BOOKLET SOLUTIONS

Classification of Elements & periodicity in properties

Level 1

1) Element A of Group V A valency 3
Element B of Group VI A valency 2

$$\overset{+3}{A}\overset{-2}{B} = A_2B_3$$

2) Refer to text
3) " " "
4) Electronegativity increases on moving left to right in a ~~Hero~~ periodic table.
5) Belong to eka-aluminium given by Mendleev.
6) Halogen have tendency to gain electron, hence high I.E.
7) Refer to text
8) On moving down the group electropositive character increases due to decrease in I.E
9) Nitrogen has ns^2np^3 (half-filled) stable p-orbital, hence high Ionisation potential.
10) In N^{3-}, the effective nuclear charge is least.
11) In Zr & Hf, the chemical properties are nearly same due to lanthanoid contraction.

12) Refer to text

13) (B) There is only one ~~e~~ electron in the valence shell of group 1 elements, hence low I.E values.

14) In ns^2np^4, the loss of one electron will be faster to achieve half filled stable ns^2np^1 configuration.

15) Refer to Text

16) Atomic radius decreases from left to right in a periodic table due to increase in effective nuclear charge.

17) If electronegativity is high, then removal of electron from the valence shell is difficult, due to high Z_{eff} (effective nuclear charge) thus high ionisation potential.

18) Refer to text

19) Size decreases from group 1 to group 17 & suddenly increases for group 18 (noble gas) as we measure vander waal radius here.

20) I.E increases from left to right., for aluminium, the I.E is less than Mg, because Mg has fully filled ns^2 configuration.

21) Along a period electronegativity increases & down the group it decreases.

22) First element of each period refers to the group 1 of the periodic table, i.e ns¹ configuration.

23) Non-metals have strong tendency to forms anions, specially elements belonging to group 15, 16 & 17 of periodic table.

24) Refer to text

25) Group 1 & group 17 elements have sufficient difference in their electronegativities, also the valency of both the groups is one, Hence XCl would be formed having ionic character.

26) Electropositive character decreases on moving left to right in a periodic table.

27) Defination of Modern Periodic table given by H. Mosley.

28) Refer to text

29) Arsenic & Bismuth belongs to same group i.e 15th group, so both have $5e^{\ominus}$ in the outermost or valence shell.

30) Refer to text

31) H can show +1 or −1

Cl can show −1, +1, +3, +5, +7

Br can show −1, +1, +3, +5, +7.

32) d-has a diffused shape as compared to p-orbital, so p is more stable than d. Also fully filled orbitals are always more stable than half filled due to high exchange energy value.
& more symmetry.

33) Higher the molar mass (atomic mass) higher will be the boiling point.

34) After removal of one electron K^+ becomes higher stable attaining Ar configuration, thus its 2nd I.E value is too high.
Group 2 elements after removal of one electron accquire ns' configuration, thus it is easy to remove 2nd $e^\ominus$ from their valence shell.
Hence the order is K > Ca > Ba.

35) Refer to text

36) Option (b) as it has small size & stable half filled configuration.

37 It is easy to remove electrons from highly electropositive metals - possessing ns^1 or ns^2 configuration.

38 Li has smallest size (volume) & lowest mass thus density is less.

39 During conversion of $O \longrightarrow O^{2-}$, the Ist step is exothermic, but the 2nd step $O^- + e^{\ominus} \longrightarrow O^{2-}$ involves absorption of energy, due to repulsion b/w O^- & $e^{\ominus}$.

40 Refer to text

41 Li due to its small size & high e/m ratio forms more stable nitrides.

42 After flourine, oxygen is the 2nd most electronegative element

43 KOH bond is most ionic, thus will break fast to form more soluble hydroxide.

44 Sn belongs to group 14 having ns^2np^2 configuration thus, it can show a valency of 4, forming SF_4.

45 Nitrogen can form various oxides with N_2O_5 having highest oxidation state i.e +5 on N. Higher the oxidation stable, better is the acidic character.

46) He is a small size element ~~smallest~~ smallest volume out of the four elements ~~out~~ mentioned here.

47) Refer to text

48) Chlorides of Group 1 for example, NaCl, KCl etc. give neutral solution in water.

49) for Zero group elements group no. is 18, no. of valence electrons are 8 & their valency is Zero.

50) Refer to text

LEVEL-2

1)

2) Bromine refer to text for values.

3) In case of Cations, radius of isoelectronic species decreases with the increase in nuclear charge. Eg:

$$Na^+ > Mg^{2+} > Al^{3+}$$

4) Cl has highest electron affinity, due to its high electronegativity & sufficient large atomic radius.

5) Refer to text

6) In Alkaline earth metals, the configuration is ns^2, thus more stable than alkali metals having ns^1 configuration. So the value of Ist I.E for alkaline earth metals is high.

7) Weaker electron-electron repulsion in Cl atom due to its sufficiently large atomic size.

8) 2nd I.E of Na is more than Mg. refer to text.

9) No. of valence electrons in a group remains constant or same ~~down~~ on moving down the group.

10) Caesium is the most electropositive element.

11) Refer to text

12) Atomic no. 16 (sulphur) belongs to VIth periodic of Mendleev periodic table & group & 16 of modern periodic table.

13) Refer to text

14) Elements of d-block (transition elements) show variable oxidation states.

15) Higher the loss in electrons, more will be the effective nuclear charge & smaller will be the size.

16. Refer to text for values of Electronegativity.

17. Zn shows only +2 oxidation state, because after removal of 2 $e^{\ominus}$, it attains stable d^{10} configuration.

18. Refer to text

19. Li ~~beta~~ being smallest in size over here, will have high effective nuclear charge, thus more heat is absorbed to remove the electron.

20. $C-C > C=C > C\equiv C$

The bond length of single bond is larger than double bond is larger than triple bond.

21. Definition of Modern Periodic Law.

22. Cr has $3d^5 4s^1$ outermost electronic configuration; After removal of $1e^{\ominus}$, it acquires stable half-filled $3d^5$ configuration, hence more stable.

23. Ans (c) N^{3-}, F^-, & Na^+ all three have 10 $e^{\ominus}$ in their atom hence, isoelectronic.

24. Refer to text

25. Higher the electronegativity of the element, more will be the acidic strength.

26) All Lanthanides & Actinides belong to group III B of Periodic table & the daughter element Th (Thorium) belongs to actinides series (5f).

27) Refer to text.

28) The Ist I.E of Mg is more than Na due to its fully filled stable ns^2 configuration, Mg has its Ist I.E even more than Al, because Al has ns^2np^1 configuration, so its easy to remove $\frac{1}{A}$ electron from p-orbital.

29) There is not much difference in energies $I.E_1$, $I.E_2$, $I.E_3$ & $I.E_4$, Suddenly there is a large increase in I.E on moving from $I.E_4$ to $I.E_5$. It is means it is easy to remove a maximum of 4 electrons from this atom & removal of 5th electron is very difficult. Thus no of valence electrons present must be four.

Si is the correct option.

30) Refer to text

31) Percentage of ionic character $= 16(X_A - X_B) + 3.5(X_A - X_B)^2$

32) Refer to text

33 NH_3, CH_4 & H_3O^+ all three have a total of 10 electrons, Hence, they are isoelectronic.

34 H_3PO_2 oxidises itself to H_3PO_4 behaving as a reducing agent

35 Adding of electron to neutral gaseous atom will produce an anion, with liberation of energy, increase in the no. of electrons will decrease the proton/electron ratio.

36 Refer to text

37 O^+ has $2s^2 2p^3$ configuration (half-filled) stable p-orbital, thus very stable. X has high I.P value. & N^{3-} has largest size out of Triad-I so lowest I.P, & at it has least effective nuclear charge on it.

38 $Z = 2, 8, 8, 1$ is most metallic as it will loose one electron present in its Valence shell readily.

39 Ist I.E does show change (increase generally, for some elements decrease) on moving left to right in a periodic table.

40 In^{+} Hg^{2+} effective nuclear charge is more as compared to Hg^{+}.

41 Refer to text

42 Refer to text

43 More electropositive the metal is, higher is the basic character of its oxides. & electropositive nature increases with increase in atomic no.

44 There is very high difference in 3rd & 4th I.E values, thus it has a valency of 3. 3 valence electrons. It will form M^{3+} ion easily.

45 L has valency 2,
P has " 1
Q " " 1
R " " 2.

46) Refer to text

47) More metallic the oxide, more will be the basic character.

48) Refer to text.

Previous Year Questions

1) Yb^{2+} has zero unpaired electrons
2)
3) Refer to text
4) Refer to text
5) Se^{2-} has 4 shells (orbits) and addition of 2 electron would increase the size further, hence Se^{2-} has largest size.
6) H_2 has smallest size, so bond enthalpy is highest.
7) refer to text
8) oxygen > Nitrogen > Beryllium > Magnesium
9) ~~refer to text~~
9) radii increase when neutral atom converts to anion & radii decreases when neutral atom converts to cation
10) Cl has larger gain enthalpy than fluorine due to sufficiently large atomic size
11) Be is $1s^2 2s^2$ so, it will be difficult to remove the 3rd $e^{\ominus}$ from Be having $1s^2$ configuration

12 ~~Nitrogen~~ Refer to text

13 lesser the value of ionisation potential more easy is the formation of cation because removal of $e^{\ominus}$ becomes faster.

14 Refer to text.

15 "

16 "

17) Anions > Neutral atom > Cation

18) I.E increase, on moving from left to right in a period but the I.E of N is more than oxygen. This is due to more stable ns^2np^3 configuration present in nitrogen.

19 More is the electropositive nature of element more basic will be the oxide formed from it & vice versa.

20 refer to text

21 refer to text

22 refer to text

23 Size of anions is greater than the parent atom & Size of cations is smaller than " " " .

24 Percentage of ionic character = ~~1.6~~

$$= 16(X_A - X_B) + 3.5(X_A - X_B)^2$$

25 Higher the nuclear charge, higher is the ionisation energy.

(26) Be has $2s^2$ configuration & N has $2s^2 2p^3$ configuration hence more stable.

(27) Electron affinity decreases on moving down in a group, but Cl has more e⊖ affinity than F due to ~~less~~ larger size.

~~less~~.

(28) (b) is incorrect because 1st I.E of oxygen is less than nitrogen.

(29) It is due to increase in the effective nuclear charge with regular increase in atomic no.

(30) Ionisation potential decreases on moving down the group due to decrease in Z_{eff}.

(31) Li is smallest, has 2 shells only

(32) Cr^+ has $3d^5\ 4s^0$
Mn^+ has $3d^5\ 4s^1$
V^+ has $3d^3\ 4s^1$
Ti^+ has $3d^2\ 4s^1$ configurations after loss of one e⊖, thus, ~~it~~ in Cr^+ $3d^5$ stable configuration is present so, highest 2nd I.E value,

(33) Refer to text

(34) Mg^{2+} is larger in size than Al^{3+}, as in Al^{3+}, there is removal of $3e^{\ominus}$, which decreases the size by increasing the effective nuclear charge.

(35) Depending upon the electronic configurations, the I.E values varies.

(36) $3s^2 3p^5$ needs one electron, this element is a 17th group element, will form a strong bond with group 1 element.

(37) K^+ has noble gas configuration of Argon, & also it has a small size, so high I.E value.

(38) Gain of electrons, decreases the effective nuclear charge increasing the atomic size.

(39) Refer to text

(40) Ca has ns^2 configuration & oxygen has $ns^2 np^4$ configuration so, they both will form a strong bond easily.

(41) M has lowest value of Ist I.E thus, it has highest atomic no. or size too.

(42) Cs being most electropositive & F being most electronegative will combine in most violent fashion.

(43) Acidic oxides are formed generally by non metals so X is most electronegative, amphoteric oxides are formed generally by metalloids, & basic oxides are formed by metals. Thus Y is least electronegative.

(44) % covalent character

$$= 100 - [0.16\Delta + 0.035\Delta^2] \times 100$$

(45) Same as ques no. 32.

(46) Ionic radii is smaller if the effective nuclear is high.

(47) Refer to text

(48) Larger the size lower is the ionisation potential.

(49) anions have larger size than neutral atom than cation, if they atoms are isoelectronic.

(50) Oxygen have small size & $2s^2 2p^4$ configuration, so high ionisation energy.

(51) Refer to text

(52) Fluorine has highest electron affinity out of these elements given here.

(53) ~~[illegible]~~

(52) Refer to text

(54) Ist I.E of Be is higher than B, ~~[illegible]~~

(55) Refer to the values of electron affinity from the text.

(56) After loss of an electron from $1s^2 2s^2 2p^6 3s^1$ configuration, this element will attain noble gas configuration. Thus Ist I.E is too low in this, & 2nd I.E is too high.

(57) $1s^2$ is He, noble gas, hence very stable.

(58) Cl_2 has ~~[illegible]~~ higher bond dissociation than F_2.

(59) Solution is same as ques no. 32.

(60) F_2 has highest electronegativity value, thus most active chemically.

(61) Lithium is metallic.

(62) Sn because in case of Pb, inert pair effect is present.

(63) When O changes to O^{2-}, electron–electron repulsion is there.

(64) Noble gas have completely filled orbitals, hence highest I.E in the respective period.

(65) Atomic radii decreases on moving left to right in a period but for noble gases the size suddenly increases as these have vander waal's radii.

(66) Refer to text for formula.

(67) N^{3-} will have size inbetween the size of C^{4-} & O^{2-}.

(68) Ist I.E of nitrogen is higher than oxygen.

(70) ns' will have lowest I.E value.

(69) Refer to text

(71) refer to text

(72) Atomic size decreases from left to right in a period.

(73) Refer to text

(74) Refer to text

(75) High effective nuclear charge.

(76) Refer to text

(77) Higher the positive charge on the cation, more is the effective nuclear charge, smaller is the size.

(78) Nitrogen has stable $ns^2 np^3$ configuration, hence high I.E.

(79) Oxygen being smaller in size has maximum charge density

(80) Due to the smallest size of Hydrogen.

(81) both O^{2-} & S^{2-} will have negative electron gain enthalpy values.

(82) Refer to text

(83) Same as solution no. 23.

(84) Refer to text

(85) Electronegative nature, to pull the electrons

(86) $I.E + E_A = \Delta H$ (eV)/atom $\Rightarrow \frac{\Delta H \times 1.6\times10^{-19} \times 6.022\times10^{23}}{1000}$

(87) Most non-metallic is Phosphous (P)

(88) d-block elements.

(89) Cs & I have large sizes.