20/08

Classification of Elements & Periodicity in properties

1. What is the basic theme of organisation in periodic table?

ans The basic theme of Organisation of elements in the periodic table is to simplify and systematize the study of the properties of all the Elements and million of their compounds. This has made the study simple because the properties of Elements are now studied in form of groups rather than Individually.

2. Which Important property did Mendeleev use to classify the Elements in his periodic table and did he stick to that?

ans Mendeleev used atomic weight as the basis of classification of Elements in the periodic table. He did stick to it and classify elements into groups and periods.

3. What is the basic difference in approach between Mendeleev periodic law and the Modern periodic law?

ans The basic difference in approach between Mendeleev's Periodic law and Modern periodic law is the change in basis of classification of Elements from atomic weight to atomic number.

4. On the basis of quantum numbers, justify that sixth period of the table should have 32 Elements.

ans The Sixth period correspond to sixth shell. The orbitals present in this shell are 6s, 4f, 5p and 6d. The Maximum number of Electrons which can be present in these sub shell is $2+14+6+10=32$. Since the no. of Elements in a period corresponds to the number of Electrons in the shells, the sixth period should have a minimum of 32 Elements.

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5 In terms of period & group where will you locate the 17th group

ans period - 7
Group - 14
Block - p

8 Why do elements in the same group have similar and chemical properties?

ans The elements in a group have valence shell electronic configuration and hence have similar physical and chemical properties

9 What does atomic radius & Ionic radius really mean to you

ans Atomic Radius - Distance between the centre of nucleus to the outermost shell of electrons in the atom any element is called Atomic Radius
Ionic Radius - The Ionic radii can be estimated by measuring the distance between cations and anions in Ionic crystals.

10 How do atomic radius vary in a period and in a group? How do you explain the variation?

ans With a group Atomic radius increases down the group
Reason - This is due to continuous increases in the number of electronic shells or orbitals numbers in the structure of atoms of the elements down a group.

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Atomic Radii - from left to right across a period generally decreases due to increase in effective nuclear charge from left to right across a period

11 What do you understand by Iso Electronic species? Name a species that will be iso electronic with each of the following atoms / Ions
(i) F^- (ii) Ar (iii) Mg^{+2} (iv) Rb^+

ans Iso Electronic species are those species (atoms / ions) which have same number of electrons. Iso Electronic species are:
(i) Na^+ (iii) Na^+
(ii) K^+ (iv) Sr^{2+}

12 Consider the following species:
$N^{3-}, O^{2-}, F^-, Na^+, Mg^{2+}, Al^{+3}$
(a) What is common in them?
(b) Arrange them in order of increasing Ionic radii

ans (a) All of them have same no. of electrons within them
(b) In Isoelectronic species, greater the nuclear charge, lesser will be the atomic or Ionic radius
$Al^{+3} < Mg^{+2} < Na^+ < F^- < O^{2-} < N^{3-}$

13 Explain why cations are smaller and anions larger in radii than their parent atoms.

ans A cation is smaller than the parent atom because it has fewer electrons while its nuclear charge remain the same. The size of anion will be larger than that of parent atom because the addition of one or more electrons would result in increased among the electrons and a decrease in effective nuclear charge

15 Energy of an Electron in the ground state atom is -2.18×10^{-18} J. Calculate the Ionization enthalpy of atomic hydrogen in terms of J Mol^{-1}

ans The Ionization Enthalpy of 1 mole atoms. Therefore ground state Energy of the atoms may be Expressed as

$$E\ (\text{ground state}) = -2.18 \times 10^{-18}\ \text{J} \times 6.022 \times 10^{23}$$
$$= -1.312 \times 10^{6}\ \text{J}$$

$$\text{Ionization enthalpy} = 0 - (-1.312 \times 10^{6})$$
$$= 1.312 \times 10^{6}\ \text{J mol}^{-1}$$

16 Among the second period Elements, the actual Ionization Enthalpies are the order:

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

Explain why

(i) Be has higher ΔH_i than B

(ii) O has lower ΔH_i than N and F ?

(i) Be – $1s^2 2s^2$ outer ~~st~~ most Election in present in 2s orbital while in B ($1s^2 2s^2 2p^1$) it is present in 2p orbital. Since 2s - Election are more strongly attracted by the nucleus than 2p - Elections, therefore, lesser amount of Energy is required to knock out a 2p - Electron than a 2s - Election.

(ii) The Electronic Configation

$N_7 = 1s^2 2s^2 2p_x^1 2p_y^1 2p_z^1$

$O_8 = 1s^2 2s^2 2p_x^2 2p_y^1 2p_z^1$

We can observe in case of nitrogen 2p - orbitals are Excatly half ~~to~~ filled. Therefore, it is difficult to remove an Election from N from O.

17 How would you Explain the fact the first ionization Enthalpy of Sodium is lower than that of Magnesium but its Second Ionization Enthalpy is higher than that of magnesium?

ans Electronic configiration of Na and Mg are

Na – $1s^2 2s^2 2p^6 3s^1$

Mg – $1s^2 2s^2 2p^6 3s^2$

First Election in both cases has to be removed from 3s orbital but the nuclear charge of Na (+11) is lower than of Mg (+12) therefore first ionization Energy of Sodium is lower than that of magnesium.

After the loss of first Election, the Election configuration

Na^+ – $1s^2 2s^2 2p^6$

Mg^+ – $1s^2 2s^2 2p^6 3s^1$

Here Na^+ has Attained Ne configration which is very Stable and hence removal of Second require much Energy.

18 What are the various factors due to which the Ionization Enthalpy of the main group Elements tends to decrease down the group?

ans (i) Atomic Size

(ii) Screening / Shielding Effect

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19 The first ionization Enthalpy values (in kJ mol⁻¹) of grp 13 Elements are

B	Al	Ga	In	Tl
801	577	579	558	589

How would you Explain this deviation from the general trend ?

ans The decrease in $\Delta_i H$, value from B to Al is due to the bigger size of Al.
In ~~gala~~ ga there is 10 $d^{?}$ Electron which does not screen as is done by s and p Electron. The same is with into Tl. The latter has fourteen 4f electron with very poor shielding Effect. This also increases the Effective nuclear charge thus the value of $\Delta_i H_i$ increases.

20 Which of the following pair of Elements would have to more negative element gain Enthalpy.
(i) O or F (ii) F or Cl

(i) Both O and F lie in 2nd ~~perod~~ period. As we move from O to F the atomic size decreases. Due to smaller size of F nuclear charge increases. Further, gain of one Electron by,
$F \rightarrow F^-$
F⁻ ions has inert gas configration, while the gain of one Electron by
$O \rightarrow O^-$
give O⁻ ions which does not have stable inert gas configration, consequently, the Energy released is much higher in going form.
In other word Electron gain Enthalply of F is much more negative than that of Oxygen.

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(ii) The reason for deviation is due to the smaller of F. Due to its small size, the Electron repulsion in the relatively compact 2p-subshell are comparatively large hence the attractive for incoming Electron is less in the case of Cl.

22 What is the basic difference between the terms Electron gain Enthalpy and Electro negatively ?

ans Electron gain ~~Electron~~ Enthalpy refers to an Isolated gaseous atom to accept an additional Electron to form a negative ion. whereas Electronegativity refers to tendency of the atom of an Element to attract shared pair of Electron towards in a covalent bond.

23 How would you react to the Statement that the Electronegativity of N on pauling scale is 3.0 in all the nitrogen compounds

ans On pauling Scale, the Electronegatively of Nitrogen (3.0) Indicates that it is sufficiently Electronegative But it is not correct to say that the Electronegativity of nitrogen in all the compounds is 3. It depend on state of Hybridisation. more is the s character more will be the Electronegativity

24 What you Expect the first ionization enthapice of two isotope of the same elements to be the same / different ! Justify.
Ionization Enthalply, among the first ionization depends on its Electronic configuration and nuclear charge since isotopes of an Elements have the same Electronic and same nuclear charge, they have same ionization

25 What are major difference between metal & non metal

Metals	Non metals
1. Have strong tendancy to lose Electrons to form cation	1. Non metals have a strong tendency to accept Electron to form anions
2. Metals are strong reducing agents	2. Non metal are strong Reducing agent.
3. Metals have low Ionization Enthalpies	3. Non metals have high Ionization Enthalpies
4. metals form basic oxides and Ionic compound	4. Non metals form acidic oxides and covalent compound.

27 Use periodic table and find out

(i) Identify the Element with 5 Electrons in outer subshell

(ii) Identify the Element that would tend to lose two Elements

(iii) Identify the Element that belong tend to gain two Elements.

(i) Elements belonging to Nitrogen family (group 15) nitrogen

(ii) Elements belonging to Alkaline Earth family (group 2) Magnesium

(iii) Element belonging to Oxygen family (group 16) Oxygen

28 Write the general Electronic configuration of s- p- d- and f-block Elements?

ans (i) s - Block Elements : ns^{1-2} where $n = 2-7$

(ii) p - Block Elements : $ns^2 np^{1-6}$ where $n = 2-6$

(iii) d - Block Element $(n-1)d^{1-10} ns^{0-2}$ where $n = 4-7$

(iv) f - block Elements $(n-2)f^{0-14} (n-1)d^{0-1} ns^2$ where $n = 6-7$

29 The Increasing order of reactivity among group I elements is Li< Na<K<Rb<Cs whereas that of group 17 is F>Cl>Br>I Explain?

ans The Elements of Group I have only one Electron in their respective valence shells and thus have a strong tendancy to lose this Electron. The tendency to lose Electron in turn, depends upon the ionization enthalpy. It is linked with Electronegativity. Since both of them decrease down the group, the reactivity decreases.

30 Assign the position of Elements having outer Electronic configuration,

(i) $ns^2 np^4$ for $n = 3$

(ii) $(n-1)d^2 ns^2$ for $n = 4$

(iii) $(n-2)f^7 (n-1)d^1 ns^2$ for $n = 6$ in periodic table?

ans (i) p-block
group - 16 } Sulphur
3-rd period

(ii) 4th period } Titanium
group 4

(iii) 6th period } gaddium
f block
group 3

31 Chosse the Incorrect option

(b) ans (b) The d-block has 8 columns, because a maximum of 8 Electrons can occupy all the orbitals in a d-sub-shell.

33 In modern periodic Table, the period Indicate
(c) principal quantum number

34 Predict the formulas of the stable Binary compounds that would formed by the combination
ans (a) LiO_2
(b) Mg_3N_2
(c) AlI_3
(d) SiO_2
(e) PF_5
(f) LuF_3

35 Anything that Influence the valence Electrons will affect the chemistry of Element.
ans (c) Nuclear mass

36 The size of iso electronic species F^-, Ne and Na is affected by
ans (a) Nuclear charge

37 which of the following statement is incorrect in relation to Ionization Enthalpy ?
(d) Removal of Electron from orbitals bearing lower n value is easier than form orbital having higher n value.

Q. 8/8 JAS

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1) BeCl is a polar compound yet $BeCl_2$ is a non polar compound.
2) Show σ and π bond formation in C_2H_6, C_2H_4, C_2H_2. Draw orbital diagrams and hybrisation
3) Account for discrepincy in bond angle
i) ∠HOH in water
ii) ∠HNH in NH_3
4) compare the bond order and relative stability of
i) O_2, O_2^-, O_2^{2-}, O_2^{2+}, O_2^+
ii) N_2, N_2^+
Predict the magnetic character
5) Define Resonance, draw the resonance structure of
i) CO_3^{-2} ii) CO_2 iii) N_3^-
6) Define Hybrisation i) SF_6
7) In PCl_5 are all the P-Cl bond same ?
8) Define Hydrogen bond give condition for formation of H bond.
9) Discuss it types and give suitable eg.

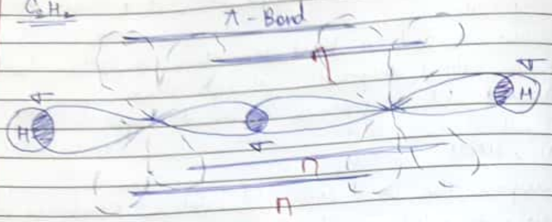
1) $BeCl_2$ is non polar because of the symmetric structure it's structure is linear so the Dipole moment of the compound becomes 0. the force of attraction of electron of both chlorine atom neutralises.

$$Cl \leftarrow Be \rightarrow Cl$$

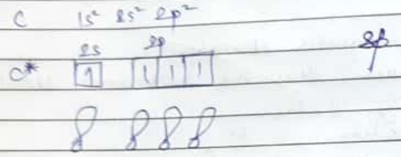
Electro negativity

So Be-Cl polar bond and overall it is non-polar bond.

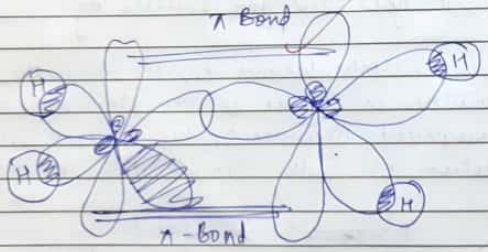
C_2H_2

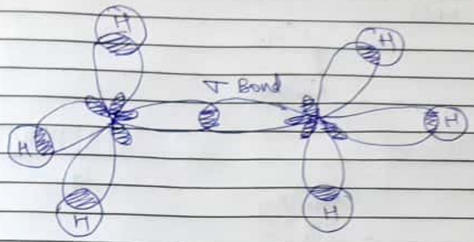


C $1s^2\ 2s^2\ 2p^2$



C_2H_4



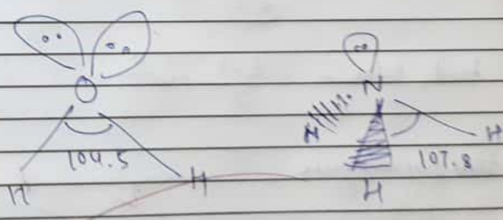


3) (i) $\angle HOH - 104.45°$

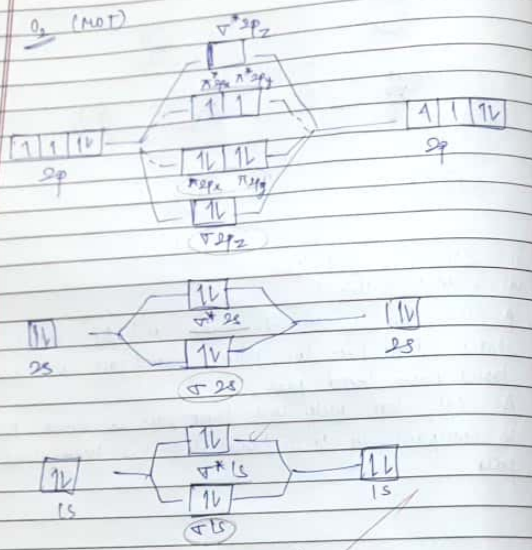
(ii) $\angle HNH - 107.8$

As we can see the difference and As VSEPR Theory states lone pair lone pair > bond pair lone pair > bond pair - bond pair.

As NH_3 has only one lone pair so there Repulsion is comparitively lowe from H_2O as they has two lone pair.



O_2 (MOT)

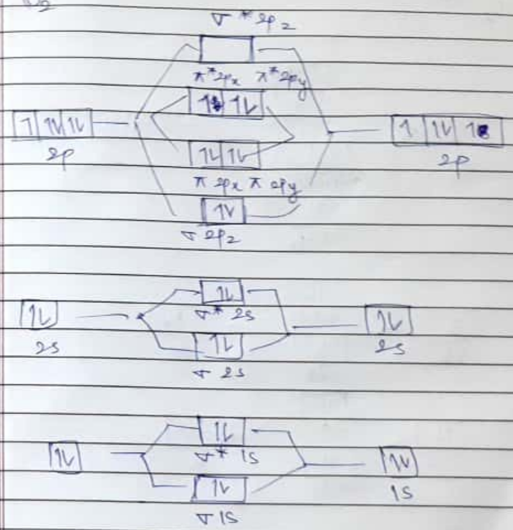


Bond Order = $\frac{8-4}{2} = 2$

~~Dia~~ paramagnetic

$\sigma 1s^2 \ \sigma^* 1s^2$

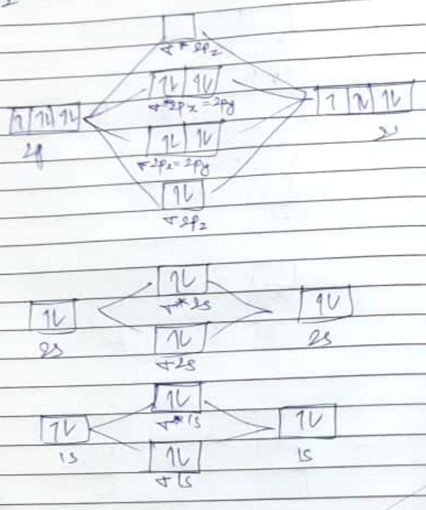
O_2^-



Bond Order $\frac{8-5}{2} = 1.5$

Paramagnetic

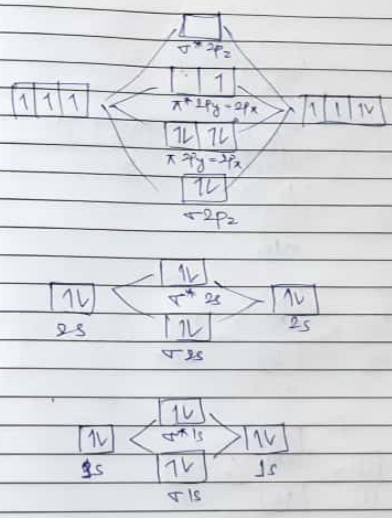
O_2^{-2}



$B.N = \frac{5(2) - 4(2)}{2} = 1$

Diamagnetic

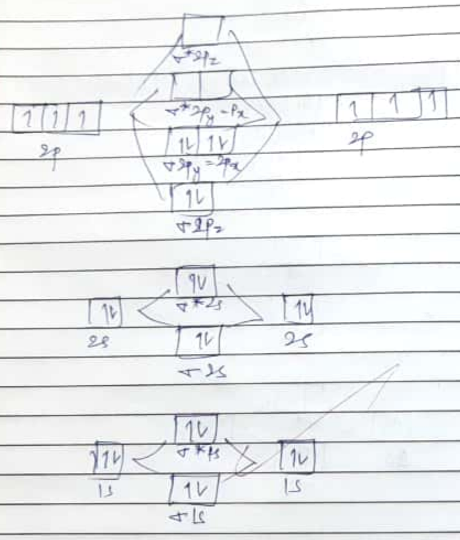
O_2^{+}



Bond Number = $\frac{5(2) - 5}{2} = 2.5$

Para magnetic

O_2^{+2}



$\frac{5(2)-4}{2} = 3$ (~~Para~~ Di magnetic)

So we could finally reach the stability as

$O_2^{+2} > O_2^{+1} > O_2 > O_2^{-1} > O_2^{-2}$

3(ii) N_2

$\sigma 1s^2\ \sigma^* 1s^2\ \sigma 2s^2\ \sigma^* 2s^2\ \sigma 2p_z^2\ \pi 2p_x^2 = 2p_y^2$

$\frac{1}{2}[10-4] = 3$ Diamagnetic

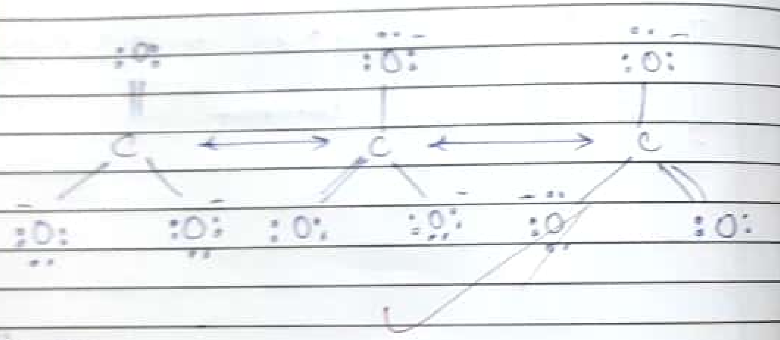
N_2^+

$\sigma 1s^2\ \sigma^* 1s^2\ \sigma 2s^2\ \sigma^* 2s^2\ \sigma 2p_z^2\ \pi 2p_x^2 = \pi 2p_y^1$

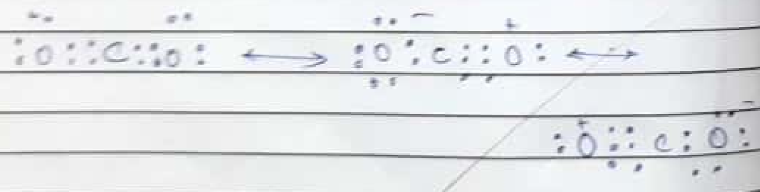
$\frac{1}{2}[10-3] = 3.5$ paramagnetic

5) Resonance is a phenomenon when a structure cannot describe a molecule accurately, a number of structures with similar energy, position of nuclei, bonding and non bonding pairs of electrons are taken as the canonical structures of the hybrid which describes the molecules accurately.

i) CO_3^{2-}



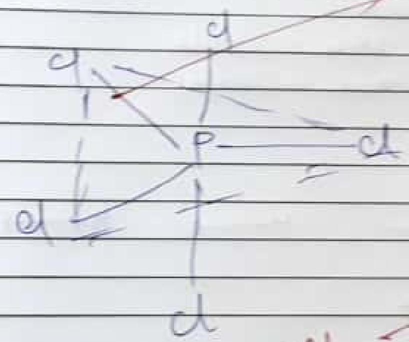
ii) CO_2



6) Hybridisation is the process of intermixing of the atomic orbitals of slightly different energies so as to redistribute their energies, resulting in the formation of new set of orbitals of equivalent energies and shape.

i) sp^3d^2

7) No in PCl_5 not all the bonds are same because of their geometry. It is sp^3d hybrid. So it will have Trigonal bipyramidal structure



$PCl_5 \xrightarrow{\Delta} PCl_3 + Cl_2$

3-Cl lie in one plane making 120 degree angle with each other and other 2-Cl line perpendicular to each other. These bonds are called Equatorial bonds. The remaining two P-Cl bonds lie above and below the Equatorial plane and make an angle 90° with plane. These bonds called Axial bonds. As Axial bond pair suffer more repulsion from the Equatorial bond pairs, axial bonds are slightly longer than Equatorial bonds.

8) A weak bond between two molecules resulting from an Electrostatics attraction between a proton in one molecule and one Electronegative atom in the other.

(i) The molecule should contain a highly Electro-negative atom linked to H-atom

(ii) The size of the Electronegative atom should be Small

9) Hydrogen bonding

(i) Inter – Other molecule

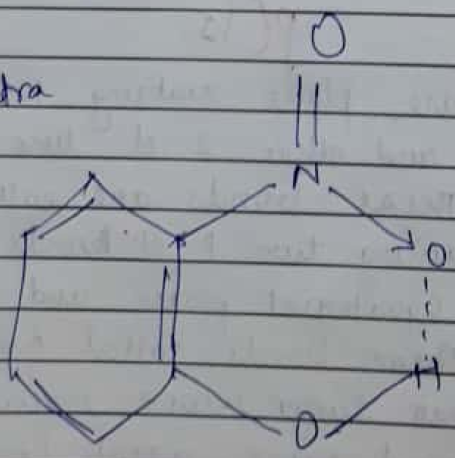
(ii) Intra – Same molecule

(i) Inter

H — F ---- H — F ---- H — F ---- H — F ---- H — F

HF Example

(ii) Intra



o- nitrophenol molecule