegativity
2. When the first electron gain enthalpy ($\Delta_{eg}H$) of oxygen is -141 kJ/mol, its second electron gain enthalpy is :
 - (A) negative, but less negative than the first
 - (B) a more negative value than the first
 - (C) almost the same as that of the first
 - (D) a positive value
3. The electronegativity of aluminium is similar to :
 - (A) Beryllium (B) Carbon
 - (C) Boron (D) Lithium
4. The effect of lanthanoid contraction in the lanthanoid series of elements by and large means :
 - (A) increase in both atomic and ionic radii
 - (B) decrease in atomic radii and increase in ionic radii
 - (C) increase in atomic radii and decrease in ionic radii
 - (D) decrease in both atomic and ionic radii
5. The amphoteric hydroxide is :
 - (A) $\text{Sr}(\text{OH})_2$ (B) $\text{Mg}(\text{OH})_2$
 - (C) $\text{Ca}(\text{OH})_2$ (D) $\text{Be}(\text{OH})_2$
6. The correct order of the atomic radii of C, Cs, Al, and S is :
 - (A) $\text{C} < \text{S} < \text{Al} < \text{Cs}$
 - (B) $\text{S} < \text{C} < \text{Cs} < \text{Al}$
 - (C) $\text{C} < \text{S} < \text{Cs} < \text{Al}$
 - (D) $\text{S} < \text{C} < \text{Al} < \text{Cs}$
7. The correct option with respect to the Pauling electronegativity values of the elements is :
 - (A) $\text{Ga} < \text{Ge}$ (B) $\text{Te} > \text{Se}$
 - (C) $\text{P} > \text{S}$ (D) $\text{Si} < \text{Al}$
8. The element with $Z = 120$ (not yet discovered) will be an/a :
 - (A) alkaline earth metal
 - (B) transition metal
 - (C) inner-transition metal
 - (D) alkali metal
9. The correct order of atomic radii is :
 - (A) $\text{Ho} > \text{N} > \text{Eu} > \text{Ce}$
 - (B) $\text{N} > \text{Ce} > \text{Eu} > \text{Ho}$
 - (C) $\text{Eu} > \text{Ce} > \text{Ho} > \text{N}$
 - (D) $\text{Ce} > \text{Eu} > \text{Ho} > \text{N}$
10. The size of the iso-electronic species Cl^- , Ar and Ca^{2+} is affected by
 - (A) Nuclear charge
 - (B) Principal quantum number of valence shell
 - (C) Azimuthal quantum number of valence shell
 - (D) Electron-electron interaction in the outer orbitals
11. The IUPAC symbol for the element with atomic number 119 would be :
 - (A) une (B) uun
 - (C) uue (D) unh
12. The element having greatest difference between its first and second ionization energies, is
 - (A) K (B) Sc
 - (C) Ca (D) Ba
13. The correct statements among I to III regarding group 13 element oxides are,
 - (I) Boron trioxide is acidic.
 - (II) Oxides of aluminium and gallium are amphoteric.
 - (III) Oxides of indium and thallium are basic.
 - (A) (II) and (III) only
 - (B) (I) and (II) only
 - (C) (I), (II) and (III)
 - (D) (I) and (III) only
14. The correct order of the first ionization enthalpies is :
 - (A) $\text{Mn} < \text{Ti} < \text{Zn} < \text{Ni}$
 - (B) $\text{Ti} < \text{Mn} < \text{Zn} < \text{Ni}$
 - (C) $\text{Ti} < \text{Mn} < \text{Ni} < \text{Zn}$
 - (D) $\text{Zn} < \text{Ni} < \text{Mn} < \text{Ti}$

15. The group number, number of valence electrons, and valency of an element with atomic number 15, respectively, are :
- (A) 15, 5 and 3 (B) 15, 6 and 2
(C) 16, 5 and 2 (D) 16, 6 and 3
16. The pair that has similar atomic radii is :
- (A) Mo and W (B) Ti and Hf
(C) Sc and Ni (D) Mn and Re
17. In comparison to boron, beryllium has
- (A) Greater nuclear charge and lesser first ionisation enthalpy.
(B) Greater nuclear charge and greater first ionisation enthalpy.
(C) Lesser nuclear charge and greater first ionisation enthalpy.
(D) Lesser nuclear charge and lesser first ionisation enthalpy.
18. Among the following, the energy of 2s orbital is lowest in:
- (A) Li (B) K
(C) H (D) Na
19. The electron gain enthalpy (in kJ/mol) of fluorine, chlorine, bromine and iodine, respectively, are :
- (A) - 349, - 333, - 325, and - 296
(B) - 333, - 325, - 349, and - 296
(C) - 296, - 325, - 333, and - 349
(D) - 333, - 349, - 325, and - 296
20. The atomic radius of Ag is closest to :
- (A) Cu (B) Ni
(C) Hg (D) Au
21. Within each pair of elements F & Cl, S & Se, and Li & Na, respectively, the elements that release more energy upon an electron gain are:
- (A) Cl, Se and Na (B) F, Se and Na
(C) Cl, S and Li (D) F, S and Li
22. The third ionization enthalpy is minimum for :
- (A) Ni (B) Fe
(C) Co (D) Mn
23. The first ionization energy (in kJ / mol⁻¹) of Na, Mg, Al and Si respectively are :
- (A) 786, 737, 577, 496
(B) 496, 737, 577, 786
(C) 496, 577, 737, 786
(D) 496, 577, 786, 737
24. The increasing order of the atomic radii of the following elements is :
- (a) C (b) O
(c) F (d) Cl
(e) Br
- (A) (b) < (c) < (d) < (a) < (e)
(B) (a) < (b) < (c) < (d) < (e)
(C) (d) < (c) < (b) < (a) < (e)
(D) (c) < (b) < (a) < (d) < (e)
25. The electronic configurations of bivalent europium and trivalent cerium are :
- (atomic number : Xe = 54, Ce = 58, Eu = 63)]
- (A) [Xe] 4f⁷ 6s² and [Xe] 4f² 6s²
(B) [Xe] 4f² and [Xe] 4f⁹
(C) [Xe] 4f² and [Xe] 4f⁷
(D) [Xe] 4f⁷ and [Xe] 4f¹
26. The acidic, basic and amphoteric oxides, respectively, are :
- (A) N₂O₃, Li₂O, Al₂O₃
(B) Cl₂O, CaO, P₄O₁₀
(C) Na₂O, SO₃, Al₂O₃
(D) MgO, Cl₂O, Al₂O₃
27. B has a smaller first ionization enthalpy than Be. Consider the following statements :
- (I) it is easier to remove 2p electron than 2s electron
(II) 2p electron of B is more shielded from the

- nucleus by the inner core of electrons than the 2s electrons of Be
- (III) 2s electron has more penetration power than 2p electron
- (IV) atomic radius of B is more than Be (atomic number B = 5, Be = 4)
- The correct statements are :
- (A) (II), (III) and (IV) (B) (I), (II) and (III)
- (C) (I), (II) and (IV) (D) (I), (III) and (IV)
- 28.** In general, the property (magnitudes only) that shows an opposite trend in comparison to other properties across a period is :
- (A) Atomic radius
- (B) Ionization enthalpy
- (C) Electronegativity
- (D) Electron gain enthalpy
- 29.** Three elements X, Y and Z are in the 3rd period of the periodic table. The oxides of X, Y and Z, respectively, are basic, amphoteric and acidic. The correct order of the atomic numbers of X, Y and Z is :
- (A) $X < Z < Y$ (B) $Y < X < Z$
- (C) $Z < Y < X$ (D) $X < Y < Z$
- 30.** The atomic number of the element unnilennium is :
- (A) 108 (B) 109
- (C) 102 (D) 119
- 31.** Consider the hypothetical situation where the azimuthal quantum number, l , takes values 0, 1, 2, $n + 1$, where n is the principal quantum number. Then, the element with atomic number :
- (A) 6 has a 2p-valence subshell
- (B) 8 is the first noble gas
- (C) 13 has a half-filled valence subshell
- (D) 9 is the first alkali metal
- 32.** The five successive ionization enthalpies of an element are 800, 2427, 3658, 25024 and 32824 kJ mol⁻¹. The number of valence electrons in the element is :
- (A) 2 (B) 3
- (C) 4 (D) 5
- 33.** The process that is NOT endothermic in nature is :
- (A) $H_{(g)} + e^- \rightarrow H_{(g)}^-$ (B) $Na_{(g)} \rightarrow Na_{(g)}^+ + e^-$
- (C) $O_{(g)}^- + e^- \rightarrow O_{(g)}^{2-}$ (D) $Ar_{(g)} + e^- \rightarrow Ar_{(g)}^-$
- 34.** The correct electronic configuration and spin-only magnetic moment (BM) of Gd³⁺ ($Z = 64$), respectively, are:
- (A) [Xe] 4f⁷ and 7.9 (B) [Xe] 5f⁷ and 8.9
- (C) [Xe] 5f⁷ and 7.9 (D) [Xe] 4f⁷ and 8.9
- 35.** In the sixth period, the orbitals that are filled are :
- (A) 6s, 5d, 5f, 6p (B) 6s, 5f, 6d, 6p
- (C) 6s, 4f, 5d, 6p (D) 6s, 6p, 6d, 6f

EXERCISE-IV

PREVIOUS YEAR EXAMINATION QUESTIONS

1. Among Li, Be, N and F, the element having the largest atomic radius, is :

[KVPY-Part-I/2008]

- (A) Li (B) Be
(C) N (D) F

2. The atomic radii of the alkali metals follow the order :

[KVPY-Part-I/2008]

- (A) $Li > Na > K > Cs$
(B) $K > Cs > Li > Na$
(C) $Na > K > Cs > Li$
(D) $Cs > K > Na > Li$

3. The most basic oxide among MnO , Mn_2O_3 , MnO_2 and Mn_2O_7 is –

[IJSO-State-I/2011]

- (A) MnO (B) MnO_2
(C) Mn_2O_3 (D) Mn_2O_7

4. Which of the following group elements from the periodic table form electron deficient molecules ?

[IJSO-State-I/2011]

- (A) Group IV (B) Group V
(C) Group III (D) Group I

5. The element with electronic configuration $1s^2 2s^2 2p^6 3s^2$ is a/an –

[IJSO-State-I/2012]

- (A) Metal (B) Non-metal
(C) Metalloid (D) Inert gas

6. Atomic number decides chemical property of an element. It also decides which group the element belongs to. Identify which of the following elements are from the same group in the periodic table.

[IJSO-State-II/2013]

- (A) 1, 3, 11, 19, 37 (B) 8, 24, 42, 74
(C) 4, 12, 20, 58 (D) 5, 13, 27, 47

7. Which of the following set of elements have the strongest tendency to form anions ?

[IJSO-State-II/2013]

- (A) N, O and P. (B) P, S and Cl.
(C) N, P and Cl. (D) N, P and S.

8. Arrange the following elements in the increasing order of their atomic radii.

[IJSO-State-II/2013]

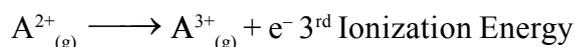
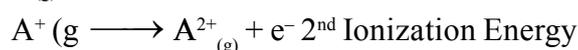
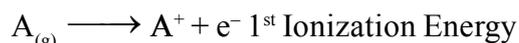
- (A) $Na < Li < Rb < C < K$
(B) $Cs < Rb < K < Na < Li$
(C) $K < Rb < Cs < Na < Li$
(D) $Li < Na < K < Rb < Cs$

9. Which of these elements has the greatest electronegativity?

[IJSO-State-I/2013]

- (A) Br (B) N
(C) O (D) S

10. Ionization Energy is defined as 'the energy required for removing the most loosely bound electron from an isolated gaseous atom or ion'.



and so on

Molar ionization energy for element 'A'	1 st	2 nd	3 rd	4 th	5 th	6 th
(kJ/mol)	1086.5	2352.6	4620.5	6222.7	37831	47277

Identify element A.

[IJSO-Stage-I/2015]

- (A) Nitrogen (B) Oxygen
(C) Carbon (D) Fluorine

11. Electronic configuration of Na^+ is (2, 8) and that of sodium element is (2, 8, 1). Choose the correct statements.
- [IJSO-Stage-I/2015]**
- i. $\text{Na}^+_{(g)}$ is more stable than $\text{Na}_{(g)}$.
 ii. $\text{Na}^+_{(g)}$ is less stable than $\text{Na}_{(g)}$.
 iii. $\text{Na}^+_{(aq)}$ is more stable than $\text{Na}_{(aq)}$.
 iv. $\text{Na}^+_{(aq)}$ is less stable than $\text{Na}_{(aq)}$.
- (A) ii, iii (B) i, iii
 (C) ii, iv (D) i, iv
12. Which of the following series of elements have nearly the same atomic radii ?
- [IJSO-Stage-I/2014-15]**
- (A) Fe, Co, Ni, Cu (B) Na, K, Rb, Cs
 (C) Li, Be, B, C (D) F, Cl, Br, I
13. Which of the following has the maximum number of unpaired electrons ?
- [IJSO-Stage-I/2014-15]**
- (A) Ti^{3+} (B) V^{3+}
 (C) Fe^{2+} (D) Fe^{3+}
14. The following variation of properties is generally seen in the periodic table.
- [IJSO-Stage-I/2014-15]**
- (A) Atomic radius and ionization energy both increase across a period.
 (B) Atomic radius increases and ionization energy decreases across a period.
 (C) Atomic radius and ionization energy both decrease across a period.
 (D) Atomic radius decreases and ionization energy increases across a period.
15. In which of the following series of transition metal ions, all metal ions have $3d^2$ electronic configuration :
- [IJSO-Stage-I/2014-15]**
- (A) $\text{Ti}^+, \text{V}^{4+}, \text{Cr}^{6+}, \text{Mn}^{7+}$
 (B) $\text{Ti}^{3+}, \text{V}^{2+}, \text{Cr}^{3+}, \text{Mn}^{4+}$
 (C) $\text{Ti}^{2+}, \text{V}^{3+}, \text{Cr}^{4+}, \text{Mn}^{5+}$
 (D) $\text{Ti}^{4+}, \text{V}^{3+}, \text{Cr}^{2+}, \text{Mn}^{3+}$
16. Ionic radii of following species are :
- [IJSO-Stage-I/2015-16]**
- (A) $\text{Si}^{4+} > \text{P}^{5+} > \text{Cl}^{7+} > \text{S}^{6+}$
 (B) $\text{S}^{6+} > \text{p}^{5+} > \text{Si}^{4+} > \text{Al}^{3+}$
 (C) $\text{N}^{3-} > \text{O}^{2-} > \text{F}^- > \text{Na}^{1+}$
 (D) $\text{Mg}^{2+} > \text{Na}^{1+} > \text{F}^- > \text{O}^{2-}$
17. An element with atomic number 44 is below which element in the periodic table ?
- [IJSO- Stage -I/2016-17]**
- (A) Calcium (B) Iron
 (C) Argon (D) Magnesium
18. There are many elements in the periodic table that are named after the country, where they were first made or obtained. For example, the Latin name for copper was coined by the Romans because their chief source of copper was from the Island of Cyprus. However, there is one country in the world which was named after an element (the Latin name). A long time ago, it was believed that this country had mountains full of a valuable element, however all expeditions to find these mountains failed. But the name stuck on. The element in question is used for many applications today, and many of its compounds are used as catalysts. The

ions of this metal have very good anti-microbial property and finds application in water purification.

The element is :

[IJSO-Stage-I/2016-17]

- (A) Sodium (B) Gold
(C) Silver (D) Francium

19. What would be the atomic number of the next halogen element, if discovered in future ?

[IJSO-Stage-I/2017-18]

- (A) 103 (B) 115
(C) 117 (D) 121

20. P^{3-} has a larger radius than atom of P because :

[IJSO-Stage-I/2018-19]

- (A) There is greater coulombic attraction between the nucleus & electrons in the P^{3-} ion.
(B) The core electrons in P^{3-} exert a weaker shielding force than those of a neutral atom.
(C) The nuclear charge is weaker in P^{3-} than it is in P.
(D) The electrons in P^{3-} have a greater coulombic repulsion than those in P atom.

21. Which of the following species is/are isoelectronic with neon ?

[IJSO-Stage-I/2021-22]

- (i) N^{3-} (ii) Mg^{2+}
(iii) K^+ (iv) Ca^{2+}
(A) Only (iv) (B) Only(ii)
(C) Both (i) and (ii) (D) Both (i) and (iii)

EXERCISE-V

- The **correct** order regarding the electronegativity of hybrid orbitals of carbon is : **[AIPMT 2006]**
 (1) $sp < sp^2 > sp^3$ (2) $sp < sp^2 < sp^3$
 (3) $sp > sp^3 < sp^2$ (4) $sp > sp^2 > sp^3$
- Which of the following is the most basic oxide ? **[AIPMT 2006]**
 (1) SeO_2 (2) Al_2O_3
 (3) Sb_2O_3 (4) Bi_2O_3
- Identify the **correct** order of the size of the following: **[AIPMT 2007]**
 (1) $Ca^{2+} < K^+ < Ar < S^{2-} < Cl^-$
 (2) $Ca^{2+} < K^+ < Ar < Cl^- < S^{2-}$
 (3) $Ar < Ca^{2+} < K^+ < Cl^- < S^{2-}$
 (4) $Ca^{2+} < Ar < K^+ < Cl^- < S^{2-}$
- With which of the following electronic configuration an atom has the lowest ionisation enthalpy ? **[AIPMT 2007]**
 (1) $1s^2, 2s^2 2p^5$ (2) $1s^2, 2s^2 2p^3$
 (3) $1s^2, 2s^2 2p^6, 3s^1$ (4) $1s^2, 2s^2 2p^6$
- The **correct** order of decreasing second ionisation enthalpy of Ti(22), V(23), Cr(24) and Mn(25) is :
 (1) $Cr > Mn > V > Ti$ (2) $V > Mn > Cr > Ti$
 (3) $Mn > Cr > Ti > V$ (4) $Ti > V > Cr > Mn$
- Amongst the elements with following electronic configurations, which one may have the highest ionisation energy ? **[AIPMT 2009]**
 (1) $[Ne] 3s^2 3p^3$ (2) $[Ne] 3s^2 3p^2$
 (3) $[Ar] 3d^{10}, 4s^2 4p^3$ (4) $[Ne] 3s^2 3p^1$
- Which of the following oxide is not expected to react with sodium hydroxide ? **[AIPMT 2009]**
 (1) BeO (2) B_2O_3
 (3) CaO (4) SiO_2
- Among the elements Ca, Mg, P and Cl, the order of increasing atomic radii is : **[AIPMT 2010]**
 (1) $Mg < Ca < Cl < P$
 (2) $Cl < P < Mg < Ca$
 (3) $P < Cl < Ca < Mg$
 (4) $Ca < Mg < P < Cl$
- Among the following which one has the highest cation to anion size ratio? **[AIPMT 2010]**
 (1) CsI (2) CsF
 (3) LiF (4) NaF
- Which of the following ions has electronic configuration $[Ar]3d^6$? **[AIPMT 2010]**
 (1) Ni^{3+} (2) Mn^{3+}
 (3) Fe^{3+} (4) Co^{3+}
- Which of the following pairs has the same size ? **[AIPMT 2010]**
 (1) Fe^{2+}, Ni^{2+} (2) Zr^{4+}, Ti^{4+}
 (3) Zr^{4+}, Hf^{4+} (4) Zn^{4+}, Hf^{4+}
- The **correct** order of the decreasing ionic radii among the following electronic species are : **[AIPMT 2010]**
 (1) $Ca^{2+} > K^+ > S^{2-} > Cl^-$
 (2) $Cl^- > S^{2-} > Ca^{2+} > K^+$
 (3) $S^{2-} > Cl^- > K^+ > Ca^{2+}$
 (4) $K^+ > Ca^{2+} > Cl^- > S^{2-}$
- Which of the following represents the **correct** order of increasing electron gain enthalpy with negative sign for the elements O, S, F and Cl ? **[AIPMT 2010]**
 (1) $Cl < F < O < S$ (2) $O < S < F < Cl$
 (3) $F < S < O < Cl$ (4) $S < O < Cl < F$
- What is the value of electron gain enthalpy of Na^+ if IE_1 of Na = 5.1 eV ? **[AIPMT 2011]**
 (1) -5.1 eV (2) -10.2 eV
 (3) +2.55 eV (4) +10.2 eV

15. Identify the wrong statement in the following : **[AIPMT 2012]**
- Amongst isoelectronic species, smaller the positive charge on the cation, smaller is the ionic radius.
 - Amongst isoelectronic species, greater the negative charge on the anion, larger is the ionic radius.
 - Atomic radius of the elements increases as one moves down the first group of the periodic table.
 - Atomic radius of the elements decreases as one moves across from left to right in the 2nd period of the periodic table.
16. Which of the following orders of ionic radii is correctly represented? **[AIPMT 2014]**
- $H^- > H^+ > H$ (2) $Na^+ < F^- < O^{2-}$
 - $F^- > O^{2-} > Na^+$ (4) $Al^{3+} > Mg^{2+} > N^{3-}$
17. Reason of lanthanoid contraction is : **[AIPMT 2014]**
- Poor screening effect of 4f orbitals
 - Constant nuclear charge
 - Decreasing nuclear charge
 - Decreasing screening effect
18. Be^{2+} is isoelectronic with which of the following ions? **[AIPMT 2014]**
- H^+ (2) Li^+ (3) Na^+ (4) Mg^{2+}
19. The species Ar, K^+ and Ca^{2+} contain the same number of electrons. In which order do their radii increase? **[AIPMT 2015]**
- $Ca^{2+} < Ar < K^+$ (2) $Ca^{2+} < K^+ < Ar$
 - $K^+ < Ar < Ca^{2+}$ (4) $Ar < K^+ < Ca^{2+}$
20. Because of lanthanoid contraction, which of the following pairs of elements have nearly same atomic radii ? (Numbers in the parenthesis are atomic numbers). **[AIPMT 2015]**
- Zr (40) and Nb (41)
 - Zr (40) and Hf (72)
 - Zr (40) and Ta (73)
 - Ti (22) and Zr (40)
21. The formation of the oxide ion, $O^{2-}(g)$, from oxygen atom requires first an exothermic and then an endothermic step as shown below : **[AIPMT 2015]**
- $$O(g) + e^- \rightarrow O^-(g); \Delta_f H^\ominus = -141 \text{ kJ mol}^{-1}$$
- $$O^-(g) + e^- \rightarrow O^{2-}(g); \Delta_f H^\ominus = +780 \text{ kJ mol}^{-1}$$
- Thus process of formation of O^{2-} in gas phase is unfavourable even though O^{2-} is isoelectronic with neon. It is due to the fact that,
- Oxygen is more electronegative
 - Addition of electron in oxygen results in larger size of the ion
 - Electron repulsion outweighs the stability gained by achieving noble gas configuration
 - O^- ion has comparatively smaller size than oxygen atom
22. In which of the following options the order of arrangement does not agree with the variation of property indicated against it? **[NEET 2016]**
- $Li < Na < K < Rb$ (increasing metallic radius)
 - $Al^{3+} < Mg^{2+} < Na^+ < F^-$ (increasing ionic size)
 - $B < C < N < O$ (increasing first ionization enthalpy)
 - $I < Br < Cl > F$ (increasing electron gain enthalpy)
23. The electronic configurations of Eu (Atomic No. 63) Gd (Atomic No. 64) and Tb (Atomic No. 65) are : **[NEET 2016]**
- $[Xe]4f^7 6s^2$, $[Xe]4f^7 5d^1 6s^2$ and $[Xe]4f^9 6s^2$
 - $[Xe]4f^7 6s^2$, $[Xe]4f^8 6s^2$ and $[Xe]4f^8 5d^1 6s^2$
 - $[Xe]4f^6 5d^1 6s^2$, $[Xe]4f^7 5d^1 6s^2$ and $[Xe]4f^9 5d^1 6s^2$
 - $[Xe]4f^6 5d^1 6s^2$, $[Xe]4f^7 5d^1 6s^2$ and $[Xe]4f^8 5d^1 6s^2$
24. The element $Z = 114$ has been discovered recently. It will belong to which of the following family/ group and electronic configuration? **[NEET 2017]**
- Halogen family, $[Rn] 5f^{14} 6d^{10} 7s^2 7p^5$
 - Carbon family, $[Rn] 5f^{14} 6d^{10} 7s^2 7p^2$
 - Oxygen family, $[Rn] 5f^{14} 6d^{10} 7s^2 7p^4$
 - Nitrogen family, $[Rn] 5f^{14} 6d^{10} 7s^2 7p^6$

25. Which of the following oxides is most acidic in nature?
[NEET 2018]

- (1) MgO (2) BeO (3) BaO (4) CaO

26. The correct order of atomic radii in group 13 elements is:
[NEET 2018]

- (1) B < Al < In < Ga < Tl
(2) B < Al < Ga < In < Tl
(3) B < Ga < Al < Tl < In
(4) B < Ga < Al < In < Tl

27. For the second period elements the correct increasing order of first ionization enthalpy is : [NEET 2019]

- (1) Li < Be < B < C < O < N < F < Ne
(2) Li < Be < B < C < N < O < F < Ne
(3) Li < B < Be < C < O < N < F < Ne
(4) Li < B < Be < C < N < O < F < Ne

28. Match the oxide given in column A with its property given in column-II.
[NEET 2019]

Column - I

Column-II

- | | |
|-------------------------------------|----------------|
| (i) Na ₂ O | (a) Neutral |
| (ii) Al ₂ O ₃ | (b) Basic |
| (iii) N ₂ O | (c) Acidic |
| (iv) Cl ₂ O 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)

29. Which of the following is an amphoteric hydroxide?
[NEET 2019]

- (1) Sr(OH)₂
(2) Ca(OH)₂
(3) Mg(OH)₂
(4) Be(OH)₂

30. Match the following : [NEET 2020]

Oxide	Nature
(a) CO	(i) Basic
(b) BaO	(ii) Neutral
(c) Al ₂ O ₃	(iii) Acidic
(d) Cl ₂ O ₇	(iv) Amphoteric

Which of the following is correct option ?

- | (a) | (b) | (c) | (d) |
|-----------|-------|-------|-------|
| (1) (iii) | (iv) | (i) | (ii) |
| (2) (iv) | (iii) | (ii) | (i) |
| (3) (i) | (ii) | (iii) | (iv) |
| (4) (ii) | (i) | (iv) | (iii) |

31. Zr (Z = 40) and Hf (Z = 72) have similar atomic and ionic radii because of : [NEET-2021]

- (1) Belonging to same group
(2) Diagonal relationship

- (1) $X = \text{Mg}; Y = \text{F}$ (2) $X = \text{F}; Y = \text{Mg}$
 (3) $X = \text{Na}; Y = \text{Mg}$ (4) $X = \text{Mg}; Y = \text{Na}$
8. The characteristics of elements X, Y and Z with atomic numbers, respectively, 33, 53, and 83 are :
[Jee Main; 2021]
 (1) X and Y are metalloids and Z is a metal.
 (2) X, Y and Z are metals
 (3) X and Z are non-metals and Y is a metalloid.
 (4) X is a metalloid, Y is a non-metal and Z is a metal.
9. The absolute value of the electron gain enthalpy of halogens satisfies :
[Jee Main; 2021]
 (1) $\text{Cl} > \text{Br} > \text{F} > \text{I}$ (2) $\text{I} > \text{Br} > \text{Cl} > \text{F}$
 (3) $\text{Cl} > \text{F} > \text{Br} > \text{I}$ (4) $\text{F} > \text{Cl} > \text{Br} > \text{I}$
10. The set of elements that differ in mutual relationship from those of the other sets is :
[Jee Main; 2021]
 (1) Li – Na (2) B – Si
 (3) Li – Mg (4) Be – Al
11. The set that represents the pair of neutral oxides of nitrogen is :
[Jee Main; 2021]
 (1) NO and N_2O
 (2) N_2O and N_2O_3
 (3) NO and NO_2
 (4) N_2O and NO_2
12. The ionic radius of Na^+ ion is 1.02 Å. The ionic radii (in Å) of Mg^{2+} and Al^{3+} , respectively, are :
[Jee Main; 2021]
 (1) 0.72 and 0.54 (2) 1.05 and 0.99
 (3) 0.68 and 0.72 (4) 0.85 and 0.99
13. The first ionization energy of magnesium is smaller as compared to that of elements X and Y, but higher than that of Z. The elements X, Y and Z, respectively, are :
[Jee Main; 2021]
 (1) Argon, lithium and sodium
 (2) Argon, chlorine and sodium
 (3) Neon, Sodium and chlorine
 (4) Chlorine, lithium and sodium
14. Outermost electronic configuration of a group 13 element E, is $4s^2, 4p^1$. The electronic configuration of an element of p-block period-five placed diagonally to element, E is :
[Jee Main; 2021]
 (1) $[\text{Ar}] 3d^{10} 4s^2 4p^2$ (2) $[\text{Kr}] 4d^{10} 5s^2 5p^2$
 (3) $[\text{Xe}] 5d^{10} 6s^2 6p^2$ (4) $[\text{Kr}] 3d^{10} 4s^2 4p^2$
15. Which one of the following statements for D.I. Mendeleeff, is incorrect?
[Jee Main; 2021]
 (1) He invented accurate barometer.
 (2) He authored the textbook - principles of chemistry.
 (3) At the time, he proposed periodic Table of elements structure of atom was known.
 (4) Element with atomic number 101 is named after him.

16. The ionic radii of K^+ , Na^+ , Al^{3+} and Mg^{2+} are in the order :
- [Jee Main; 2021]**
- (1) $Na^+ < K^+ < Mg^{2+} < Al^{3+}$
 (2) $Al^{3+} < Mg^{2+} < Na^+ < K^+$
 (3) $K^+ < Al^{3+} < Mg^{2+} < Na^+$
 (4) $Al^{3+} < Mg^{2+} < K^+ < Na^+$
17. Number of electrons present in 4f orbital of Ho^{3+} ion is _____. (Given Atomic No. of Ho = 67)
- [Jee Main; 2021]**
18. The ionic radii of F^- and O^{2-} respectively are 1.33 Å and 1.4 Å, while the covalent radius of N is 0.74 Å. The correct statement for the ionic radius of N^{3-} from the following is :
- [Jee Main; 2021]**
- (1) It is smaller than O^{2-} and F^- , but bigger than of N
 (2) It is smaller than F^- and N
 (3) It is bigger than F^- and N, but smaller than of O^{2-}
 (4) It is bigger than O^{2-} and F^-
19. Match List - I with List - II ;
- [Jee Main; 2021]**
- | List - I | List - II |
|----------------|------------------|
| (a) NaOH | (i) Acidic |
| (b) $Be(OH)_2$ | (ii) Basic |
| (c) $Ca(OH)_2$ | (iii) Amphoteric |
| (d) $B(OH)_3$ | (e) $Al(OH)_3$ |
- Choose the most appropriate answer from the options given below :
- (1) (a)-(ii), (b)-(ii), (c)-(iii), (d)-(i), (e)-(iii)
 (2) (a)-(ii), (b)-(i), (c)-(ii), (d)-(iii), (e)-(iii)
 (3) (a)-(ii), (b)-(iii), (c)-(ii), (d)-(i), (e)-(iii)
 (4) (a)-(ii), (b)-(ii), (c)-(iii), (d)-(ii), (e)-(iii)
20. The correct order of first ionisation enthalpy is :
- [Jee Main; 2021]**
- (1) $Mg < Al < S < P$ (2) $Al < Mg < S < P$
 (3) $Mg < S < Al < P$ (4) $Mg < Al < P < S$
21. Chalcogen group elements are :
- [Jee Main; 2021]**
- (1) Se, Te and Po (2) Se, Tb and Pu
 (3) O, Ti and Po (4) S, Te and Pm
22. The number of f electrons in the ground state electronic configuration of Np ($Z = 93$) is (integer answer)
- [Jee Main; 2021]**
23. The nature of oxides V_2O_3 and CrO is indexed as 'X' and 'Y' type respectively. The correct set of X and Y is:
- [Jee Main; 2021]**
- (1) X = basic Y = basic
 (2) X = amphoteric Y = basic
 (3) X = basic Y = amphoteric
 (4) X = acidic Y = acidic
24. The correct order of ionic radii for the ions, P^{3-} , S^{2-} , Ca^{2+} , K^+ , Cl^- is :
- [Jee Main; 2021]**
- (1) $K^+ > Ca^{2+} > P^{3-} > S^{2-} > Cl^-$
 (2) $P^{3-} > S^{2-} > Cl^- > K^+ > Ca^{2+}$
 (3) $P^{3-} > S^{2-} > Cl^- > Ca^{2+} > K^+$
 (4) $Cl^- > S^{2-} > P^{3-} > Ca^{2+} > K^+$

25. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.
- Assertion (A)** : Metallic character decreases and non-metallic character increases on moving from left to right in a period.
- Reason (R)** : It is due to increase in ionisation enthalpy and decrease in electron gain enthalpy, when one moves from left to right in a period.
- In the light of the above statements, choose the **most appropriate** answer from the options given below.

[Jee Main; 2021]

- (1) (A) is false but (R) is true
- (2) (A) is true but (R) is false.
- (3) Both (A) and (R) are correct and (R) is the correct explanation of (A)
- (4) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

Answer Key
EXERCISE-I

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

EXERCISE-III

1.	C	2.	D	3.	A	4.	D	5.	D	6.	A	7.	A
8.	A	9.	C	10.	A	11.	C	12.	A	13.	C	14.	C
15.	A	16.	A	17.	C	18.	B	19.	D	20.	D	21.	C
22.	B	23.	B	24.	D	25.	D	26.	A	27.	B	28.	A
29.	D	30.	B	31.	B	32.	B	33.	A	34.	A	35.	C

EXERCISE-IV

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	D	A	C	A	A	B	D	C	C	B	A	D	D	C
16	17	18	19	20	21									
C	B	C	C	C	D									

EXERCISE-V

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
D	D	B	C	A	A	C	B	B	D	C	C	B	A	A
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
B	A	B	B	B	C	C	A	B	B	D	C	D	D	D
31														
C														

EXERCISE-VI

1.	1	2.	2	3.	4	4.	1	5.	4	6.	1	7.	3
8.	4	9.	3	10.	1	11.	1	12.	1	13.	2	14.	2
15.	3	16.	2	17.	10	18.	4	19.	3	20.	2	21.	1
22.	4	23.	1	24.	2	25.	2						