ASSIGNMENT 2HIS

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Year of study: 2nd year.

① ⓐ electronegativity is the ability of an atom to attract an electron whereas electron affinity is the energy associated with the addition of an electron to a gaseous atom.

ⓑ covalent bond is the bond associated with the sharing of electron to achieve its configuration while ionic bond is the bond result from transfer of electron to form ions.

ⓒ pure covalent bond is the type of covalent bond that result from equal sharing of electrons participating in a bonding whereas polar covalent bond is one result from ~~ameq~~ inequal sharing of electrons.

ⓓ Valence Bond Theory is the theory that explains the chemical bond between atoms and uses the hybrid orbitals that are assigned to one specific atom whereas MO uses the combination of atomic ~~eb~~ orbitals to yield molecular orbitals ~~to expain~~ that are delocalized

Electronegativity increases up the group and across the period.

~~Na, K~~, Rb

increasing ⟶

(2) (a) Na, K, Rb → Rb, K, Na.

(b) B, O, Ga → Ga, B, O

(c) F, Cl, Br → Br, Cl, F.

(d) S, O, F → S, O, F.

(3) LiF, K_2O, SO_2, N_2 and ClF_3.

LiF > K_2O > SO_2 > ClF_3 > N_2

(4) Octect rule is the tendency of an atom to achieve a configuration where its valence shell contains eight (8) electrons.

Limitations

(i) The rule failed to predict the shape and stability of molecules

(ii) It is based upon the inert nature of noble gases.

(iii) It cannot be applied to the elements in and beyond the third period of the periodic table.

Significance.

(i) It explains formation of chemical bonds depending upon the octet

(ii) Used to determine stability in atoms

(iii) Helps to figure out how atoms bonds with one another.

(5) (a) H_2S $ve^- = 2(1) + 6 = 8$

F.C = $6 - \frac{1}{2}(4) - 4$

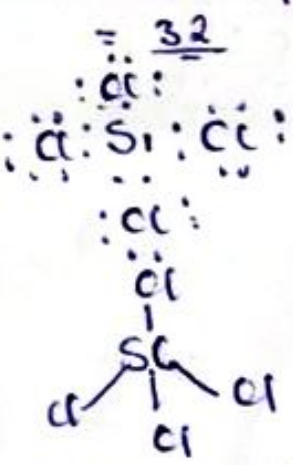
$= 0$

F.C (S) $= 0$

(b) $SiCl_4$

$ve^- = 4 + (7)4$

$= 32$

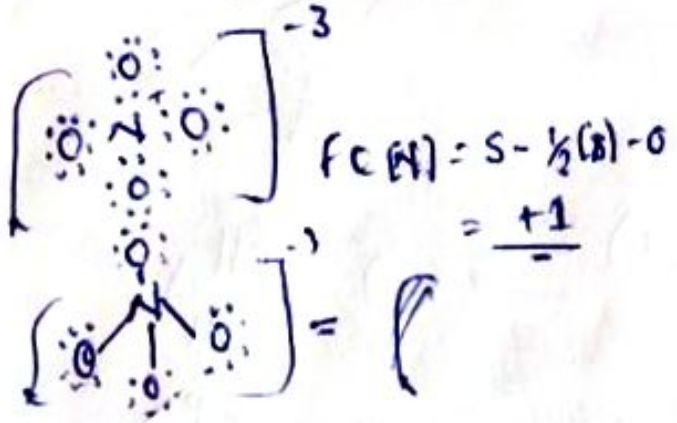


FC of Si = $4 - \frac{1}{2}(8) - 0$

$= 0$

(c) NO_4^{3-} $ve^- = 5 + 6(4) + 3$

$= 32$

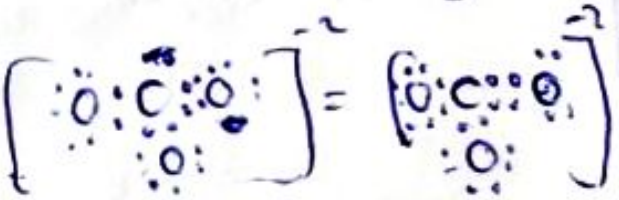


FC (N) = $5 - \frac{1}{2}(8) - 0$

$= +1$

(d) CO_3^{2-} $ve^- = 4 + 2 + 3(6)$

$= 24$

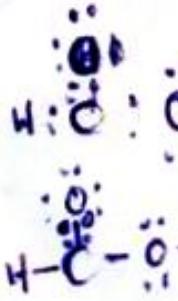


FC of C = $4 - \frac{1}{2}(8) - 0$

$= 0$

(e) $HCOOH$ $ve^- = 6(2) + 4 + 2(1)$

$= 18$



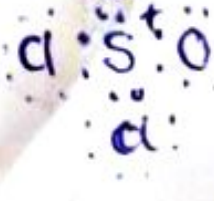
FC of C = $4 - \frac{1}{2}(8) - 0$

$= 0$

(f) SO_2Cl_2

$ve^- = 6 + (6)2 + (7)2$

$= 32$



FC of S = $6 - \frac{1}{2}(8) - 0$

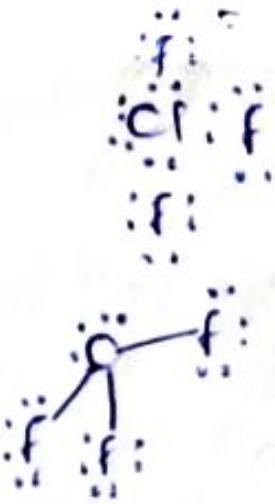
$= +2$

6 (a) SF_4 $ve = 6 + 7(4)$

(b) ClF_3

$ve = 7 + 3(7)$

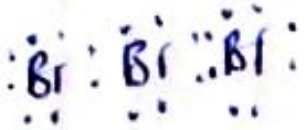
$= 28$



(c) $Br^{3\ominus}$

$ve = 7$ [illegible]

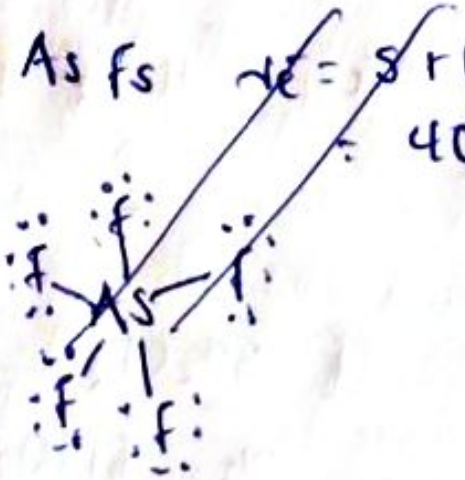
$= 0021$



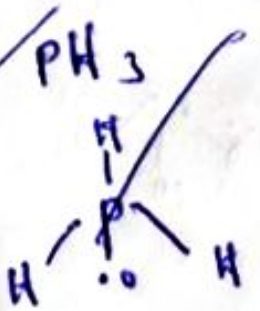
(d) SF_6 $ve = 48$

(e) AsF_5 $ve = 5 + (8 \times 7)$

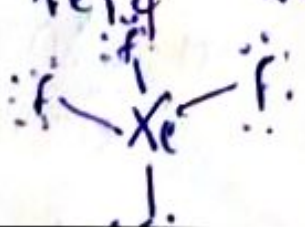
$= 40$



(e) PH_3



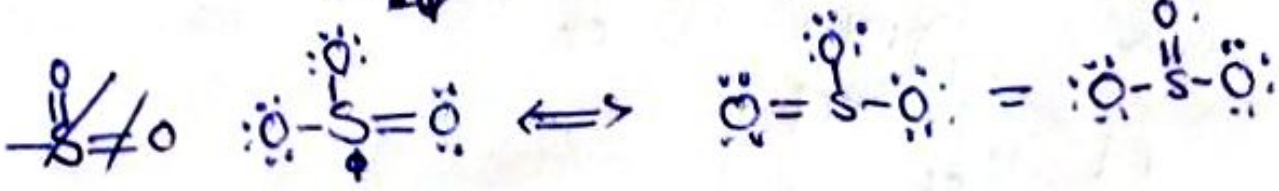
(e) XeF_4 $ve =$



7?

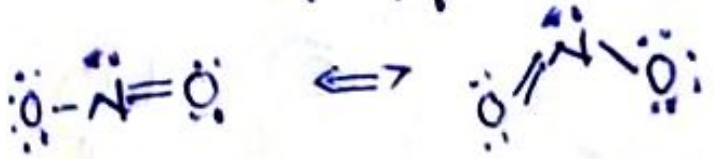
(8) (a) SO_3 ve = 6(3) + 6

= 24.



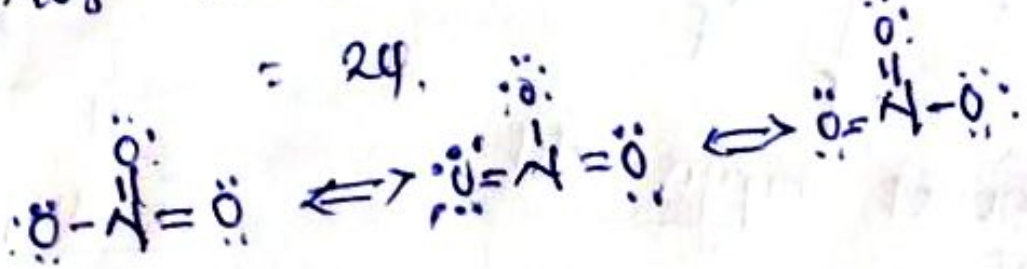
(b) NO_2 ve = 5 + (6)(2)

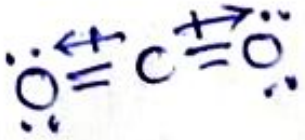
= 17.



(c) NO_3^- ve = 5 + 6(3) + 1

= 24.



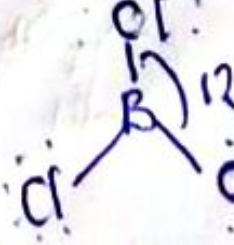
(9) H_2O  CO_2 

according to the shape of each two molecules, H_2O has a net dipole moment since CO_2 its dipole cancel of each other hence has no net dipole moment.

(10) (a) $BeCl_2$

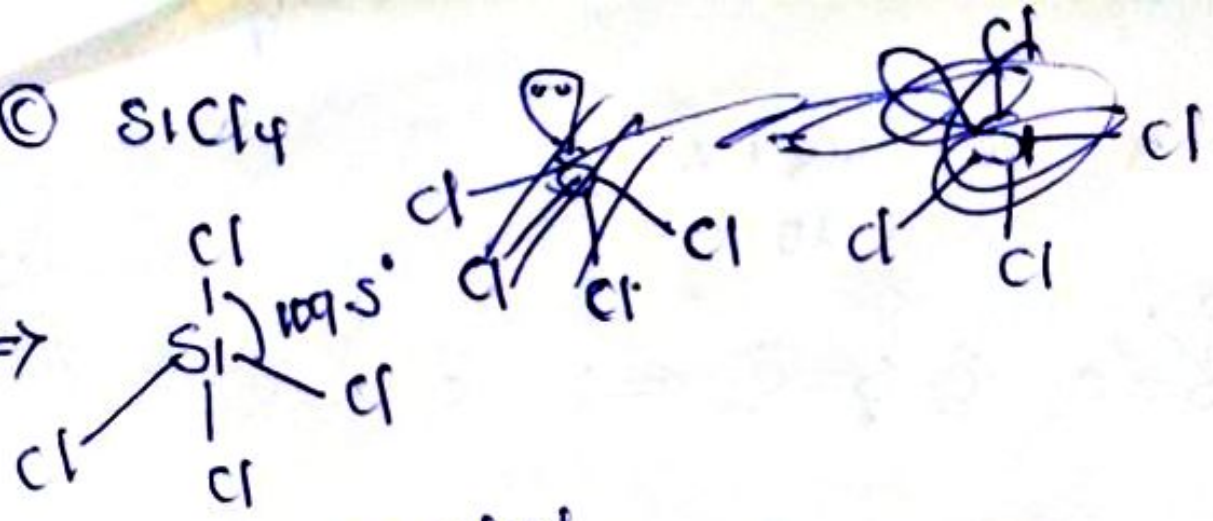
$Cl-\ddot{B}e-Cl$ linear

(b) BCl_3



Trigonal planar

(10) (c) $SiCl_4$

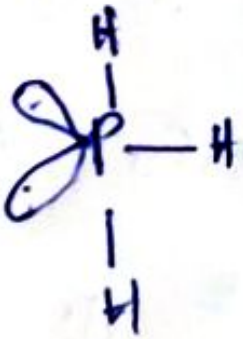


shape = tetrahedral

(d) AsF_5

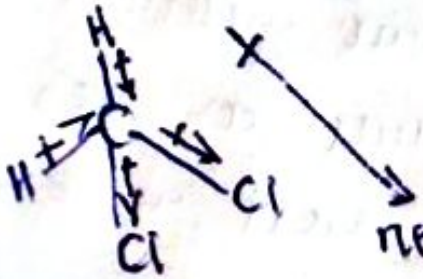
trigonal bipyramidal

(e) PH_3



T. shape

(11) (a) CH_2Cl_2 the molecule is polar.



tetrahedral

net dipole moment

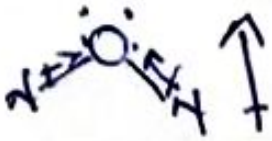
(b) $CHCl_3$ (tetrahedral)

net dipole moment

hence molecule is

(11) (b) CO_2 (not polar) $\ddot{O}=C=\ddot{O}$ linear

H_2O (bent)



net dipole moment
molecule is polar.

(c) PH_3 (T-shaped)

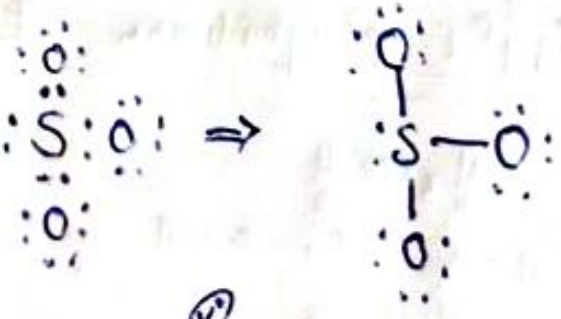
NH_3 (trigonal pyramidal)

net polar
the molecule is polar.

The lone pair of electrons on phosphorus cause the molecule to be asymmetrical w.r.t. charge distribution and that's why the molecule is polar even though it has non-polar bonds.

(12) SO_3^{-2} $Ve = 6 + 2 + 6(3)$

$= 26.$



(a) ~~26~~ 8 electrons - tetrahedral

(b) trigonal pyramidal

(c) (sp^2x, sp^2y) (sp^3 hybridization)

(d) 120° less than 109.5°.

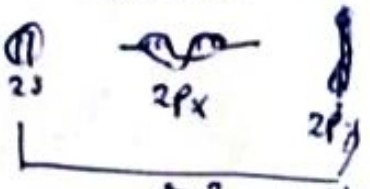
(13) Hybridization is the mixing of orbitals of the same atom with slightly different energies so as to redistribute energies

sp hybridization

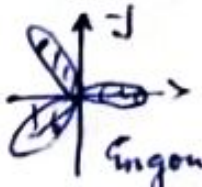
involves the mixing of one orbital of s-sublevel and one p-sublevel of valence shell electrons to form sp hybrid orbitals of 50% s and 50% p characters of equivalent shape and energies.

- ## Sp^2 hybridization

- involves mixing of one s-sublevel and 2 p-orbitals of valence shell to form sp^2 hybrid orbitals. Each hybrid orbitals lie in a plane and directed towards the corner of the equivalent triangle.



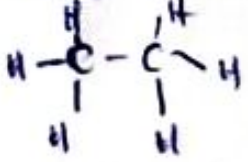
sp^2 hybridization



Sp^3 hybridization

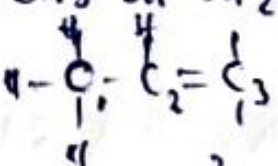
- involves the combination of one s and three p orbitals
- has 25% s and 75% p characters.
- has shape of tetrahedral $\theta = 109.5°$ to minimize repulsion

Q. (14) (a) $CH_3 - CH_3$



both carbons are sp^3 hybridization

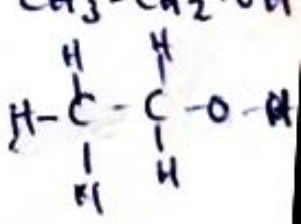
(b) $CH_3-CH-CH_2$



$C_1 = sp^3$

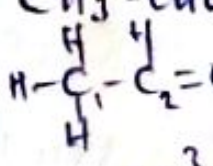
$C_3 \begin{cases} C_2 = sp^2 \text{ hybridization} \end{cases}$

(c) CH_3-CH_2-OH



sp^3 hybrid

(d) CH_3-CHO



$C_1 = sp^3$

$C_2 = sp^2$

(e) CH_3COOH

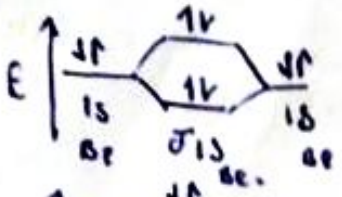
$C_1 = sp^3$

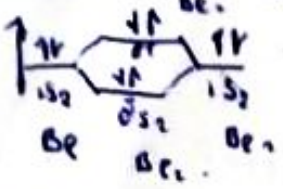
$C_2 = sp^2$ hybridization.

Q (15)

Be_2

Bond order = $\frac{\text{Bonding } \bar{e} - \text{non bonding}}{2}$





Magnetic properties

Since Bond order is zero, Be_2 does not exist. It is diamagnetic due to absence of any unpaired electrons. Without half filled orbital, the overlapping is not possible.

This molecule is diamagnetic

(16)

Q 16

(a) O_2 $\bar{e} = 16$

electron configuration

$(\sigma 1s^2, \sigma^* 1s^2)(\sigma 2s^2 \simeq \sigma^* 2s^2)$,

$(\pi 2p_x^2 \simeq \pi 2p_y^2)$ $(\pi^* 2p_x^1, \pi^* 2p_y^1)$

valence electron structure

Bond order = $\frac{10-6}{2} = 2$

molecule is paramagnetic

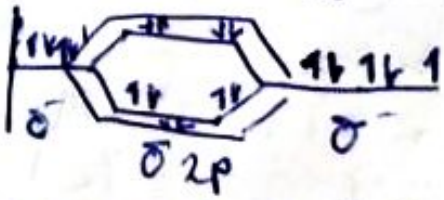
(b) O_2^- ⇒ $\bar{e} = 17$

$\bar{e}$ configuration

$(\sigma 1s^2, \sigma^* 1s^2)(\sigma 2s^2 \simeq \sigma^* 2s^2)$

$(\pi 2p_x^2 \simeq \pi 2p_y^2)$

$(\pi 2p_x^2, \pi 2p_y^2, \sigma p^2)$



Bond order = $\frac{16-7}{2} = 4.5$.

(c) O_2^+ = 15

$(\sigma 1s^2, \sigma^* 1s^2)(\sigma 2s^2, \sigma^* 2s^2)(\sigma 2p^2$

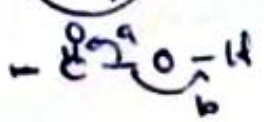
$(\pi 2p_x^2 = \pi 2p_y^2)$ $(\pi^* 2p_y = \pi^* 2p_y)$

Bond order = $\frac{10-5}{2} = \frac{2.5}{2}$

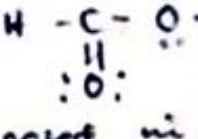
Bond strength order

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

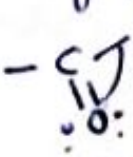
(17)



$ve^- = 18$



first c carbon with three region of electron density so it would have a trigonal planar shape with bond angle 120°.



secondly, would be oxygen of OH group connected to the Carbon with a bent shape with bond angle < 109.5°.

overall

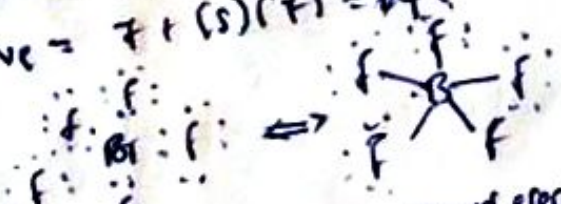
$a = 120°$

$b = 109.5°$.

(18)

(a) BrF_3

$ve^- = 7 + (3)(7) = 28$



(b) for Br = $ve^- - \frac{1}{2}$ shared electron pairs − unbonded pairs

$= 7 - \frac{1}{2}(6) - 2$

$= 0$

(c) Reaction with

$F = -1$

$Br = -1$ but when bonded to F

$Br = +1$.

$\therefore BrF_3$ $Br = +3$

$F = -3$

(d) Bond angle

(a) F-F = 90°

(ii) the lone pair of F. must are 3 straight lin = 180°.

(e) Square pyramidal

(f) = the molecule of the po as it is not symmetric dipole moment doesn't completely cancel. u