CHEMISTRY

BOOKS - CENGAGE CHEMISTRY (HINGLISH)

CHEMICAL BONDING AND MOLECULAR STRUCTURE

Illustration

1. Which statement is correct for ionic bond?

(a) It is non-directional .

(b) It is formed by overlapping of orbitals

(b) It is formed by overlapping of orbitals.

(c) it is formed by the elements with same EN

(d) Both (a) and (b) are correct .

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2. Which one is having high hydration energy?

(a) $K^{\oplus}$

(b) $Li^{\oplus}$

(c) $Na^{\oplus}$

(e) $Cs^{\oplus}$.

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3. Which statement is/are correct(more than one correct) ?

(a) In aqueous solution $A1$ gives hydrated ions

$\left[A1(H_2O)_6\right]^{3+}$

(b) Most of aluminium compounds are covalent because formation of $A1^{3+}$ requires much more energy $\left(=5138kJmo1^{-1}\right)$ which is not available ordinarily

(c) In aqueous solution $A1$ forms hydrated ions becuse og high (negative) heat of hydration of $A1^{3+}$ compensates the high IE_3 of $A1$

(d) Magnitude of hydration energy of $A1^{3+} < IE_3$ of $A1$.

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4. Which statement is/are correct

(a) Formation of anions with unit charge (e.g $CI^{\Theta} Br^{\Theta}, Br^{\Theta}, I^{\Theta}$ are very common because the EA of these atoms is positive and quite high or $\Delta_{eg}H^{\Theta}$ of these atoms are negative and quite high

(b) EA' or $\Delta_{eg}H^{\Theta}$ of these atoms is positive and quite high

(c) Formation of anions with -23 charge $\left(e.\,g.\,S^{2-}, O^{2}\right)$ is not so easy as their second EA are negative i.e energy is needed to add second electron

(d) Formation of anions with -3 charge $\left(e.\,g.\,N^{3-}, p^{3-}\right)$ is almost rare as the third $\Delta_{eg}H^{\Theta}$ are positive i,e energy in needed to add third electron .

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5. Which statement is/are correct?

(a) Ionic compounds like sulphate and phosphates of Ba and Sr $\left[e.\,gBaSO_4, SrSO_4, Ba_3(PO_4)_2 \text{ and } Sr_3(PO_4)_2\right]$ are insoluble in water

(b) The above compounds are soluble in water

(c) Magnitude of lattice energy $\left(\Delta_U H^{\Theta}\right)$ of the above

compounds is greater than their hydration energy $\left(\Delta_{hyd}H^{\Theta}\right)$ High $\Delta_{U}H^{\Theta}$ of these compounds is due to polyvalent nature of both the cations and the anions

(d) In these cases,hydration of ions fails to liberate sufficient energy to offset the lattice energy .

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6. Write the Lewis dot structure of CO molecule .

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7. Write the Lewis dot structure of the nitrite ion $\left(NO_2^{\Theta}\right)$.

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8. Write the Lewis dot structure of CO_3^{2-} ion .

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9. Write the Lewis structure for CN^{Θ} ion .

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10. Write the Lewis structure for SO_5^{2-} (Per oxodisulphate ion) .

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11. Calculate the formal charge on atoms in carbonate (CO_3^{2-}) .

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12. Calculate the formal charge on each atoms in nitrite ion.

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13. Calcuate the formal charge on each atom in SO_5^{2-} (per -oxosulphate ion) .

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14. Calculate the formal charge on each atoms in CO_4^{2-} (per -oxocarbonate ion) .

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15. Explain the structure of CO_3^{2-} ion in terms of resonance

(b) Explaine the resonance structures of CO_2 molecule .

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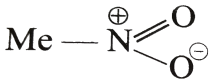
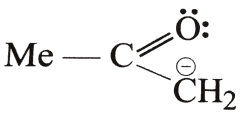
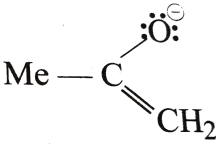
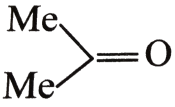
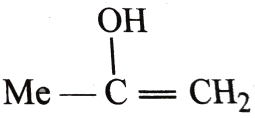
16. Which of the following pairs do not constitute resonance structures ?

a.  and 

b.  and 

c.  and 

d. Me CH $=$ CH Me and Me CH_2 CH $=$ CH_2

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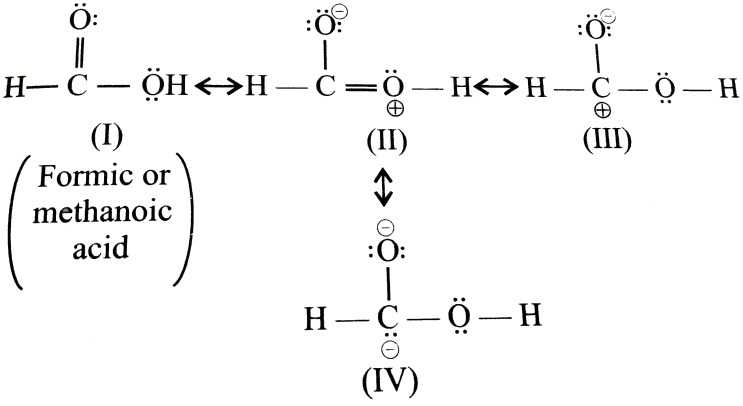
17. A arrange the following resonating structures in the order of decreasing stability



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18. Write the resonance structure of phenol in order of decreasing stabilities .

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19. Write the resonance structure of NO_2^{Θ} (nitrite) and NO_3^{Θ} (nitrate ion) .

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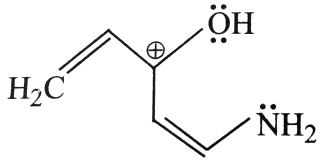
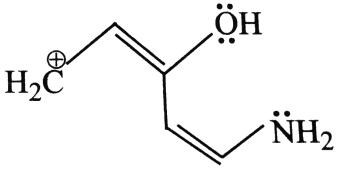
20. Which of the following is the most stable resonance structure

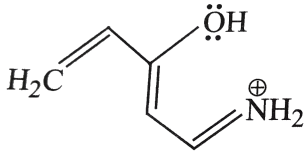
a.



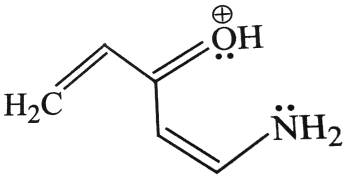
b.



c.



d.



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21. Give the stability of the following resonance structures

(a) $H_2C = \overset{\oplus}{N} = \Theta$

(b) $H_2\overset{\oplus}{C} - N = \overset{\Theta}{N}$

(c) $H_2\overset{\Theta}{C} - \overset{\oplus}{N} \equiv N$

(d) $H_2\overset{\Theta}{C} - N = \overset{\oplus}{N}$.

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22. Explain :

(i) $\mu of NH_3 > NF_3$

(ii) $\mu of CH_3C1 > CH_3F > CH_3Br > CH_3I$

(iii) $\mu of CO_2$ is zero, nut $\mu of SO_2 \neq 0$

(iv) Why the lone pair of $\bar{e}'s$ has no effect on the μ of PH_3.

The bond angle in PH_3 is 92°.

(v) $\mu of CH_2C1_2 > CHC1_3$.

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23. Arrange the following compounds in decreasing order of dipole moment values Explain the order

(a) CBr_4 , (b) $CHBr_3$, (c) CH_2Br_2 , (d) CH_3Br .

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24. (a) Assign orientation to the three chlorotoluenes with $\mu = 1.3, 1.78$ and 1.9 D

(b) Assign orientation to the three cholornitrobenzenes with $\mu = 2.5, 3.4$ and $4.3D$

(c) Which has higher mu

 .

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25. Explain the following (a) Dipole moment of CH_3F is 1.85D and $t\hat{o}f$CD_(3)Fis1.86D` .

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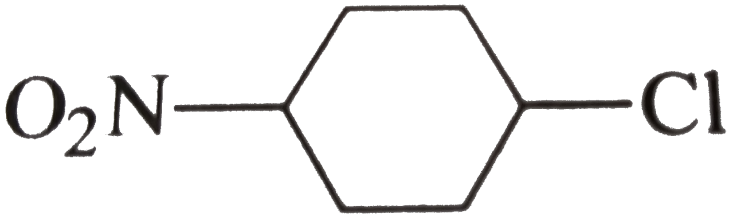
26. The dipole moment of HBr is $2.6 \times 10^{-30} Cm$ and interatomic spacing is $1.41A$ What is the percent ionic character of HBr

(b) A diatomic molecule has $\mu = 1.2D$ Its bond distance is $1.0A$ What fraction of electronic charge exists on each atom?

(c) In water, $(H - O_H)$ bond angle is 105° The distance between $(O - H)$ is $0.94A$. μ of $H_2O = 1.85D$ Determine the magnitude of the charge on the oxygen atom in water molecule and hydrogen atom

(d) BI_3 is a symmetrical planar molecule, all the $(B-1)$ bonds lie at 120° of each other. The distance between the I atoms is 3.54 A the radius of covalently bonded I atom is $1.33A$ Estimate the covalent radius of boron

(e) Calculate the dipole moment of the following compounds



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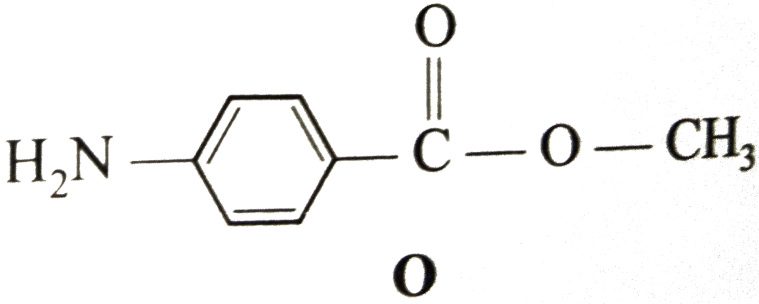
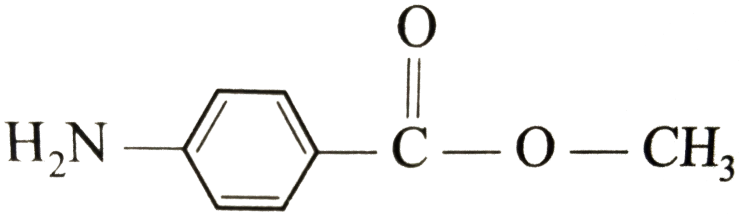
27. Caslculate the number of σ, π and con bonding (i.e lone pair) electrons in the following compounds

(a) $H_2C=CH-CH=CH_2$

(b) $H_3C-C\equiv C-CH=CH-CH_3$

(e) $H_3C - \underset{\underset{CH_3}{|}}{C}H - \overset{\overset{O}{||}}{C} - C \equiv C - CH = CH - C \equiv N$





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28. Discuss the hybridisation of carbon atoms in allene (C_3H_4) and show the π-orbital overlap.

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29. Out of the following species, group them having similar structures

$CH_4, CO_3^{2-}, CO_2, \overset{\oplus}{N}H_4, NO_3^{\Theta}, N_3^{\Theta}, BF_4^{\Theta}, SO_2, NO_2^{\Theta}$.

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30. Determine the hybridisation, geometry, number of lone pairs (lps's) and bond pairs (bp's) excluding pi bonds in the following compounds

(a) PF_6^{Θ}

(b) I_3^{Θ}

(c) CIF_3

(d) $XeOF_4$

(e) SO_2

(f) SO_3

(g) $IF_4^{\oplus}$

(h) $\overset{\oplus}{N}H_4$.

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31. Which p and d orbitals of central atoms are involved in the hybridisation of the following compounds

(a) $[PtCI_4]^{2-}$

(b) AsF_3

(c) IF_3

(d) XeO_2F_2

(e) $XeOF_4$

(f) XeF_6

(g) IF_7 .

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32. Which among the following has highest boilling point and why?

(b) Explain why boilling point of n-alkanes increases regularly with the increase in the number of carbon atoms .

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33. Which of the following intermolecular force is vander Waals interaction

(i) Ion dipole, (ii) Dipole -Dipole

(iii) Ion - induced dipole

(b) Which of the following intermolecular forces ion nonvan ber Waals interaction

(i) Dipole induced dipole

(ii) Instantaneous dipole induced dipole

(iii) Ion- induced dipole

(iv) None

(c) Which of the foolowing intermolecular forces have a potential energey distance function as $E \propto \frac{1}{r^2}$

(i) Ion -dipole (ii) Dipole -dipole (iii) Ion -induced dipole (iv) London dispersion forces .

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34. Ethy1 alcohol (C_2H_5OH) has higher boiling point than dimethyl ether $(CH_3 - O - CH_3)$ although the molecular weight of both are same .

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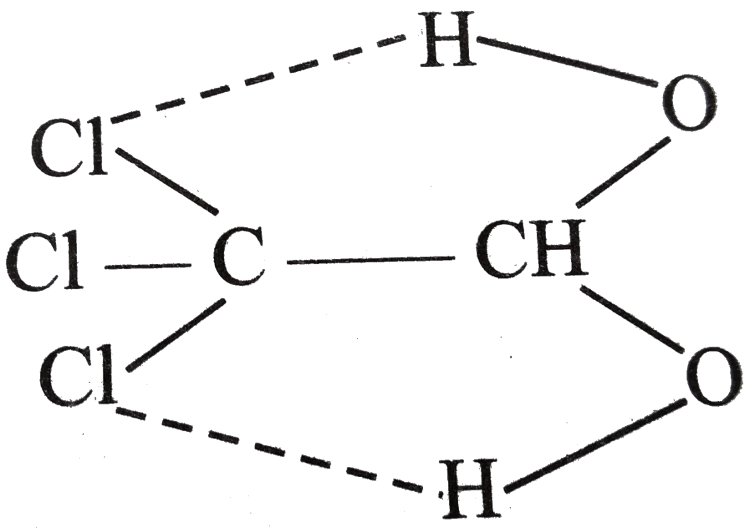
35. Explain unusual stabillity of chorohybrate thugh a compound with two or more -OH groups present on one carbon atom is usually unstabel



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36. o-Hydroxy benzaldehyde is more soluble in water than p-hybroxy benzaldehde

(b) o-Hydroxy benzaldehyde is liquid at room temperature while p-hydroxy benzaldehyde is high melting solid .

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37. (a) Nitrogen and chlorine have almost same EN' s but N forms H-bonding

(b) H_2O is liquid whereas H_2S is gas

(c) Compare the acidic strength of o-,m-and p-hydroxy benzoic acid

$(d) NH_3$ exists as liguid whereas HCI as gas

(e) Among the compounds CH_3COOH, NH_3HF and CH_4 in which the strongest H-bonding is persent (f) Among HF, CH_3OH, N_2O_4 amd which would have intermolecular H-bonding

(g) Salt-like KHF_2 is stable but $KHCI_2$ is not known (h)

H_3PO_4 is a syrupy liquid

(i) H_2SO_4 is colourless viscous oily liquid and has high boiling point

(j) Water forms four H-bonds as compared to two in HF EXplain

(k) Density of ice is less than that of water or ice floats over water .

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38. (I) Arrange the compounds (a0 in the order of decreasing boilling points and (b) in the order of decreasing solubility in water

(A) (1) Ethanol (2) Propane, (3) Pentanol

(B) (1) Butane (2) 1,2,3-Pentanetriol (3) Buty1 alcohol

(C) Pentane (2) Pentanol (3) Hexanol

(II) Arrange the following in the decreasing order of their boilling points

(A) (1) C_3H_8 (2) C_2H_5OH , (3) $(CH_3)_2O$

(4) HOH_2C-CH_2OH

(B) (1) 3-Pentanol, (2) n-Pentane, (3) 2,2 Dimethyl propanol, (4) n-pentanol

(III) Arrange the following alcohols (a) in the decreasing order of their boiling points and (b) in the decreasing order of their boilling points and (b) in the decreasing order of their solubility in water

(1) n-Buty1 alcohol

(2) sec-Buty1 alcohol and

(3) tert Buty1 alcohol

(IV) Arrange the following compounds in the order their increasing boiling points

(1)

CH_3COCI, (2)$(CH_3CO)_2O$, (3)CH_3CONH_2, (4)CH_3COOH

.

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39. Arrange in decreasing order of melting and boiling pouints of hydrides of groups 15, 16 and 17

(b) Give the decreasing order of melting and boiling points of H_2ONH_3 and HF

(c) Give the decreasing order of boiling points (I) C_2H_5OH (II) $(CH_3)_3NH$ (III) $C_2H_5NH_2$

(d) Give the decreasing of solubility in H_2O (I) $PhNH_2$ (II) $(C_2H_5)_2NH$, (III) $C_2H_5NH_2$.

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40. Compare the bond lenth of $O-O$ in the following molecules

(a) KO_2 , (b) $O_2[AsF_6]$

(c) O_2 , (d) Na_2O_2 .

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41. Which diatomic molecule of second period basides O_2 should be paramagnetic ? .

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42. Write the molecular orbital electron distribution of oxygen (O_2) Specify its bond order and magnetic property

Fill in the blanks

When N_2 goes to $N_2^{\oplus}$, the $N-N$ bond distance___ and when O_2 goes to $O_2^{\oplus}$ the $O-O$ bond distance ____ .

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43. Which of the two peroxide ion or superoxide ion has larger bond length ?

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44. How the bond energey varies from N_2^{Θ} and $N_2^{\oplus}$ and why ?

(b) On the basic of molecular orbital theory what is the similarity between

(i) F_2 and O_2^{2-} (ii) CO, N_2 and $NO^{\oplus}$? .

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45. Select from the following molecular orbitals which are gerade ungerade

(a) $\sigma(2s)$ (b) $\pi^*(2p_x)$ (c) $\pi^*(2p_y)$

(d) $\sigma^*(1s)$ (e) $\pi(2p_x)$ (f) $\pi(2p_x)$.

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Solved Examples

1. Construct a table comparing metals with non-metals in terms of

(a) The sign of the charges possible on monoatomic ions

(b) The possibility of reaction with other elements of the

same class

(c) The range of the possible number of valence electrons

(d) The ability of the elecments to conduct electricity in the elementary state .

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2. In which of the following compounds is the bonding essentially ionic in which is the bonding essentially covalent, and in which are both types of bonding represented ?

(i) C_2H_5OH (ii) $NaBr$ (iii) $Ba(CN)_2$ (iv) $(NH_4)_2S$ (v) PCI_3

(b) Write the formula for a compound of CI which contains (i) Ionic bonds only (ii) Ionic and covalent bonds and (iii) Covalent bonds only

(c) Covalent bonds are called directional while ionic bonds are called non-directional Explain .

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3. Pure liquid H_2SO_4 solidifies below $10.4^\circ C$ Neither the pure liquid nor the solid conducts electricity however, aqueous solution of H_2SO_4 conducts electricity

Solid Na_2SO_4 which melts at $884^\circ C$ does not conduct electricity, but molten Na_2SO_4 as well as aqueous solutions of Na_2SO_4 conduct electricity Explain the difference in properties between pure Na_2SO_4 and H_2SO_4 .

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4. Write electron dot and line structure for

(a) SeO_3^{2-} ,(b) Li_3PO_4 (c) $CIO_2^{\oplus}$ (d) $COCI_2$

(e) H_2CO

(f) C_2H_2 (g) HCO_2H .

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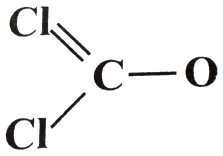
5. By completing the following structures, adding unshared e^- pairs when necessary calculate the charges

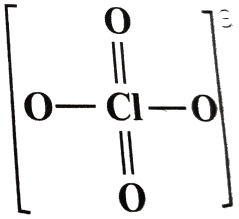
(a) $N \equiv C - \equiv N$

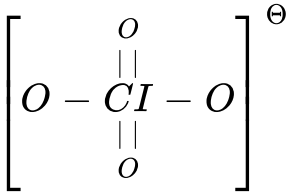
$CI - C \equiv N$

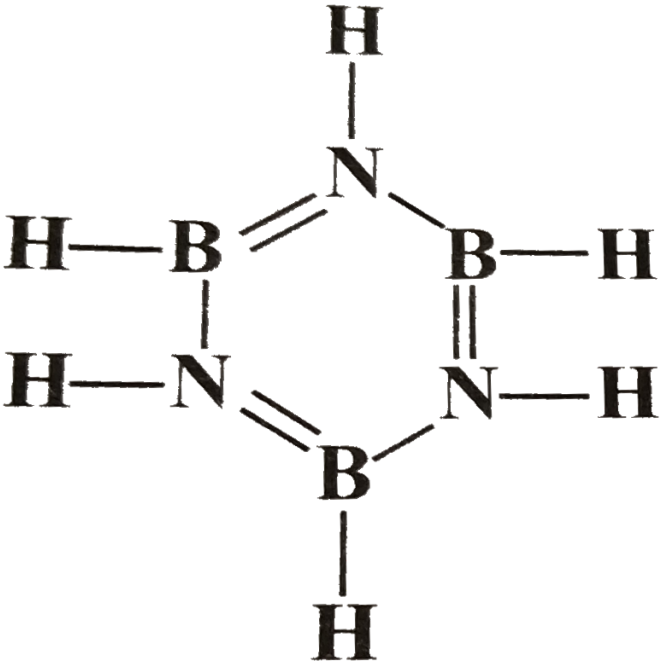
a. $\mathbf{N \equiv C - C \equiv N}$

b. $\mathbf{Cl - C \equiv N}$

c. 

d. 





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6. In each of the following paris select the species having the greater resonance stabilisation

$H_2O = O$ and $\underset{\underset{O^{\Theta}}{|}}{HC} = O$

(ii) HNO_3 and NO_3^{Θ}

(b) Draw all possible octet structural formulas for N_3^{Θ} Which ones are possible resonance forms ? .

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7. Distinguish between a polar bond and a polar molecule To which does the term dipole refer?

(b) Which is having the higher b.pt: Br_2 or ICI

(c) Can a molecule have a dipole moment if it has no polar covalent bonds

(ii) How is it possible for a molecule to have polar bonds but no dipole moment?

(d) Arrange in decreasing polarity of bonds SbH_3, AsH_3, PH_3, NH_3 , .

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8. The decreasing order of dipole moment of $SO_2 > NH_3 > AsH_3 > BF_3 > CO_2(\mu = 0)$ What can be concluded about the shapes of the molecules ?

(b) What is the value of ID in SI unic

(c) The dipole moment of HBr is $2.60 \times 10^{30} Cm$ and the interatomic spacing is $1.41A$ What is the percentage of ionic character of HBr ? .

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9. The single and multiple bond radii of some elements given in the following table Calculate the bond lengths in

(a) SCI_2

(b) NH_3

(c) CH_2CI_2

(d) $HOCI$

(e) HCN

(f)H_3PO_4

(g) CH_3NH_2

Single bond radii (Å)					
H	0.28	P	1.10	Te	1.37
C	0.77	As	1.21	F	0.64
Si	1.77	Sb	1.41	Cl	0.99
Ge	1.22	O	0.66	Br	1.14
Sn	1.40	S	1.04	I	1.33
N	0.70	Se	1.17		

Multiple bond radii (Å)	
C =	0.67
C ≡	0.61
N =	0.63
N ≡	0.55

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10. Arrange $C-C, C=C$ and $C \equiv C$ in order of

(i) Decreasing bond energey

(ii) Decreasing bond lengths

(b) The $As-CI$ bond distance in $AsCI_3$ is $2.20A$ Estimate the single- bond covalent radius of As .

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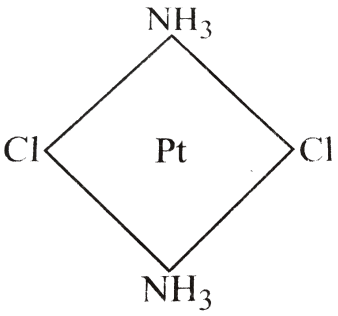
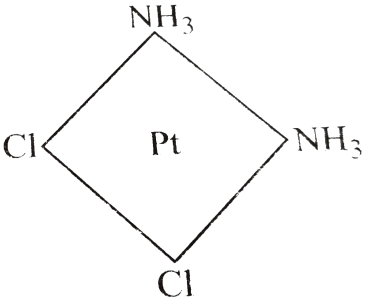
11. The $Pt-CI$ distance is $2.32A$ in several crystaline compounds

What is the $CI-CI$ distance in structure (i) and in

structure (ii)



(i)



(ii)

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12. The averge (C_C) bond energy is $343kJmo1^{-1}$. What do you predict for the Si -Si single bond energy

(b) Carbrundum (SiC) and corundun $(A1_2O_3)$ are important abrasives Comment on the structures for these compounds to explain why they have such hardness .

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13. Compare the shapes of p-orbital and sp-hybrid orbital Which on has a greater directional orientation ?

(b) What are the hybridisation state of each C-atom in the following molecules ?

(i) Benzene (ii) $CH_3CH_2CH_2CH_3$

(iii) $HC \equiv CH$

(iv) $CH_2 = CH - CH = CH_2$

(v) $CH_3 - CH = CH - CH_3$

(c) What hybidisation is expected on the central atom of each of the following molecules ?

(d) (i) Which molecule AX_3, AX_4, AX_5, AX_6 is likely to have to a trigonal bipyramid structure

(ii) If the central atom A has no lone pairs, what type of hybridisation will it have .

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14. Complete the following table

(b) Which of the sets of hybridised orbitals $spsp^2$, sp^3, dsp^3, d^2, sp^3, sp^3d^2 do (does) not maximise the angles between electron pairs ?

(c) Fluorine molecule is formed by the overlap of __

(d) Predict the shapes of the following species and desribe the type of hybrid orbitals on the central atom

(i) $PbCI_4$, (ii) N_2CI_4 ,(iii) PCI_3 ,(iv) BH_4^{Θ}, $(v)SbF_6^{\Theta}$

(e) How many σ and π bonds are present in a benzene molecule ? .

	Hybrid type	Geometry
a.	_____	Linear
b.	dsp^2	_____
c.	_____	Trigonal bipyramid
d.	_____	Octahedral
e.	sp^2	_____

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15. What is the number of molecular orbitals obtained by mixing of two atomic orbitals ?

(b) Out of F_2 and OF which of these molecules is (are) paramagnetic

(ii) Which should be more stable towards dissociation into atoms OF or F_2

(c) Explain why $NO^{\oplus}$ is more stable towards dissociation into atoms than NO whereas $CO^{\oplus}$ is less stable than CO

(d) Predict whether $He_2^{\oplus}$ ion in its electronic ground state is stable towards dissociation into he and $He^{\oplus}$.

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16. Compare and contrast the concepts of hybrid orbitals and molecular orbitals with respect to

(i) The number of atoms involved

(ii) The number of orbitals produced from a given number of ground state orbitals

(iii) The energies of the resulting orbitals with respect to one another

(b) Distinguish between non-bonding and antibonding orbitals

Hybrid orbital	Molecular orbital
i. One central atom	i. More than one atom
ii. Same number	ii. Same number
iii. All the same	iii. Bonding orbitals lower in energy than antibonding orbitals

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17. State the bond order and indicate whether the species is paramagnetic

(i) B_2 (ii) C_2 (iii) N_2

(iv) O_2 (v) Br_2 (vi) $CI_2^{\oplus}$

Which of the following molecules has the highest bond order

(i) Ne_2 (ii) F_2

(c) Explain why N_2 has a greater dissociation energy than $N_2^{\oplus}$, whereas O_2 has a lower dissociation energy tnan $O_2^{\oplus}$

(b) The bonding σ 2s orbital has a higher energy than the antibonding σ^* 1s orbitals Why is the former a bonding orbital while the latter is an antibonding .

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18. Which properties of element depend on the electronic configuration of atoms and which do not

(b) Why the chemical properties of a group are similar Why do they not have identical properties

(c) Account for the great chemical similarity of the lanthanoid elements (Z =57 to 71)

(d) Select the largest species in each group

(i) Ti^{2}, Ti^{+3} (ii) $F^{\Theta}, Ne, Na^{\oplus}$

(e) Select the species with the largest IE in each group

(i)na, K, Rb (ii) F,Ne,Na

(f) Which ion has the smallest radius

$Li^{\oplus}, Na^{\oplus}, K^{\oplus} Be^{+2}, Mg^{+2}$

(g) Select among the element that has the lowest and highest IE $K, Ca, Se, B, Kr,$

(h) The ionic radii of S^{2-} and Te^{2-} are and 220 pm

respectively Predict the ionic radius of Se^{2-} and for p^{3-}

(i) In the ionic compound KF the $K^{\oplus}$ and $F^{\oplus}$ have practically identical radii, about 134 pm each. Predict the relative atomic radii of $1K$ and F.

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19. Select from each of the following gropus, the one which has the largest radius

(i) Co, Co^{2+}, Co^{3+} (ii) $S^{2-}, Ar, K^{\oplus}$ (iii) Li, Na, Rb

(iv) C, N, O (v) Ne,Na,Mg (vi) La, Lu

(vii) Cu, Ag, Au (viii) Ba, H_r

(ix) $Mg, naNa^{\oplus}, Mg^{+2}, Al$

(b) IE_1 of C is $11.2eV$ What would be the value of iE_1 of Si to be greater or less than this amount ?

(c) IE_1 of Li and K are 5.4 and $4.3eV$ respectively What

would be the value of IE_1 of P ?

(d) IE_1 of Na? .

(e) The IE' s of Li, Be and C are $5.4, 9.3$ and $11.3eV$ What would be the value of IE s of B and N ?

(f) Which of these elements have the lowest IE_1 Sr, As, Xe, S,F ?

(g) Select from each of the following group the element which has the largest IE

(i) Na, P, CI (ii) He, Ne, Ar (iii) O, F, Na

(h) Arrange the species in each group in order of decreasing IE' s and in each case explain the reason for the sequence

(i) K, Rb, Cs

(ii) Be, B, C (iii) Cu, Ag, Au ?

(iv) C, N, O (v) N, O, F (vi) K, Ca, Sc

(vii) Na, Mg, AI (viii) Fe, Fe^{+2}, Fe^{+3} (ix) $K^{\oplus}$, Ar, CI^{Θ}

(i) Explain why IE_1 of Cu is higher than that of K whereas

IE_2 are in reverse order

(j) Account for the difference in IE

(i) between $K^{\oplus}$ and $Ca^{\oplus}$

(ii) between $Cu^{\oplus}$ and $Zn^{\oplus}$

(k) Ionisation potential is an old term for ionisation energy. Explain why yhe two are synonymous ? .

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20. Give the decreasing order of the property mentioned against each of the following

$C_2H_2, BF_3, H_2O, NH_3, CH_4$ (bond angle)

(b) $NH_3, \overset{\Theta}{N}H_2, \overset{\oplus}{N}H_4$ (bond angle)

(c) $K-F, Li-CI, Na-I, Br-H, F-H, C-H$ (ionic character)

(d) NH_3, PH_3 (bond angle)

(e) NF_3, NH_3 (dipole mement)

(f) CH_3CI, CH_2CI_2, $CHCI_3$, CCI_4 (dipole moment)

(g) MgO, CaO (hardness)

(h) HCI, HBr (ionic characacter)

(i) NO_2, $NO_2^{\oplus}$ NO_2^{Θ} (bond angle)

(j) CI_2, O_2, F_2, N_2 (bond strenght)

(k) O, N, F, CI, S (strength of H - bonging)

(I) N_2, $N_2^{\oplus}$, N_2^{Θ}, N_2^{2-} (order of stability)

(m) O_2^{2+}, O_2, $O_2^{\oplus}$, O_2^{Θ} O_2^{2-} (order of stability)

(n) N_2, F_2, O_2, H_2 (bond lenght) .

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21. Answer the following

(a) How many σ, π non - bonding electrons present in

(i) P_4O_6 (ii) P_4O_{10}

(b) Which of the following are isostructural and isocelectonic ?

$NO_3, CO_3^{2-}, CIO_3^{\Theta}, SO_3$

(c) Why CO_2 and SO_2 are not isostructural ?

(d) Why PCI_5 dissociate to give PCI_3 and CI_4 whereas SF_6 does not dissociate to give SF_4 and F_2 on heating ?

(e) Discuss the shapes of molecular orbitals formed by the combination of the following atomic orbitals

(i) $2p_z$ and $2p_z$ (ii) $2p_x$ and $2p_x$

(f) Why IF_7 dissociate to give $IF_2 + \frac{5}{2}F_2$ not $IF_2 + F_2$ Expalin

(g) Why axial bonds of PCI_5 are longer than equatorial bonds ?

(h) BH_4^{Θ} and $\overset{\oplus}{N}H_4$ are isolobal Explain

(i) Name the anion which is isostructural with BF_3 (j) Name the cation which is isostructural with CH_4

(k) Which of the following alkali metal chlorides is expected th have the highest melting point

(i) $LiCI$ (ii) KCI (iii) $RbCI$ (iv) $NaCI$.

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22. Explain

(a)Which d-orbital in involved in

(i) sp^3d hybridisation (ii) sp^3d^2 hybridisation

(iii) dsp^2 hybridisation (iv) sp^3d^3 hybridisation

(b) Why H_2O is liquid while H_2S is gas

(c) Why KHF_2 exists but $KHCI_2$ does not

(d) Benzene ring contains alternate single and double bonds yet all the $C-C$ bonds are of equal lenght why

(e) Out of $P-F, CI-F, S-F$ and $F-F$ bonds, which bond is the least ionic? .

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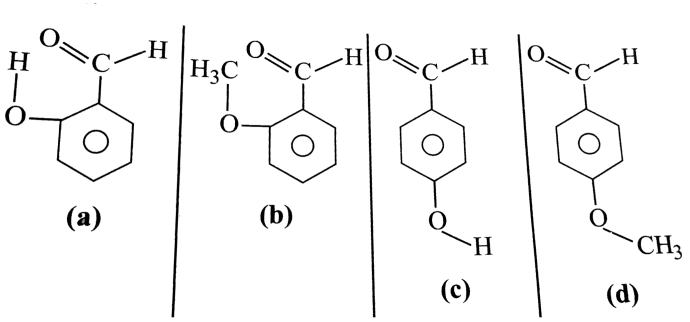
23. How do you account for the difference in melting points between (a) and (b) between (c) and (d) and between these two differences ?



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24. A plant virus was found to consist of uniform cylindrical particles $100A$ in diameter and $4000A$ long The virus has a specific volume $0.314cm^3g^{-1}$ If the virus particle is

considered to be one molecule, what is its molecular weight ? .

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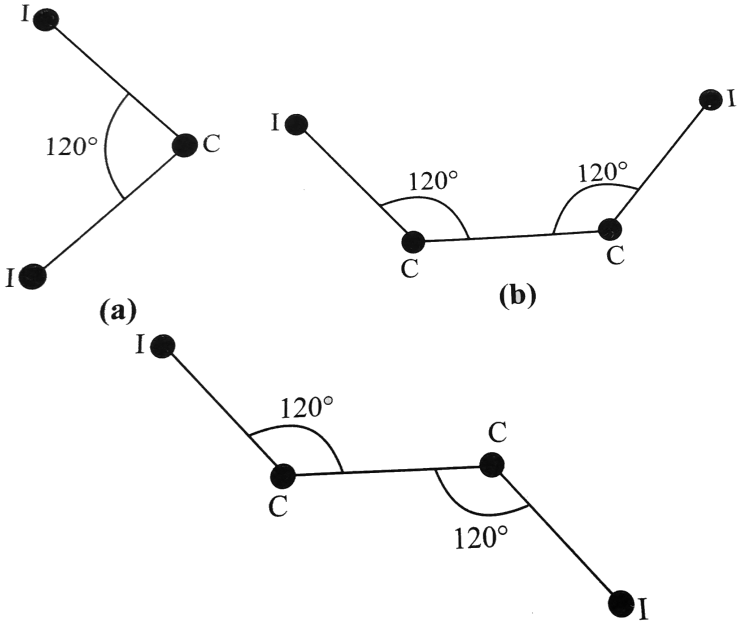
25. Calculate the I-I distance in each of the isomeric compounds $C_2H_2I_2$ as shown below

Give Bond length of $C-I \Rightarrow 210$ pm

Bond length of $C=C \Rightarrow 133$ pm



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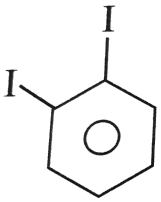
26. Calculate the I-I distance in each of the three isomeric diiodobenzenes Assume that the ring is a regular hexagon and that each $C-I$ bonds lies on a line through the centre of the hexagon .

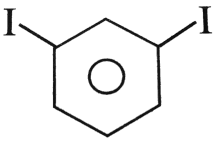
Given $C-I$ bond length $=210$ pm

The distance between two adjacent C-atom (i.e C-C)

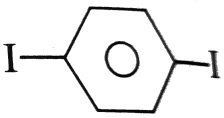
$=140$ pm



(a)



(b)



(c)

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27. Enthalpic of hydrogenation of ethene (C_2H_4) and benzene (C_6H_6) are -136.68 and $205.65kJmo1^{-1}$ respectively

Calculate the resonance energy of benzene

(a)

$C_2H_{4(g)} + H_{2(g)} \rightarrow C_2H_6, \Delta H_1 = -136.68\text{kJ mo1}^{-1}$

(b)

$C_6H_{6_{(1)}} + 3H_{2(g)} \rightarrow C_6H_{12}, \Delta H_2 = -205.65\text{kJ mo1}^{-1}.$

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28. Select the species which is best described to the right

(a) CI_2, Br_2, I_2 (has the lowest boiing point)

(b) CI, Ar, K (has the smallest IE)

(c) CH_4, NH_3, HF (has the highest boiling point)

(d) CO_2, NH_3, CO (has zero dipole moment)

(e) $HOI, HOBr, HOCI$ (is the weakest acid) .

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29. The $CI - O$ bond distance in CIO_4^{Θ} is 144pm What do you conclude about the structure of this ion ?

(b) The $POCI_3$ molecule has the shape of an irregular tetrahedron with the P atom located centrally The $CI - P - CI$ angle is found to be 1035° Give a qualitative explanation for the deviation of this structure from a regular tetrahedron .

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30. Draw all geometrical isomers of PBr_2CI_3 molecule State which isomer (s) have no dipole moment .

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31. Write electron dot structures and describe the geometry of the following molecules

(a) NH_2OH (Hydroxylamine)

(b) NH_2NH_2 (Hybrazine)

(c) CH_3COCI (Acety1 chloride)

(d) $CH_2 = NH$(methylenamine) .

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32. Reduce the hybridisation, geometry and shape of the following

(i) CH_2^{2+} (ii) Br_3^{Θ} (iii) $CIO_3^{\oplus}$

(iv) F_2SeO (v) $IO_2F_2^{\Theta}$

Either of the hybridisation (i) sp^2 and (ii) sp^3d^2 of a central atom can lead to a squar planar molecule Give one example of each .

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33. State the bond order and indicate whether the species is paramagnetic

$CN^{\oplus}$ (b) CN (c) CN^{Θ} (d) No .

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34. If the internuclear axis in the diatomic molecule AB is designated as the z-axis what are the varoius pairs of s,p or d atomic orbitals that can be combined to from (a) π_x and (b) π_y orbitals ? .

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35. Make a table giving (i) number of orbitals with a given energy (ii) maximum number of electrons per orbital and (iii) maximum number of electrons per orbital and (iii) maximum number of electrons at a given energu for the following types of orbitals

(a) s

(b) p (c) sp^2 (d) sp^3

(e) σ (f) σ^* (g) π^* .

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36. When 2s orbital overlaps with $2p_x$ or $2p_y$ orbital (assuming Z -axis as the internuclear axis) threr is a partical overlap and they do not form any MO Explain why ? .

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Ex 2 .2 Subjective (Intermolecular Forces And H-Bonding)

1. Write a Lewis structure for $\mathrm{CC}I_2F_2$ one of the compounds indicated in the depletion of stratoshpheric ozone .

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2. Write Lewis structure for the following

(a) Ethene (C_2H_4) the most important reactant in polymer manufacture

(b) Nitrogen (N_2) the most abundant atmosheric gas

(c) Methanol (CH_4O) an important industrial alcohol that is beign used as a gasoline alternative in car engines .

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3. The dipole moment of LiH is $1.964 \times 10^{-29} Cm$ and interatomic distance between Li and H in this molecule is $1.6A$ What is the per cent ionic character in LiH ? .

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4. Predict whether each of the following molecule has a dipole momnet

(a) BF_3 (b) IBr (c) CH_2CI_2 .

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5. The dipole moment of KCI is $3.36 \times 10^{-29} Cm$ The interatomic distance between $K^{\oplus}$ and CI^{Θ} in this unit of KCI is $2.3 \times 10^{-10} m$ Calculate the percentage ionic character of KCI .

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6. Account of the following observations

(a) Ammonium salts are more soluble in water than the

corresponding sodium salts

(b) $BeCI_2$ is linear but $SnCI_2$ is angular

(c) F_2 gas is more reactive than CI_2 gas

(d) The bond lengths of both $O-O$ bonds in ozone are equal .

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7. State whether the following are ionic or covalent

(a) CaH_2 (b) MgO (c) Na_2CO_3 (d) NH_4CI

(e) HCI (f) $CaCI_2$ (g) Na_2S(h) $SnCI_2$

(i) Diamond (j) CaC_2 (k) NaH (i) C_2H_2 .

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Ex 2 .2 Subjective (Molecular Orbital Theory)

1. Identify which of them are polar and non-polar

(a) HF (b) $BeCI_2$ (c) $HgCI_2$ (d) NH_3

(e) H_2O (f) N_2 (g) $AICI_2$ (h) CCI_4

(i) CI_2 (j) $SiCI_4$.

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2. Give reasons for the following

(a) PF_5 is know but NF_3 is not

(b) H_2O is a good solvent

(c) BF_3 is non- polar but planar

(e) Carbon -oxygen $(C-O)$ bond lengths are equal in Na_2CO_3

(f) MgF_2 is more soluble in water than $MgCI_2$.

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3. Give reasons for the following

(a) CO_2 has no dipole moment but SO_2 and H_2O have considerable dipole moments

(b) Carbon has two unpaired electrons in the outermost orbit, but it is tetravalent in organic compound

(c) CaF_2 is more ionic than CaI_2

(d)Sigma bonds are stronger than pi bonds

(e) C_2H_4 is planar while C_2H_2 is linear

(f) H_2O is more polar than H_2S

(g) Ionic compounds do not canduct electricity in solid state, but they conduct electricity in solution or in molten state .

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4. Indicate wheter the following pairs of elements form ionic or covalent compounds Also write their molecular formula

(a) C and S (b) Na and CI (c) S and O (d) Ca and H .

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Ex 2 .2 Objective

1. Arrange the following as directed

(a) N_2, O_2, F_2, CI_2 (Decreasing order of bond energey)

(b) $S-O, N-CIMg-O,$ As -F (Decreasing polarity of bonds)

(c) sp, sp^2, sp (Decreasing order of energy of orbitals)

(d) HF, HCI, HBr, HI (Decreasing order of dipole moments)

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2. Expalin the following

(a) The central $C-C$ bond in Buta 1,3 diene is shorter than that of n-butane

(b) Why the dipole moment of $cis-1,2$ dichloroethene is greater than that of trans -1,2 -dichloroethene

(c) CIF_2^{Θ} is linear, but $CIF_2^{\oplus}$ is bent

(d)Two different bond lengths are observed in PF_5 but only one bond lenght is observed in SF_6 .

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3. Arrange the following in decreasing order of dipole moment

(a) Toluene (2) m-Dichlorobenzene

(3) o-Dichlorobenzene (4) p-Dichlorobenzene

(b) BF_(3) (2) H_2S (3) H_2O

(c) cis-1 Chloropropene

(2) Trans -1 -Chloropropene

(3) 1,1-Dichloroethene .

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4. Predict the shape of the following Xenon compounds

(a) XeO_3 (b) $XeOF_4$ (c) XeO_2F_2 .

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5. Considering X axis as the internuvlear axis, which out of the following will form a sigma bond

(a) $1s$ and ls (b) ls and $2p_x$

(c) $2p_y$ and $2p_y$ (d) $2p_x$ and $2p_y$

(e) $1s$ and $2s$.`

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6. Arrange the following types of interation in order of decreasing stability

(a) Covalent bond (b) van ber Waals force

(c) H-bonding (d) Dipole interation

(e) Ionic bond .

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7. Arrange the following types of intermolecular forces in order of decreasing their strength

(a) Ion dipole

(b) Keesom forces

(C) Dispersion or London forces

(d) Dipole-induced dipole

(e) Ion-induced dipole (Debye forces) .

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8. Name the types of interaction or intermolecular forces of which potential energy-distance function are given below

(a) $E \propto \frac{1}{r}$ (b) $E \propto \frac{1}{r^2}$ (c) $E \propto \frac{1}{r^3}$

(d) $E \propto \frac{1}{r^4}$ (e) $E \propto \frac{1}{r^6}$.

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9. List properties of water that stem from H-bonding

(b) Two two molecules indicated below are capable of forming interamolecular H-bonding Which is likely to form more stable H-bonds Give reasons

(i) $CH_3COCH = \overset{CH_3}{\underset{|}{C}} - OH$

(ii) $CH_3COCH_2 \overset{CH_3}{\underset{|}{C}} - OH$.

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10. Perdict the order of decreasing boiling points of noble gases

(b) Predict the ordert of decreasing boiling points of the following H_2, He, Ne, Xe, CH_4 .

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11. Which of the following pairs is expected to exhibit H-bonding

(a) CH_3CH_2OH and CH_3OCH_3

(b) CH_3NH_2 and CH_3SH

(c) CH_3OH and $(CH_3)_3N$.

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12. Give the decreasing order of melting points of the following $NH_3, PH_3, (CH_3)_3N$ Explain

(b) In which molecule is the van der Waals force likely to be the most important in determining the m.pt and b.pt for ICI, Br_2, HCI, H_2S, CO .

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13. How many nodal planes are present in the following $MO's$ (Taking Z-axis as the internuclear axis)

(i) σ ls (ii)σ^* ls (iii) $\sigma 2p_z$

(iv) $\sigma^* 2p_z$ (v) $\pi 2p_y$ (vi) $\pi^* 2p_x$ or $\pi^* 2p_y$

Give the number of electrons which occupy the bonding orbitals in $H_2^{\oplus} H_2$ and $O_2^{\oplus}$

(c) Why N_2 has greater bond dissociation energey than $N_2^{\oplus}$ whereas $O_2^{\oplus}$ has greater bond dissociation energy than O_2 .

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14. Compare the relative stabilities and magnetic behaviour of the following species

(a) O_2^{Θ} and $N_2^{\oplus}$ (b) O_2^{2-} and N_2^{Θ} (c) O_2^{2-} and N_2^{2-} .

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15. Expalin

(a) $H_2^{\oplus}$ and H_2^{Θ} ions have same bond order but $H_2^{\oplus}$ ions are more stable than H_2^{Θ}

(b) It is possible to have a diatomic molecule with its ground sate MO s full with electrons

(c) Why $2p_{x0}$ or $2p_y$ orbitals do not combine with 2s orbitals to form MO (Taking Z-axis as the internuclear axis) .

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16. Which of the following species have same bond order and same shape

(a) N_3^{Θ} (b) O_3 (c) CO_2 (d) NO_2^{Θ}.

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17. Which of the following is soluble in water

A. CS_2

B. $CHCI_3$

C. CCI_4

D. CH_3OH

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18. Which one among the following does not have the hybrogen bond ?

A. Liquid NH_3

B. Liquid HCI

C. Water

D. Phenol

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19. The molecule having one unpaired electrons is .

A. O_2

B. CN^{Θ}

C. NO

D. CO

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20. The H-bond is strongest in

A. $F-H\ldots O$

B. $C-H\ldots . O$

C. $O-H\ldots S$

D. $F-H\ldots F$

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21. Hydrogen bond is maximum in .

A. Propanol

B. Propyl chloride

C. Tripropylamine

D. Diropyl ether

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22. Number of $H-$ bonds formed by a water molecule is:

A. 1

B. 2

C. 3

D. 4

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23. Number of paired electrons in O_2 molecule is .

A. 16

B. 14

C. 8

D. 7

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24. Among KO_2, ALO_2^{Θ} and O_2,unpaired electrons is present in .

A. KO_2 only

B. $NO_2^{\oplus}$ and BaO_2

C. KO_2 and AIO_2^{Θ}

D. BaO_2 only

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25. The correct order of decreasing $C-O$ bond length of (1) CO, $(II)CO_3^{2-}$ $(III)CO_2$ is .

A. $I > III > II$

B. $I > II > III$

C. $III > II > I$

D. $II > III > I$

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26. Which of the following statement is correct among the species $CN^{\ominus}$, CO and $NO^{\oplus}$.

A. Isolelectronic and weak field ligands

B. Isolelectronic with three bond order

C. Bond order three and weak field ligands

D. Bond order two and pi-acceptor

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27. Which of the following molecular species has unpaired electrons(s) ? .

A. O_2^{2-}

B. F_2

C. N_2

D. O_2^{Θ}

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28. Which of the following are isolectronic and iso-structural ?

NO_3^{Θ} ,CO_3^{2-}, CIO_3^{Θ} ,SO_3 .

A. CO_3^{2-}, CIO_3^{Θ}

B. CO_3^{2-}, NO_3^{Θ}

C. SO_3, CO_3^{2-}

D. SO_3, NO_3^{Θ}

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29. According to MOT whch of the following statement about magnetic character and bond order is corrent regarding $O_2^{\oplus}$.

A. paramagnetic and $BO > O_2$

B. paramagnetic and $BO < O_2$

C. Diamagnetic and $BO > O_2$

D. Diamagnetic and $BO < O_2$

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30. Which of the following compound is paramagnetic ? .

A. K_2O_2

B. O_3

C. KO_2

D. N_2O

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31. The species having bond order differnet from that in CO is .

A. N_2

B. NO^{Θ}

C. $NO^{\oplus}$

D. CN^{Θ}

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32. In forming $(i)N_2 \rightarrow N_2^{\oplus}$ and $O_2 \rightarrow O_2^{\oplus}$ the electrons respectively removed from .

A. $(\pi^* 2p_y \text{ or } \pi^* 2p_x)$ and $(\pi 2p_y \text{ or } \pi 2p_x)$

B. $(\pi.^* 2p_y \text{ or } \pi.^* 2p_x)$ and $(\pi.^* 2p_y \text{ or } \pi.^* 2p_x)$

C. $(\pi 2p_y \text{ or } \pi 2p_x)$ and $(\pi 2p_y \text{ or } \pi 2p_x)$

D. $(\pi 2p_y \text{ or } \pi 2p_x)$ and $(\pi.^* p_y \text{ or } \pi^* p_y \text{ and } \pi^* 2p_x)$

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33. Using MOT predict which of the following species has the shortest bond length ? .

A. $O_2^{2\oplus}$

B. O_2^{Θ}

C. O_2^{2-}

D. $O_2^{\oplus}$

Answer: A

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34. Which of the following has //have identical bond order ?

A. O_2^{Θ}

B. CN^{Θ}

C. $NO^{\oplus}$

D. $O_2^{\oplus}$

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Exercises Linked Comprehension

1. The shape of a moleculs is determined by electron pair repulsions in the valence shell A.lp occupies a larger space than a bp because it is not shared by two nuclei The the lp lp repulsion is greater than the lp-lp repulsion, which in trun is greater the lp-lp repulsion. The presence of lp causes distortion of bond angles hence, a daviation from an ideal shape THe extent of distortion depends upon the orientation of the lp's around the central atom In a trigonal bipyramid, the lp's occupy equatorial positions than the apical ones In AB_n type molecules, as the EN of A increases, the bp's come closer and the repulsion between them increases. On the

other hand, as EN of B increases, the lp s get farther and repulsion decreases

In which of the following molecules is the bond angle largest ? .

A. PF_3

B. PCI_3

C. PBr_3

D. PI_3

Answer: D

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2. The shape of a moleculs is determined by electron pair repulsions in the valence shell A.lp occupies a larger space

than a bp because it is not shared by two nuclei The the lp lp repulsion is greater than the lp-lp repulsion, which in trun is greater the lp-lp repulsion. The presence of lp causes distortion of bond angles hence, a daviation from an ideal shape THe extent of distortion depends upon the orientation of the lp's around the central atom In a trigonal bipyramid, the lp's occupy equatorial positions than the apical ones In AB_n type molecules, as the EN of A increases, the bp's come closer and the repulsion between them increases. On the other hand, as EN of B increases, the lp s get farther and repulsion decreases

The shape of which of the following molecules will not be distored ?

A. BrF_3

B. CIF_3

C. XeF_4

D. XeF_6

Answer: C

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3. The shape of a moleculs is determined by electron pair repulsions in the valence shell A.lp occupies a larger space than a bp because it is not shared by two nuclei The the lp lp repulsion is greater than the lp-lp repulsion, which in trun is greater the lp-lp repulsion. The presence of lp causes distortion of bond angles hence, a daviation from an ideal shape THe extent of distortion depends upon the orientation of the lp's around the central atom In a trigonal bipyramid, the lp's occupy equatorial positions than the apical ones In

AB_n type molecules, as the EN of A increases, the bp's come closer and the repulsion between them increases. On the other hand, as EN of B increases, the lp s get farther and repulsion decreases

Which of the following statements is true ?

A. $F-N-F$ angle in NF_3 is greater than $H-N-H$ angle in NH_3 .

B. $F-N-F$ angle in NF_3 is smaller than $H-N-H$ angle in NH_3 .

C. $H-O-H$ angle in H_2O is greater than $H-N-H$ angle in NH_3 .

D. $F-O-F$ angle in F_2O is greater than $H-O-H$ angle in H_2O ..

Answer: B

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4. The shape of a moleculs is determined by electron pair repulsions in the valence shell A.lp occupies a larger space than a bp because it is not shared by two nuclei The the lp lp repulsion is greater than the lp-lp repulsion, which in trun is greater the lp-lp repulsion. The presence of lp causes distortion of bond angles hence, a daviation from an ideal shape THe extent of distortion depends upon the orientation of the lp's around the central atom In a trigonal bipyramid, the lp's occupy equatorial positions than the apical ones In AB_n type molecules, as the EN of A increases, the bp's come closer and the repulsion between them increases. On the

other hand, as EN of B increases, the lp s get farther and repulsion decreases

Which of the following species will have the lone pair effects cancelled ? .

A. ICI_2^{Θ}

B. CIF_3

C. PCI_3

D. BrF_5

Answer: A

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5. In MO energy diagram for heteronuclear diatomic molecule is similar However, the energies of the AO s of the

atom having higher atomic number being lower, the diagram will be unsymmetrical, but that will not make a difference in the electron count The bond order is half the difference in the number of electrns of the bonding $(\sigma \text{ and } \pi)$ and anti-bonding $(\sigma \text{ and } \pi)$ MOs For a bond to have been formed the bond order the shorter is the bond distance and the greater is the bond dissociation energey But if the bond order is smae in the above two cases, then the bond distance will be greater and the bond dissocation energy smaller in the case which has more populated anti-bonding orbitals The presence of unpaired electron(s) in a molecualr orbital will make the system paramagnetic

Which among the following will have a triple bond order ? .

A. CO

B. CN^{Θ}

C. $NO^{\oplus}$

D. All of these

Answer: D

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6. In MO energy diagram for heteronuclear diatomic molecule is similar However, the energies of the AO s of the atom having higher atomic number being lower, the diagram will be unsymmetrical, but that will not make a difference in the electron count The bond order is half the difference in the number of electrns of the bonding $(\sigma \text{ and } \pi)$ and anti-bonding $(\sigma \text{ and } \pi)$ MOs For a bond to have been formed the bond order the shorter is the bond distance and the greater is the bond dissociation energey But if the bond

order is smae in the above two cases, then the bond distance will be greater and the bond dissocation energy smaller in the case which has more populated anti-bonding orbitals The presence of unpaired electron(s) in a molecualr orbital will make the system paramagnetic

Which of the following species is not expected to exist ? .

A. $He_2^{\oplus}$

B. $H_2^{\oplus}$

C. Be_2

D. $Be_2^{\oplus}$

Answer: C

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7. In MO energy diagram for heteronuclear diatomic molecule is similar However, the energies of the AO s of the atom having higher atomic number being lower, the diagram will be unsymmetrical, but that will not make a difference in the electron count The bond order is half the difference in the number of electrns of the bonding $(\sigma \text{ and } \pi)$ and anti-bonding $(\sigma \text{ and } \pi)$ MOs For a bond to have been formed the bond order the shorter is the bond distance and the greater is the bond dissociation energey But if the bond order is smae in the above two cases, then the bond distance will be greater and the bond dissocation energy smaller in the case which has more populated anti-bonding orbitals The presence of unpaired electron(s) in a molecualr orbital will make the system paramagnetic

Which of the following species is expected to be paramagnetic ? .

A. NO^{Θ}

B. O_2^{Θ}

C. O_2^{o}

D. All of these

Answer: D

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8. In MO energy diagram for heteronuclear diatomic molecule is similar However, the energies of the AO s of the atom having higher atomic number being lower, the diagram will be unsymmetrical, but that will not make a difference in

the electron count The bond order is half the difference in the number of electrns of the bonding $(\sigma \text{ and } \pi)$ and anti-bonding $(\sigma \text{ and } \pi)$ MOs For a bond to have been formed the bond order the shorter is the bond distance and the greater is the bond dissociation energey But if the bond order is smae in the above two cases, then the bond distance will be greater and the bond dissocation energy smaller in the case which has more populated anti-bonding orbitals The presence of unpaired electron(s) in a molecualr orbital will make the system paramagnetic

Which of the following orders is correct in respect of bond dissociation energey ? .

A. $N_2^{\oplus} > N_2^{\Theta}$

B. $O_2 > O_2^{\Theta}$

C. $NO^{\oplus} > NO$

D. All of these

Answer: D

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9. Hydrogen bond is formed between hydrogen atoms and highly electronegative elements It is of two types - intermolecular and intramolecualar It is a weaker bond than ionic, covalent and metallic bonds

Which is correct stament ? .

A. Keto form of acetoacetic ester involves hydrogen bonding

B. In water vapour, hydrogen bonding exists

C. For first ionisation, maleic acid is stronger acid than fumaric acid This can be explained on the basis of concept of hydrogen bonding .

D. Boiling point of HCI is higher than that of HF

Answer: C

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10. Hydrogen bond is formed between hydrogen atoms and highly electronegative elements It is of two types - intermolecular and intramolecualar It is a weaker bond than ionic, covalent and metallic bonds

In a suitable slovent such as benzene, benzoic aicd associates and exists as a .

A. dimer

B. trimer

C. tetramer

D. hexamer

Answer: A

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11. Hydrogen bond is formed between hydrogen atoms and highly electronegative elements It is of two types - intermolecular and intramolecualar It is a weaker bond than ionic, covalent and metallic bonds

The number of hydrogen bonds in $H_9O_4^{\oplus}$ species is .

A. 2

B. 3

C. 4

D. 1

Answer: B

12. Hydrogen bond is formed between hydrogen atoms and highly electronegative elements It is of two types - intermolecular and intramolecualar It is a weaker bond than ionic, covalent and metallic bonds

Which is a correct statement ? .

A. Paranitophenol is steam volatile but not orthonitrophenol

B. Ethyl alcohol is more viscous than glycerol

C. If a dry paper is torn, sound is heard due to breaking of hydrogen bonds one after another in a rhythmatic manner .

D. In fermic salt, bonds present are covalent, metallic and hydrogen bond .

Answer: C

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13. in an ionic bond the cation tends to polarise the electron cloud of the anion by pulling electron density towards itself This causes development of covalent character in the ionic bond because the electron density gets localised in between the nuclei The tendency of the cation to bring about the polarisation of the anion is expressed as its polasising power The ability of ion to undergo polarisation is called its polarisability The polarising power of a cation or an anion is decided on the basis of F ajans' rules as follows .

(i) The smaller the cation, the higher is its polarising power

(ii) Cations with pseudo-noble gas configuration $\left(ns^2np^6nd^{10}\right)$ have relatively high polarising power than those with noble gas configuration $\left(ns^2np^6\right)$

(iii) The larger the size of the anion, the higher is its polarisability

The ionic conductance of which of the following is the highest ? .

A. $Li^{\oplus}_{(aq)}$

B. $Na^{\oplus}_{(ag)}$

C. $K^{\oplus}_{(aq)}$

D. $Cs^{\oplus}_{(aq)}$

Answer: D

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14. in an ionic bond the cation tends to polarise the electron cloud of the anion by pulling electron density towards itself This causes development of covalent character in the ionic bond because the electron density gets localised in between

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(iii) The larger the size of the anion, the higher is its polarisability

Among the following which will have the lowest metlting point and the highest solubility $LiCI$, $BeCI_2$, BCI_3, CCI_4 .

A. CCI_4, $LiCI$

B. $LIiCI$, CCI_4

C. $BeCI_2, BCI_3$

D. $BCI_3, BeCI_2$

Answer: A

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15. in an ionic bond the cation tends to polarise the electron cloud of the anion by pulling electron density towards itself This causes development of covalent character in the ionic bond because the electron density gets localised in between the nuclei The tendency of the cation to bring about the polarisation of the anion is expressed as its polasising power The ability of ion to undergo polarisation is called its polarisability The polarising power of a cation or an anion is decided on the basis of F ajans' rules as follows .

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(ii) Cations with pseudo-noble gas configuration $\left(ns^2np^6nd^{10}\right)$ have relatively high polarising power than those with noble gas configuration $\left(ns^2np^6\right)$

(iii) The larger the size of the anion, the higher is its polarisability

Choose the correct order of polarisability for the following $I^{\Theta}, Br^{\Theta}, CI^{\Theta}F^{\Theta}$.

A. $I^{\ominus} > Br^{\ominus} > Cl^{\ominus}F^{\ominus}$

B. $I^{\ominus} > Br^{\ominus} = Cl^{\ominus} > F^{\ominus}$

C. $I^{\ominus} = Br^{\ominus} = Cl^{\ominus} > F^{\ominus}$

D. $I^{\ominus} = Br^{\ominus} < Cl^{\ominus} = F^{\ominus}$

Answer: A

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16. in an ionic bond the cation tends to polarise the electron cloud of the anion by pulling electron density towards itself This causes development of covalent character in the ionic bond because the electron density gets localised in between the nuclei The tendency of the cation to bring about the polarisation of the anion is expressed as its polasising power The ability of ion to undergo polarisation is called its polarisability The polarising power of a cation or an anion is decided on the basis of F ajans' rules as follows .

(i) The smaller the cation, the higher is its polarising power

(ii) Cations with pseudo-noble gas configuration $\left(ns^2np^6nd^{10}\right)$ have relatively high polarising power than those with noble gas configuration $\left(ns^2np^6\right)$

(iii) The larger the size of the anion, the higher is its

polarisability

Arranfe of the following species in dereasing order of polarising powers $Ag^{\oplus}, TI^{\oplus}, Na^{\oplus}$.

A. $TI^{\oplus} > Ag^{\oplus} > Na^{\oplus}$

B. $TI^{\oplus} > Ag^{\oplus} > Ag^{\oplus}$

C. $Ag^{\oplus} > TI^{\oplus} > Na^{\oplus}$

D. $Na^{\oplus} > TI^{\oplus} > Ag^{\oplus}$

Answer: C

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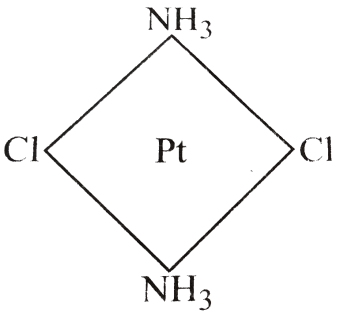
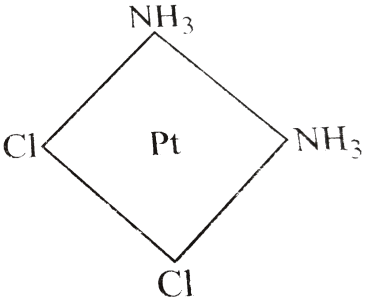
17. The $Pt - CI$ distance is $2.32A$ in several crystaline compounds

What is the $CI - CI$ distance in structure (i) and in

structure (ii)



(i)



(ii)

A. 4.32Å

B. 4.32Å

C. 1.16Å

D. 9.28Å

Answer: B

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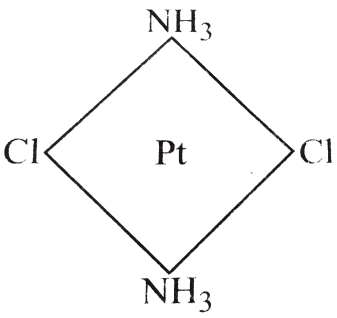
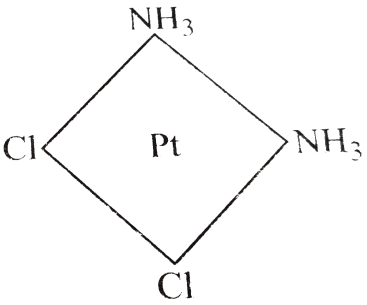
18. The $Pt - CI$ distance is $2.32A$ in several crystaline compounds

What is the $CI - CI$ distance in structure (i) and in structure (ii)



(i)



(ii)

A. 2.32Å

B. 1.52Å

C. 2.15Å

D. 3.28Å

Answer: D

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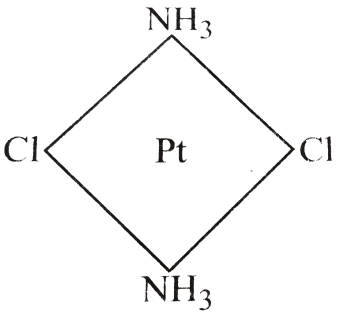
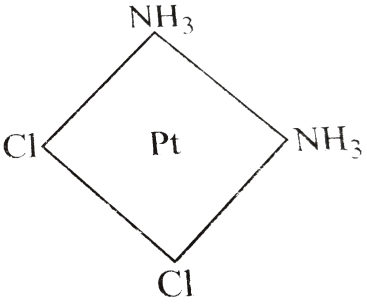
19. The $Pt - CI$ distance is $2.32A$ in several crystaline compounds

What is the $CI - CI$ distance in structure (i) and in structure (ii)



(i)



(ii)

A. cis-isomer

B. trans-isomer

C. chiral isomer

D. none of these

Answer: B

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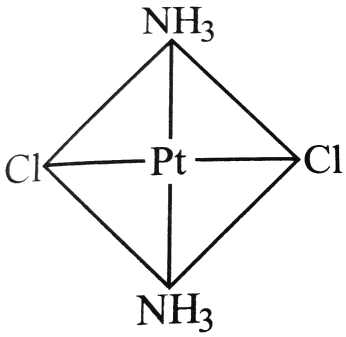
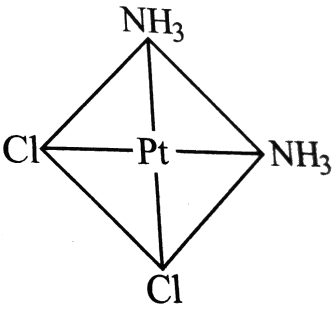
20. The platinum-chlorine distance has been found to be 2.32Å in several crystalline compounds This value applies to both compounds A and B given here



(A)



(B)

Based on the above structures, answer the following

questions

Structure B is .

A. cis-isomer

B. trans-isomer

C. nuclear isomer

D. co-ordinate isomer

Answer: A

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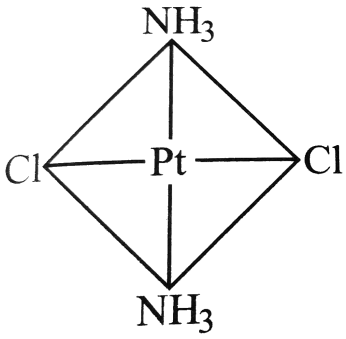
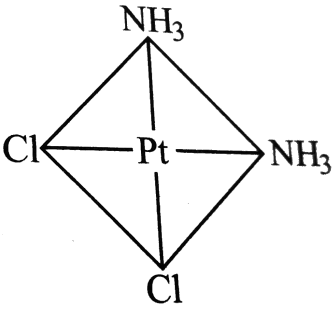
21. The platinum-chlorine distance has been found to be 2.32Å in several crystalline compounds This value applies to both compounds A and B given here



(A)



(B)

Based on the above structures, answer the following questions

The $C-C$ single-bond distnaance is 1.54Å What is the distance between the terminal carbons is propane ? Assume that the four bonds of any carbon atoms arre pointed towards the corners of a requlr tetrahedron .

A. 3.08Å

B. 1.54Å

C. 2.52Å

D. 1.26Å

Answer: C

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22. The HF_2^{Θ} ion solid state and in liquid HF but not in the dilute aqueous solution

HF_2^{Θ} exists in solid state and in liquid HF because HF_2^{Θ} ions are held together by .

A. hydrogen bonding

B. van der Waals force

C. London force

D. All of these

Answer: A

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23. The HF_2^{Θ} ion solid state and in liquid HF but not in the dilute aqueous solution

In aqueous solution

A. HF forms $H_2F^{\oplus}$ and $\overset{\Theta}{H}$, H_2O being a stronger acid than HF

$$H_2O + \Leftrightarrow H_2F^{\oplus} + O\overset{\Theta}{H}$$

B. HF forms $H_3O^{\oplus}$ and F^{Θ}, H_2O being a weaker acid than HF

$$H_2O + HF \Leftrightarrow H_2O^{\oplus} + F^{\Theta} .$$

C. H-bonding between HF and H_2O is observed

D. No change is observed

Answer: B

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24. The HF_2^{Θ} ion solid state and in liquid HF but not in the dilute aqueous solution

At $300K$ and 1.00 atm, the density of HF is $3.17gL^{-1}$ We conclude that there is a .

A. dimer formation by H-bonding

B. trimer formation by H-bonding

C. tetramer formation by H-bonding

D. ionisation formation HF_2^{Θ} and $H^{\oplus}$

Answer: C

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25. The HF_2^{Θ} ion solid state and in liquid HF but not in the dilute aqueous solution

Energy of H-bond is maximum in .

A. $F-H---O$

B. $F-H---F$

C. $O-H---O$

D. $O-H---F$

Answer: B

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26. The HF_2^{Θ} ion solid state and in liquid HF but not in the dilute aqueous solution

Consider the following molecules .

A:Anti -pyridine -2-carboxaldoxime

B:syn pyridine -2-carboaxaldoxime

C: nickel -dimethyl glyoximate

C : nickel-dimethyl glyoximate

D : o-nitrophenol

E : p-nitrophenol

F : p-salicylaldehyde

In which case chelate formation occurs ? .

A. A, B

B. B, C

C. C, F

D. C only

Answer: D

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27. The HF_2^{Θ} ion solid state and in liquid HF but not in the dilute aqueous solution

Consider the following molecules .

A:Anti -pyridine -2-carboxaldoxime

B:syn pyridine -2-carboaxaldoxime

C: nickel -dimethyl glyoximate

C : nickel-dimethyl glyoximate

D : o-nitrophenol

intermolecular hydrogen bonding (inQ.5) is observed in .

A. A, B, C, D

B. A, B, E, F

C. B, C, D

D. A, C, D

Answer: D

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28. Valence-bond theory is one of the two quantum mechanical approaches that explains bonding in molecules In some cases, valence bond theroy cannot cannot satisfactorily account for observed properties of molecules

Consider the following molecular geometries

$NO \quad CO \quad O_2$

Select correct statement(s) about these (More than one correct) .

A. NO is paramagnetic CO and O_2 are diamagnetic

B. NO and O_2 are paramagnetic CO is diamagentic

C. Bond order is in order $O_2 < NO < CO$

D. Number of unpaired electrons are

NO	1
CO	0
O_2	0

Answer: B::C

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29. Valence-bond theory is one of the two quantum mechanical approaches that explains bonding in molecules In some cases, valence bond theroy cannot cannot satisfactorily account for observed properties of molecules Valnce-bond theroy can explain molecular geometries .

A. predicated by $VSEPR$ model

B. predicated by MO theory

C. predicated by both (a) and (b)

D. predicated by none of these

Answer: A

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30. Valence-bond theory is one of the two quantum mechanical approaches that explains bonding in molecules In some cases, valence bond theroy cannot cannot satisfactorily account for observed properties of molecules Bond order and magnetic behaviour shown by different species have been matched Which is the incorrect matching .

A.

Species	Bond order	Magentic behaviour
$CN^{\Theta}(14)$	3.0	dimagnetic

B.

Species	Bond order	Magentic behaviour
$BN(14)$	2.0	dimagnetic

C.

Species	Bond order	Magentic behaviour
$C_2(12)$	2.0	dimagnetic

D.

Species	Bond order	Magentic behaviour
$B_2(10)$	3.0	paramagnetic

Answer: D

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31. Valence-bond theory is one of the two quantum mechanical approaches that explains bonding in molecules In some cases, valence bond theroy cannot cannot satisfactorily account for observed properties of molecules MO electronic configuration of superoxide ion is .

A.

$$KK^{*}(\sigma 2s)^{2},(\sigma^{*}2s)^{2},(\sigma 2p_{z})^{2}\left(\pi 2p_{y}\right)^{2}(\pi^{*}2p)^{2}(\pi^{*}2p_{x})^{1}$$

B.

$$KK^{*}(\sigma 2s)^{2},(\sigma^{*}2s)^{2},(\sigma 2p_{z})^{2}\left(\pi 2p_{y}\right)^{2}(\pi^{*}2p)^{2}(\pi^{*}2p_{x})^{2}$$

C.

$$KK^{*}(\sigma 2s)^{2},(\sigma^{*}2s)^{2},(\sigma 2p_{z})^{2}\left(\pi 2p_{y}\right)^{2}(\pi^{*}2p)^{2}(\pi^{*}2p_{x})$$

D. none of these

Answer: A

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32. Valence-bond theory is one of the two quantum mechanical approaches that explains bonding in molecules In some cases, valence bond theroy cannot cannot satisfactorily account for observed properties of molecules Which of the following statements is correct about $O_2, O_2^{\Theta}, O_2^{2-}$ species ? .

A. KO_2 and K_2O_2 are diamagnetic while O_2 is paramagnetic .

B. KO_2 and O_2 are paramagnetic while K_2O_2 is diamagnetic .

C. Bond length increase in the order $O_2 < O_2^{\Theta} < O_2^{2-}$

D. Bond enthalpy increases in the order

$$O_2^{2-} < O_2^{\Theta} < O_2 .$$

Answer: A

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33. According to the moleular orbital theory, all atomic orbitals combine to form molecular orbital by $LCAO$ (linear combination of atomic orbitals) method When two atomic orbitals have additive (constructive) method When two atomic orbitals have additive (constructive) overlapping they form bonding molecular orbitals (BMO) which have lower energy than atomic orbitals whereas when atomic orbitals overlap subtractive higher energy antibonding molecular orbitals $(ABMO)$ are formed Each MO occupies two

electrons with opposite spin Distribution of electrons in MO follows Aufbau principle as well as Hund's rule MO theory can successfully explain the magnetic behaviour of molecules O_2^{2-} will have .

A. bond order equal to H_2 and diamagnetic

B. bond order equal to H_2 but diamagnetic

C. bond order equal to N_2 and diamagnetic

D. bond order higher than O_2

Answer: A

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34. According to the moleular orbital theory, all atomic orbitals combine to form molecular orbital by $LCAO$ (linear

combination of atomic orbitals) method When two atomic orbitals have additive (constructive) method When two atomic orbitals have additive (constructive) overlapping they form bonding molecular orbitals (BMO) which have lower energy than atomic orbitals whereas when atomic orbitals overlap subtractive higher energy antibonding molecular orbitals $(ABMO)$ are formed Each MO occupies two electrons with opposite spin Distribution of electrons in MO follows Aufbau principle as well as Hund's rule MO theory can successfully explain the magnetic behaviour of molecules Which of the following is/are not paramagnetic ? .

A. NO

B. B_2

C. CO

D. O_2

Answer: C

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35. According to the moleular orbital theory, all atomic orbitals combine to form molecular orbital by $LCAO$ (linear combination of atomic orbitals) method When two atomic orbitals have additive (constructive) method When two atomic orbitals have additive (constructive) overlapping they form bonding molecular orbitals (BMO) which have lower energy than atomic orbitals whereas when atomic orbitals overlap subtractive higher energy antibonding molecular orbitals $(ABMO)$ are formed Each MO occupies two electrons with opposite spin Distribution of electrons in MO follows Aufbau principle as well as Hund's rule MO theory

can successfully explain the magnetic behaviour of molecules

Bond strength increases when

A. bond order increases

B. bond length increases

C. antibonding electrons increases

D. bond angle increases

Answer: A

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36. Most of the polyatomic molecules except a few such as CO_2 and CS_2 are linear or angular with a bond angle generally somewhat greater than 90° A bond angle is defined as the angle between the direction of two covalent

bonds Since the atoms in molecules are in constant motion with respect to each other they are not expected to have a fixed value of bond angle Repulsion between non-bonded atoms alone does not provide an adequate explanation Hybridisation of bonding orbitals an adequate explanation Hybridisation of bonding orbitals also plays a very important role in detrmining the value of bond angle It has been observed that in hybridisation as the s-character of hybrid orbital increases the bond angle increases

In P_4 molecule phosphorous atoms are tetrahedrally arranged The angle $P-P-P$ in the molecule is .

A. 108°

B. 120°

C. 60°

D. 180°

Answer: C

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37. Most of the polyatomic molecules except a few such as CO_2 and CS_2 are linear or angular with a bond angle generally somewhat greater than 90° A bond angle is defined as the angle between the direction of two covalent bonds Since the atoms in molecules are in constant motion with respect to each other they are not expected to have a fixed value of bond angle Repulsion between non-bonded atoms alone does not provide an adequate explanation Hybridisation of bonding orbitals an adequate explanation Hybridisation of bonding orbitals also plays a very important role in detrmining the value of bond angle It has been

observed that in hybridisation as the s-character of hybrid orbital increases the bond angle increases

Which of the following have highest bond angle ? .

A. H_2S

B. H_2Te

C. H_2Se

D. All have same bond angle

Answer: A

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38. Most of the polyatomic molecules except a few such as CO_2 and CS_2 are linear or angular with a bond angle generally somewhat greater than 90° A bond angle is

defined as the angle between the direction of two covalent bonds Since the atoms in molecules are in constant motion with respect to each other they are not expected to have a fixed value of bond angle Repulsion between non-bonded atoms alone does not provide an adequate explanation Hybridisation of bonding orbitals an adequate explanation Hybridisation of bonding orbitals also plays a very important role in detrmining the value of bond angle It has been observed that in hybridisation as the s-character of hybrid orbital increases the bond angle increases

Which of the following hybridisation may have more than one type of bond angle ? .

A. sp^2

B. sp^3

C. sp^3d

D. sp^3d^2

Answer: C

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39. $MO's$ are formed by the overlap of $A'Os$ Two $AO's$ combine to form two $MO's$ called bonding molecular orbital (BMO) and antibonding molecular orbital $(ABMO)$ Differnet $AO's$ of one atom combine with these $AO's$ of the second atom which have comparable energies and proper orienation Further, If the overlapping is head on, the MO is called 'pi' The $MO's$ are filled with electrons following the same rules as followed for filling of atomic orbitals However the order of filling is not the same for all molecules or their ions Bond order is one of the most

important parameter to compare a number of their characteristics

Which one of the following statements is correct .

A. BMO is lowered by the same amount of energy by which $ABMO$ is raised .

B. BMO is lowered by a greater amount of energy than the amount by which $ABMO$ is raised .

C. BMO is lowered by less amount of energy than the amount by which $ABMO$ is raised .

D. Any one of the above is possible .

Answer: C

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40. $MO's$ are formed by the overlap of $A'Os$ Two $AO's$ combine to form two $MO's$ called bonding molecular orbital (BMO) and antibonding molecular orbital $(ABMO)$ Differnet $AO's$ of one atom combine with these $AO's$ of the second atom which have comparable energies and proper orienation Further, If the overlapping is head on, the MO is called 'pi' The $MO's$ are filled with electrons following the same rules as followed for filling of atomic orbitals However the order of filling is not the same for all molecules or their ions Bond order is one of the most important parameter to compare a number of their characteristics

H_2, Li_2B_2 each has bond order equal to 1 The order of their stability is .

A. $H_2 = Li_2 = B_2$

B. $H_2 > Li_2 > B_2$

C. $H_2 > B_2 > Li_2$

D. $B_2 > Li_2 > H_2$

Answer: C

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41. $MO's$ are formed by the overlap of $A'Os$ Two $AO's$ combine to form two $MO's$ called bonding molecular orbital (BMO) and antibonding molecular orbital $(ABMO)$ Differnet $AO's$ of one atom combine with these $AO's$ of the second atom which have comparable energies and proper orienation Further, If the overlapping is head on, the MO is called 'pi' The $MO's$ are filled with electrons

following the same rules as followed for filling of atomic orbitals However the order of filling is not the same for all molecules or their ions Bond order is one of the most important parameter to compare a number of their characteristics

In which of the following pair both to $MO's$ are gerade or ungerade ? .

A. $\sigma 2s, \pi 2p_x$

B. $\sigma^* 2s, \pi^* 2p_x$

C. $\sigma^* 2s, \pi 2p_x$

D. $\pi 2p_x, \pi^* 2p_x$

Answer: C

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42. $MO's$ are formed by the overlap of $A'Os$ Two $AO's$ combine to form two $MO's$ called bonding molecular orbital (BMO) and antibonding molecular orbital $(ABMO)$ Differnet $AO's$ of one atom combine with these $AO's$ of the second atom which have comparable energies and proper orienation Further, If the overlapping is head on, the MO is called 'pi' The $MO's$ are filled with electrons following the same rules as followed for filling of atomic orbitals However the order of filling is not the same for all molecules or their ions Bond order is one of the most important parameter to compare a number of their characteristics

Which one of the following has maximum number of nodal planes ? .

A. $\sigma^* 1s$

B. $\sigma^* 2p_z$

C. $\pi 2p_x$

D. $\pi^* 2p_y$

Answer: D

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43. $MO's$ are formed by the overlap of $A'Os$ Two $AO's$ combine to form two $MO's$ called bonding molecular orbital (BMO) and antibonding molecular orbital $(ABMO)$ Differnet $AO's$ of one atom combine with these $AO's$ of the second atom which have comparable energies and proper orienation Further, If the overlapping is head on, the MO is called 'pi' The $MO's$ are filled with electrons

following the same rules as followed for filling of atomic orbitals However the order of filling is not the same for all molecules or their ions Bond order is one of the most important parameter to compare a number of their characteristics

Which of the following has pair is expected to have the same bond order ? .

A. O_2, N_2

B. $N_2^{\oplus}, N_2^{\Theta}$

C. $O_2^{\Theta}, N_2^{\oplus}$

D. $O_2^{\Theta}, N_2^{\Theta}$

Answer: B

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Exercises Multiple Correct(Chemical Bonding)

1. The type of bond s present in ammonium chloride is (are) :

A. Ionic

B. Covalent

C. Coordinate

D. Singlet

Answer: A::B::C

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2. Which of the following statement (s) is (are) true ? .

A. $CuCI$ is more covalent than $NaCI$

B. $HF$is more polar than HBr

C. HF is less polar than HBr

D. Cemical bond formation takes plane when forces of attraction overcome the forces of repulsion .

Answer: A::B::D

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3. Which is (are) correct among the following ? .

A. The radius of CI^{Θ} ion is 1.56Å while that of $Na^{\oplus}$ ion is 0.95Å .

B. The radius of CI atom is 0.99 while that of Na atom is 1.54

C. The radius of CI atom is 0.99 while that of CI^{Θ} ion is 0.81

D. The radius of Na atom is 0.95 while that of $Na^{\oplus}$ ion is 1.54 .

Answer: A::B

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4. Which of the following is (are) correct? .

A. A double bond is shorter than a single bond .

B. A sigma- vbond is weaker than a pi-bond .

C. Adouble bond is stronger than a single bond .

D. A covalent bond is stronger than a hydrogen bond .

Answer: A::C::D

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5. The non-metallic cation is persent in .

A. CrO_2CI_2

B. $VOCI$

C. OF_2

D. PF_3

Answer: C::D

Watch Video Solution

6. Peroxo bond $(-O-O-)$ is present in

A. Na_2O_2

B. CrO_5

C. PbO_2

D. SrO_2

Answer: A::B::D

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7. Among the following the electron-deficient compound is .

A. $BeCI_2$

B. CCI_4

C. CHI_3

D. $CHCI_3$

Answer: A::D

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Exercises Multiple Correct (Dipole Moment)

1. Which among the following molecules have minimum dipole moment ?

A. CH_4

B. CCI_4

C. CHI_3

D. $CHCI_3$

Answer: A::B

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2. Which among the following pairs of molecules have zero dipole moment ? .

A. SiF_4 and CO_2

B. SiF_4 and NO_2

C. O_2 and CO_2

D. NO_2 and O_3

Answer: A::C::D

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3. Which of the following satements are false ? .

A. Dipole-dipole interations between molecules are greatest if the molecules possess possess only temporary dipole moments .

B. All compounds containing hydrogen atoms can participate in hydrogen bonding .

C. Dispersion forces exist between all atoms, molecules and ions

D. The extent of ion-induced dipole interaction depends only on the charge of the ion .

Answer: A::B::D

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Exercises Multiple Correct(Hybridisation)

1. Which of the following are tetrahedral structures ? .

A. $\left[Ni(CN)_4\right]^{2-}$

B. $\left[Ni(CO)_4\right]$

C. $[NiCI_4]^{2-}$

D. CrO_4^{2-}

Answer: B::C::D

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2. Which among the following are isostructural ? .

A. XeO_2F_2, SF_4

B. CO_2, I_3^{Θ}

C. SO_3^{2-}, CO_3^{2-}

D. CIF_3, XeF_2

Answer: A::B

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3. In which of the following molecules all the atoms lie in one plane ? .

A. $\dot{\dot{N}}H_3$

B. PF_5

C. BF_3

D. XeF_4

Answer: C::D

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4. Which of the following have sp^3 d hybridisation of the central atom ? .

A. XeF_4

B. XeO_2F_2

C. CIO_3^{Θ}

D. BrF_3

Answer: B::D

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5. Which are the species in which central atom undergoes sp^3 hybridisation ? .

A. SF_4

B. SCI_2

C. SO_4^{2-}

D. H_2O

Answer: B::C::D

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6. The pair od species having identical shapes for molecules of both species is ? .

A. BF_3, PCI_3

B. XeF_2, CO_2

C. CF_4, SIF_4

D. PF_5, IF_5

Answer: B::C

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7. Which among the following is (are) having two lone pair of electrons on central atom ? .

A. CO_2

B. CIF_3

C. SO_3^{2-}

D. XeF_4

Answer: B::D

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8. The state of hybridisation of atoms in boric acid (H_3BO_3) is .

A. sp^3

B. sp^2

C. sp

D. None of these

Answer: A::B

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9. Which of the following have sp^3 d hybridisation ? .

A. SF_4

B. $BrCI_3$

C. $XeOF_2$

D. $H_3O^{\oplus}$

Answer: A::B::C

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10. The hybridisation number of lone pair of electron and shape of I_3^{Θ} is .

A. sp^3 d hybridisation

B. It has trigonal bipyramidal shape

C. It is linear

D. It has three lone pair of electrons

Answer: A::C::D

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11. Which of following is (are) correct for B and N in $NH_3.BF_3$ adduct ? .

A. Both have sp^3 hybrid orbitals

B. Both have tetrahedral structures

C. N is sp^3 hybridised while B is sp^2 hybridised .

D. N in NH_3 is pyramidal, while B in BF_3 is planar .

Answer: A::B

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12. Which of the following is not square planar ? .

A. XeF_4

B. XeF_2

C. $XeOF_4$

D. CH_3CI

Answer: B::C::D

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Exercises Multiple Correct(Hydrogen Bonding)

1. Which property is due to H-bonding ? .

A. High boiling point of water

B. Solubility of NH_3 in H_2O

C. Polar nature of halogen acid

D. High viscosity of H_3PO_4

Answer: A::B::C

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2. Hybrogen bonds are present in

A. Ice

B. Solid CO_2

C. HF

D. Water

Answer: A::C::D

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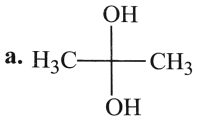
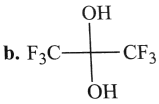
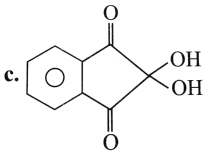
3. Which of the following gem-diol is stable ? .

A. 

B. 

C. 

D. none of these

Answer: B::C

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Exercises Multiple Correct(Bond Angle)

1. Bond angle in PH_3 is

A. Much less than NH_3

B. Much less than PF_3

C. More than NH_3

D. More than PF_3

Answer: A::B

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2. Which statement (s) is (are) wrong for bond angle ?

A. $NH_3 > NF_3$

B. $NF_3 > NCI_3$

C. $NO_2^{\oplus} > NO_2$

D. $NO_3^{\ominus} > NO_2^{\ominus}$

Answer: A::C::D

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3. Which statement (s) is (are) wrong for bond angle ?

A. $CH \equiv CH > BF_3 > CH_4$

B. $H_2O > NCI_3$

C. $\overset{\oplus}{N}H_4 > NH_3 > PCI_5$

D. $CO_2 > NH_3 > CH_4$

Answer: B::D

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4. Bond angle in I_3^{Θ} is .

A. More than CIO_2

B. 180°

C. Less than CIO_2

D. $> 109.5^\circ$

Answer: A::B

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5. Which statements (s) is (are) correct for AB_x type molecule ? .

A. If the EN of central atom decreases, the bond angle decreases .

B. If the size of central atom increases the bond angle decreases.

C. If the EAN of atom B decreases that bond angle increases

D. If the EAN of atom B decreases that bond angle decreases .

Answer: A::B::C

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Exercises Multiple Correct(Molecular Orbitaltheory (Mot))

1. Which of the folowing have identical bond orders ? .

A. O_2^{Θ}

B. CN^{Θ}

C. $NO^{\oplus}$

D. $CN^{\oplus}$

Answer: B::C

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2. Which of the following diatomic molecule //ions have same bond order ? .

A. O_2

B. CN^{Θ}

C. N_2

D. C_2

Answer: B::C

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3. Which of the following species exhibits the diamagnetic behaviour ?

A. O_2

B. $O_2^{\oplus}$

C. NO

D. O_2^{2-}

Answer: A::B::C

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4. Which of the following molecules has one unpiared electron in antibonding orbitals ? .

A. CO

B. $O_2^{\ominus}$

C. $O_2^{\oplus}$

D. NO

Answer: B::C::D

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5. Which of the following show paramagnetism ? .

A. Na_2O

B. NO_2

C. NO

D. KO_2

Answer: B::C::D

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6. Which of the following is (are) correct statements ? .

A. Probability of finding the electron in bonding MO is more than combining atomic orbitals .

B. Bonding $MO's$ are formed when same sign of orbitals overlap

C. d-d combination of atomic orbitals gives delta and delta^(**) $MO's$.

D. None of these

Answer: A::B::C

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7. Which of the following is (are) gerade (g) $MO's$? .

A. $\sigma 2s$

B. $\sigma 2pz$

C. $\pi^{*}(2px)$

D. $\sigma^{*} 2s$

Answer: A::B::C

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In which of the following pair both to $MO's$ are gerade or ungerade ? .

A. $\sigma^{*}(2pz)$

B. $\pi(2p_x)$

C. $\pi(2p_y)$

D. $\pi^{*}(2py)$

Answer: A::B::C

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9. Which of the following MO s have one nodal plane ? .

A. $\sigma 1s$

B. $\sigma^* 1s$

C. $\sigma 2p_z$

D. $\sigma^* 2p_z$

Answer: B::D

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10. Which of the following `MO's have two nodal plane ? .

A. $\sigma 2p_z$

B. $\pi^* 2p_x$

C. $\pi^* 2p_y$

D. $\sigma^* 2p_z$

Answer: A::B::C

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Exercises Multiple Correct (Miscellaneous)

1. Select corrcet orders for corresponding property as indicated in bracket for the following .

A. $NH_3 > BiH_3 > SbH_3 > AsH_3 > PH_3$ (Boiling point)

B. $H_2O > H_2Te > H_2Se > H_S(2)$ (Boiling point)

C. $NH_3 > PH_3 > AsH_3 > SbH_3$ (Basic character)

D. $H_2O < H_2S < H_2Se < H_2$ Te (Acidic character)

Answer: B::C::D

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2. Which one or more among the following involve (s) (pi - dpi) bonding ? .

A. $(SiH_3)_3N$:

B. $(CH_3)_3N$:

C. $: \overset{\Theta}{C}CI_3$

D. $: \overset{\Theta}{C}F_3$

Answer: A::C

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3. Paramagnetic pairs (s) among the following is (are) .

A. $[BaO_2, NO_2]$

B. $[KO_2, NO]$

C. $[H_2O_2, NO]$

D. $K_3[Fe(CN)_6], CuCI_2$

Answer: B::D

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4. Which of the following orders are correct for property indicated in brackets ? .

A. $NH_3 > NF_3 > BF_3$ (dipole moment)

B. $CI > S > O > N$ (electron affinity)

C. $Si > Mg > A1 > Na$ (first ionisation enthalpy)

D. $HCIO_4 > HBrO_4 > HIO_4 (pK_a \text{values})$

Answer: A::B::C

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5. The first element of groups $13 - 16$ differ rest of the elements This is due to .

A. Small size and high electronegativity

B. Inability to expand the octet

C. Ability to form strong$p\pi$ $p\pi$ multiple bonds

D. Due to greater abundance

Answer: A::B::C

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6. Select the correct satements .

A. The heat of hydrogen of the dipositive earth metal ions increases with an increase in their ionic size

B. Hydration of alkali metal ions is less than that of group 2

C. Alkaline earth metal ions because of their much larger charge to size ratio exert a much stronger electrostaic attaction on the oxygen of water molecule surrounding them .

D. Melting point of sodium halides is as follows $NaF > NaCI > NaBr > Nal$.

Answer: B::C::D

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7. Write vitriol is not isomorphous with .

A. K_2SO_4

B. $MgSO_4$

C. $CaSO_4$

D. H_2SO_4

Answer: A::B::C::D

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8. The stability of ions of Ge Sn and Pb will be in the order .

A. $Ge^{2+} < Sn^{2+} < Pb^{2+}$

B. $Pb^{2+} > Pb^{4+}$

C. $Sn^{4+} > Pb^{2+}$

D. $Ge^{4+} < Sn^{4+} < Pb^{4+}$

Answer: A::B

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9. Select the correct satements (s) .

A. NF_3 is weaker base than NH_3

B. $NO^{\oplus}$ is more stable than O_2

C. $AICI_3$ has higher melting point than AIF_3

D. $SbCI_3$ is more covalent than $SbCI_5$

Answer: A::B

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10. Which of the following are true ?.

A. SH_6 and $BiCI_5$ do not exist

B. There are two $p\pi - d\pi$ bond is SO_3

C. SeF_4 and CH_4 are tetrahedral ion

D. I_3^{Θ} is a linear molecule with sp^3 d hybridisation

Answer: A::B::D

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Exercises Single Correct (Chemical Bonding)

1. Which of the following is the most ionic ? .

A. P_4O_{10}

B. MnO

C. CrO_3

D. Mn_2O_7

Answer: B

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2. Among $LiCI, BeCI_2$ and CCI_4 the covalent bond character varies as .

A. $LiCI < BeCI_2 < BCI_3 > CCI_4$

B. $LiCI < BeCI_2 > BCI_3 > CCI_4$

C. $LiCI < BeCI_2 > BCI_3 > CCI_4$

D. $LiCI < BeCI_2 > BCI_3 > CCI_4$

Answer: C::D

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3. In a matallic crystal the .

A. Valence electrons remain within the fields of influence of their own kernels

B. Valence electrons constitute a sea of mobile electrons

C. Valence electrons are localised between the two kernels

D. Kernal as well as the electrons move rapidly

Answer: B

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4. Polarisation involves the distortion of the shape of an anion by an adjacently placed cation In this context, which of the following statements is correct ? .

A. Maximum polarisation is brought about by a cation of high charge

B. Maximum polarisation is brought about by a cation of high charge

C. A large cation is likely to bring about a high degree of polarisation .

D. The polarising power of a cation is less than that of an anion

Answer: A

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5. Which of the following is required for the formation of an ionic bond ? .

A. An electron from the more electronegative element should be transferred to the less electronegative .

B. The total energey of the resulting molecule should be less than the total energy of the reactants .

C. The lattice energy of the resultants molecule should be as low as possible .

D. The ionic potential of the reactants should be identical .

Answer: B

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6. $AICI_3$ is covalent while AIF_3 is ionic This can be justified on the basic of .

A. The valence bond theory

B. Fajans rules

C. The molecuar orbital theory

D. Hydration energy

Answer: B

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7. Which of the following oxyacids of phosphorouse are monoprotic (mono basic) ? .

A. H_3PO_3

B. H_3PO_3

C. H_3PO_2

D. $H_4P_2O_7$

Answer: C::D

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8. Which of the following has greater bond length ? .

A. $P - O$

B. $S - O$

C. $CI - O$

D. $O = O$

Answer: A

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9. Which of the following has been arranged order of increasing covalent character ? .

A. $KCI < CaCI_2 < AICI_3 < SnCI_4$

B. $SnCI_4 < AICI_3 < CaCI_2 < KCI$

C. $AICI_3 < CaCI_2 < KCI < SnCI_4$

D. $CaCI_2 < SnCI_4 < KCI < AICI_3$

Answer: A

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10. Which of the following pairs have nearly identical valuse of bond energey ? .

A. O_2 and H_2

B. N_2 and CO

C. F_2 and I_2

D. O_2 and CI_2

Answer: D

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11. Which of the following alkali metal ions has the lowest ionic mobility in aqueous solutions?

A. $Li^{\oplus}$

B. $Na^{\oplus}$

C. $K^{\oplus}$

D. $Cs^{\oplus}$

Answer: D

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12. In PO_4^{3-}, $P-O$ bond order is .

A. 1.25

B. 2

C. -0.75

D. -3

Answer: A

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13. Which of the following has lest covalent $P - H$ bond ? .

A. PH_3

B. P_2H_6

C. P_2H_5

D. $PH_6^{\oplus}$

Answer: D

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14. Which of the following diatomic molecule would be stabilised by the removal of an electron ? .

A. O_2

B. CN^{Θ}

C. N_2

D. C_2

Answer: A

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15. In which of the following species the bonds are non-directonal ?

A. NCI_3

B. $RbCI$

C. $BeCI_2$

D. BCI_2

Answer: B

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16. Which contains both polar and non-polar bonds ? .

A. NH_4CI

B. HCN

C. H_2O_2

D. CH_4

Answer: C

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17. The bond angle between two hybrid orbitals is 180° The percentage s-character of hybrid orbital is between .

A. 50 and $55\ \%$

B. 9 and $12\ \%$

C. 22 and $23\ \%$

D. 11 and $12\ \%$

Answer: A

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18. Which type of bond is not present in HNO_2 molecule ? .

A. Covalent

B. Coordinate

C. Ionic

D. Both ionic and coordinate

Answer: D

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19. KF combines with HF to form KHF_2 The compound contains the species .

A. $K^{\oplus}$, F^{Θ} and $H^{\oplus}$

B. $K^{\oplus}$, F^{Θ} and $H^{\oplus}$

C. $K^{\oplus}$ and $[HF_2]^{\Theta}$

D. $[KHF]^{\oplus}$ and F_2

Answer: C

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20. There is $S - S$ bond in .

A. $S_2O_6^{2-}$

B. $S_4O_6^{2-}$

C. $S_2O_3^{2-}$

D. $S_2O_7^{2-}$

Answer: D

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21. Angle between two hybridised orbital is 105° and hence the percentage of s-character in the hybridised orbital would be in the range .

A. $23 - 24\,\%$

B. $20 - 21\,\%$

C. $50 - 55\,\%$

D. $11 - 12\,\%$

Answer: A

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22. The octer rule is not valid for the molecule .

A. CO_2

B. H_2O

C. O_2

D. CO

Answer: D

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23. The total number of electrons that take part in forming the bond in N_2 is .

A. 2

B. 4

C. 6

D. 10

Answer: C

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24. Bonds presents in $CuSO_4.5H_2O$ is

A. Electrovalent and covalent

B. Electrovalent, coordinate covalent .

C. Electrovalent, covalent and coordinate covalent .

D. Covalent and coordinate covalent .

Answer: C

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25. The bond between two identical non-metal atoms has a pair of electrons:

A. Unqually shared between the two

B. Transferred fully between the two

C. With identical spins

D. Equally shared between them

Answer: D

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26. The number and type of bonds between two C-atom in SrC_2 are .

A. $1\sigma, 1\pi$

B. $1\sigma, 2\pi$

C. $1\sigma, 5\pi$

D. 1σ

Answer: B

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27. Which species has the maximum number of lone pair of electrons on the central atom ? .

A. $[ClO_3]^{\Theta}$

B. XeF_4

C. N_2O

D. $[I_3]^{\Theta}$

Answer: D

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28. Among the following electrons-deficient compound is .

A. CCI_4

B. PCI_5

C. OF_2

D. BCI_3

Answer: D

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29. Which of the following does not follow the octet rule ? .

A. CO_2

B. PCl_3

C. ICl

D. ClF_3

Answer: D

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30. Which of the following does not have coordinate bonds ?

.

A. CO_3^{2-}

B. $H_3C - NC$

C. CO

D. O_3

Answer: A

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31. Which of the following bonds is the strongest ? .

A. $I - I$

B. $F - F$

C. $H - H$

D. $O - O$

Answer: C

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32. When two atoms combine to form a molecule .

A. Energy is released

B. Energy is absorbed

C. Energy is neither released nor absorbed

D. Energy may either be absorbed or relesed

Answer: A

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33. Most favourable conditions for inoic bonding are .

A. Low charge on ions,large cations,small anions

B. Low charge on ions,large cations,large anions

C. High charge on ions, small cations, large anions

D. High charge on ions, small cations, small anions

Answer: A

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34. Which of the following is not a correct statement ? .

A. Ionic compounds are electrically netural.

B. Boilling point of an ionic compound is more than a covalent compound .

C. Melting point of a covalent compound is more than an ionic compound

D. Ionic compound are soluble in polar solvent .

Answer: C

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35. Element A has three electrons in the outermost orbit and B has six electrons in the outermost orbit The formula of the compound will be .

A. A_2B_3

B. A_2B_6

C. A_2B

D. A_3B_2

Answer: A

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36. The pair of elements which form ionic bond is .

A. $C + CI$

B. $H + F$

C. $Na + Br$

D. $O + H$

Answer: C

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37. Lattice energy of an ionic compound depedns upon :

A. Charge on the ion and size of the ion

B. Packing of ions only

C. Size of the ion only

D. Charge on the ion only

Answer: A

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38. The bonds present in N_2O_5 are .

A. Only ionic

B. Covalent and coordinate

C. Only covalent

D. Covalent and ionic

Answer: B

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39. Which of the following statement is correct for CO ?

A. A double bond between C and O atoms

B. 1σ, 1π and 1 coordinate bond between C and O atoms

C. One lone pair of electrons on each atom

D. 1σ, 2π bonds between C and O atoms

Answer: B

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40. Which of the following statemwnt regarding valence bond theory (VBT) is not true ? .

A. A molecule is considered to be a collection of atoms, and the interactions between different atoms is considered .

B. For a molecule to be stable the electrostatic attactions must predominate over the repulsion .

C. The potential energy of a diatomic molecule is less than the sum of potential energies of free atoms .

D. The net force of altration acting on the atoms in a molecule is not zero .

Answer: D

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41. Correct statement about VBT is .

A. Each bond is formed by maximum overlap for its maximum stability .

B. It represents localised electron modal of bonding.

C. Most of electrons retain the same orbital localisation as in a separate atom .

D. All are correct .

Answer: D

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42. The strength of bonds formed by overlapping of atomic orbitals is in the order .

A. $s-s>s-p>p-p$

B. $s-s>p-p>s-p$

C. $s-p>s-s>p-p$

D. $p-p>s-s>s-p$

Answer: A

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43. The nodal plane in the π-bond of ethene is located in:

A. The molecular plane

B. A plane parallel to the molecular plane

C. A plane perpendicular to molecular plane which bisects th $(C - C)$ sigma-bond at a right angle .

D. A plane perpendicular to the molecular plane which contains the $(C - C)$ sigma-bond .

Answer: A

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44. Which of the following statement is wrong ? .

A. A sigma bond is shorter than a pi-bond .

B. Bond energies of sigma and pi bonds are of the order of 264 and $347kJmo1^{-1}$.

C. Free rotation of atoms about sigma bond is allowed but not in case of a-pi bond .

D. A sigma-bond determines the direction between C-atoms but a pi-bond has no primary effect which leads to bonding .

Answer: B

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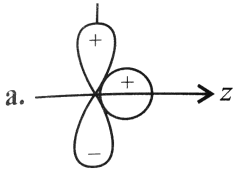
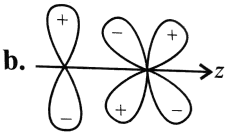
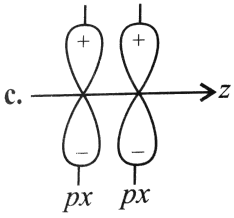
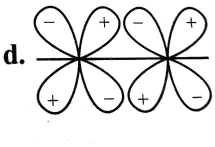
45. Which of the following is a positive overlap which leads to bonding ? .

A. 

B. 

C. 

D. 

Answer: C

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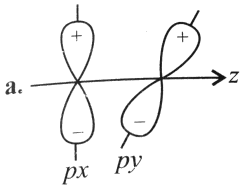
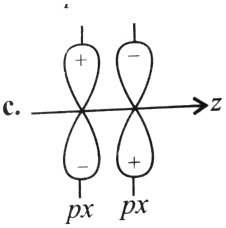
46. Which of the following is a zero overlap which leads to non-bonding?

A. 

B. 

C. 

D.

Answer: A

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Exercises Single Correct (Dipole Moment)

1. The $H-O-H$ bond angle in the water molecule is 105°, the$H-O$ bond distance being 0.94Å, The dipole moment for the moelcule is $1.85D$. Calculate the charge on the oxygen atom .

A. 2×10^{-10} esu

B. 3.28×10^{-10} esu

C. 3.22×10^{-10} esu

D. 1.602×10^{-19} esu

Answer: C

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2. Diatomic molecule has a dipole moment of $1.2D$ If its bond 1.0Å what fraction of an electronic charge exists on each atom ? .

A. $11\ \%$

B. $20\ \%$

C. $25\ \%$

D. Noe of these

Answer: C

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3. The compound with no dipole moment is .

A. CH_3Cl

B. CCl_4

C. Methylene chloride (CH_2Cl_2)

D. chloroform $(CHCl_3)$

Answer: B

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4. The molecule which have zero dipole moments is .

A. CH_2CI_2

B. BF_3

C. NF_3

D. CIO_2

Answer: B

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5. The critical temperature of water is higher than that of O_2 because the H_2O molecule has

A. A fewer electrons than O_2

B. A dipole momnent

C. a V shape structure

D. Two covalent bonds

Answer: B

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6. The correct order of dipole moment is :

A. $CH_4 < NF_3 < NH_3 < H_2O$

B. $NF_3 < CH_4 < NH_3 < H_2O$

C. $NH_3 < NF_3 < CH_4 < H_2O$

D. $H_2O < NH_3 < NF_3 < CH_4$

Answer: A

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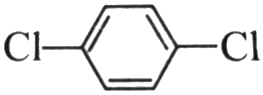
7. Among the following which is polar ? .

A. CO_2

B. SO_2

C. $BeCl_2$

D. 

Answer: B

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8. Which of the following is polar ? .

A. NF_3

B. BF_3

C. SF_6

D. SiF_4

Answer: A

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9. The resultant dipole moment (μ) of two compounds NOF and NO_2F is $1.81D$ and $0.47D$ respectively Which dipole momnet do you predict ? .

A. $1.81D$ for NO_2F and $0.47D$ for NOF .

B. $0.47D$ for NO_2F and $1.81D$ for NOF

C. For both NO_2F and NOF dipole moment (μ) is $1.81D$

D. For both NO_2F and NOF dipole moment (μ) is $0.47D$

Answer: B

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10. In terms of polar character the correct, the correct order is .

A. $H_2S > HF > H_2O > NH_3$

B. $HF > H_2O > NH_3 > H_2S$

C. $HF > H_2S > NH_3 > H_2O$

D. $H_2S > NH_3 > H_2O > HF$

Answer: B

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11. How many sigma and pi bonds are there in the molecule of tetracyano ethylene ? .

A. $4\sigma, 14\pi$

B. $5\sigma, 13\pi$

C. $8\sigma, 10\pi$

D. $9\sigma, 9\pi$

Answer: D

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12. H_2O is depolar, wheras BeF_2 is not. it because

A. EN of $F > EN$ of O

B. H_2O involes H-bonding whereas BeF_2 is a discrete molecule .

C. H_2o is linear and BeF_2 is angular

D. H_2O is angular and BeF_2 is linear

Answer: D

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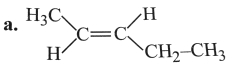
13. Which of the following hydrocarbons has the lowest dipole moment.

A. 

B. $H_3C - C \equiv C - CH_3$

C. $H_3C - CH = C = CH_2$

D. $H_3C - CH_2 - C \equiv CH$

Answer: B

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14. Which one of the following arrangements of molecules is correct on the basic of their dipole moments?

A. $NH_3 > BF_3 > NF_3$

B. $NH_3 > NF_3 > BF_3$

C. $BF_3 > NH_3 > NF_3$

D. $BF_3 > NF_3 > NH_3$

Answer: B

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15. Which statement (s) is/are correct about dipole momnet

(I) Debye is equivalent to $3.33 \times 10^{-30} Cm$

(II) 1 Debye is equivalent to $10^{-18} esu$

(III) SI unif of dipole momnet is coulomb meter (Cm)

$\left(1Cm = q \times d = 1.602 \times 10^{-19} \times 10^{-9} m\right)$

(IV) Dipole moment of a molecule is useful to expalain the shape of a molecule and also to predict other properties of the molecule .

A. I, II

B. I, III, IV

C. I, II, III

D. All

Answer: D

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16. Which of the following molecule (s) have dipole moment

(I) Trans -pent -2-me

(II) cis-hex -3-ene

(III) 2,2-Dimethy1 propane

(IV) $2, 2, 3, 3$ tetramethy1 butane .

A. I, II

B. II, III

C. I, III

D. I, IV

Answer: A

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Exercises Single Correct (Hybridisation)

1. The shapes of $PCI_4^{\oplus}, PCI_4^{\Theta}$ and $AsCI_5$ and are respectively .

A. Squar planar, tetrahedral and see-saw

B. Tetrahedral,see-saw and trigonal bipyramidal

C. Tetrahedarl ,square planar and pentagonal bipyramidal

D. Trigonal bipyramidal, tetrahedral and square pyramidal

Answer: B

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2. The I_3^{Θ} ion has .

A. Five equatorial lone pairs on the central I atom and two axial bonding pairs in a trigonal bipyramidal arrangement.

B. Five equatorial lone pairs on the central I atom and two axial bonding pairs in a pentagonal bipyramidal arrangement

C. Three equatorial lone pairs on the central I atom and two axial bonding pairs in a trigonal bipyramidal arrangement .

D. Two equatorial lone pairs on the central I atom and three axial bonding pairs in a trigonal bipyramidal arrangement .

Answer: C

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3. In the reaction $2PCI_5 \Leftrightarrow PCI_4^{\oplus} + PCI_6^{\Theta}$ the change in hybridisation is from .

A. $sp^3d \rightarrow sp^3$ and sp^3d^2

B. $sp^3d \rightarrow sp^3$ and sp^3d^2

C. $sp^3d \rightarrow sp^3$ and sp^3d^2

D. $sp^3d \rightarrow sp^3$ and sp^3d^2

Answer: A

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4. There are four species CO_2, $N_3\Theta$, $NO_2^{\oplus}$ and I_3^{Θ} Which of the following statement is correct about these species ? .

A. All are linear and having sp hybridisation central atoms .

B. All are linear but only CO_2, N_3^{Θ} and I_3^{Θ} have sp hybridisation on their central atom .

C. All are linear but only CO_2, $N_3^{\ominus}$ and $\overset{\oplus}{N}O_2$ have sp hybridisation on their cental atom .

D. CO_2, $N_3^{\ominus}$ and $NO_3^{\oplus}$ are linear but $I_3^{\ominus}$ is not .

Answer: C

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5. One hybridization of one s and one p orbital we get

A. Two mutually perpendicualr orbitals

B. Two orbitals at 180° .

C. Two orbitals directed tetrahedrally

D. Three orbitals in a plane

Answer: B

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6. Which moleucle is T-shaped ?

A. BeF_2

B. BCI_3

C. NH_3

D. CIF_3

Answer: D

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7. The hybridisation of the central atom in $ICI_2^{\oplus}$ is .

A. sp^3

B. sp^2

C. sp^2

D. sp

Answer: A

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8. The melecule that has linear structure is:

A. CO_2

B. NO_2

C. SO_2

D. SiO_2

Answer: A

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9. The species which has pyramidal shape is

A. PCI_3

B. SO_3

C. CO_3^{2-}

D. $NO_3^{\oplus}$

Answer: A

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10. The compound with C uses in the sp^3 hybrid orbitals for bond formation is .

A. $HCOOH$

B. $(H_2N)_2CO$

C. $(CH_3)_3COH$

D. CH_3CHO

Answer: C

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11. Which one of the following compounds has sp^2 hybridisation ? .

A. CO_2

B. SO_2

C. N_2O

D. CO

Answer: B

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12. CO_2 has same geometry as .

A. $HgCI_2$

B. NO_2

C. $SnCI_2$

D. CH_4

Answer: A

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13. In which pair of species both species do have the similar geometry ? .

A. CO_2, SO_2

B. NH_3, BH_3

C. CO_3^{2-}, NO_2^-

D. $SO_4^{2-}, CIO_4^{\Theta}$

Answer: D

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14. The geometry and the type of hybrid orbitals present about the central atom in BF_3 is :

A. Linear sp

B. Trigonal planar, sp^2

C. Tetrahedral, sp^3

D. Pyramidal sp^3

Answer: B

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15. SF_2, SF_4 and SF_6 have the hybridisation at sulphur atom respectively as .

A. sp^2, sp^3, sp^2d^2

B. sp^3, sp^3, sp^3d^2

C. sp^{23}, sp^3d, sp^3d^2

D. sp^3, spd^2, sp^3

Answer: C

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16. Two types FXF angles are present in which of the following molecule $(X = S, Xe, C)$? .

A. SF_4

B. XeF_4

C. SF_6

D. CF_4

Answer: A

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17. A sigma bonded molecule MX_3 is T-shaped The number of non-bonding pairs of electrons is .

A. 2

B. 1

C. 0

D. Can be predicted only if atomic number of M is known

Answer: A

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18. In $\oplus NH_4$ and OF_2 th hybridisation of central atom respectively are .

A. sp^3, sp^2

B. sp^3, sp^3

C. sp^3d, sp^3, d

D. sp^3d, sp^3

Answer: B

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19. Hybridisation involves .

A. Orbitals of same atom with slightly different energies .

B. Orbitals of different atom but with equal energies .

C. Orbitals of different atoms with exactly equal energies .

D. Orbitals of same atoms with exactly equal energies .

Answer: A

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20. As F_5 molecule is sp^3 d hybridised and is trigonal bipyramidal (TbP) shape Which d-orbital is involved in sp^3 d

hyridisation .

A. $dx^2 - y^2$

B. dz^2

C. dxy

D. dzx

Answer: B

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21. $[PtCI_4]^{2-}$ molecules id dsp^2 hybridised and is square planar Which d-orbital is involved in dsp^2 hybridisation .

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22. SeF_6 is sp^3 hybridised and is octahedral (OH) Which d orbitals are involved in hybridisation .

A. $dx^2 - y^2, dxy$

B. $dx^2 - y^2, dz^2$

C. dxy, dyz

D. dz^2, dxy

Answer: B

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23. IF_7 is sp^3 hybridised and is Pbp (pentagonal bipyramid) Which d orbitals are involved in hybridisation .

A. dxy, dyz, dxz

B. $dx^2 - y^2, dxy, dz^2$

C. $dx^2 - y^2, dyz, dxz$

D. $dx^2 - y^2, dz^2, dyz$

Answer: A

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24. In a regular octahedral molecule SF_6 the number of $F - M - F$ bonds at 180° is .

A. 2

B. 3

C. 4

D. 6

Answer: B

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25. The maximum number of 90° angles between bp-bp of electrons is observed in .

A. sp^3 d hybridisation

B. dsp^3 hybridisation

C. dsp^2 hybridisation

D. sp^3d^2 hybridisation

Answer: D

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26. Among the following ions the $p\pi - d\pi$ overlap is present in .

A. $NO_3^{\oplus}$

B. $PO_3^{\oplus}$

C. CO_3^{2-}

D. $NO_3^{\oplus}$

Answer: B

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27. Which of the following have distored octahedral structure ? .

A. SF_6

B. PF_6^{Θ}

C. SiF_6^{2-}

D. XeF_6

Answer: D

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28. Sulphur reacts with chlorine in $1:2$ ratio and forms X hydrolysis of X gives a sulphure compound Y. What is the hybridisation state od central atom in the compound?

A. sp^3

B. sp^2

C. sp

D. dsp^2

Answer: A

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29. Orthonitrophenol is steam volatile but paranitrophenol is not because .

A. Orhtonitrophenol has intramolecular hydrogen bonding while paranitrophenol has intermolecular hydrogen bonding .

B. Both ortho and paranitropenol have intramolecular hydrogen bonding .

C. Orthonitrophenol has intermolecular hybrogen bonding and paranitrophenol has intramolecular hydrogen bonding .

D.

Answer: A

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30. Which of the following compounds has the least tendency to from H-bonds ? .

A. HF

B. HCI

C. H_2O

D. NH_3

Answer: B

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31. Which of the following molecule forms linear polymeric structure due to H-bonding ?

A. HCI

B. HF

C. H_2O

D. NH_3

Answer: B

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32. Which one of the following hydrogen halides has the lowest boilling point ? .

A. HF

B. HCI

C. HBr

D. HI

Answer: B

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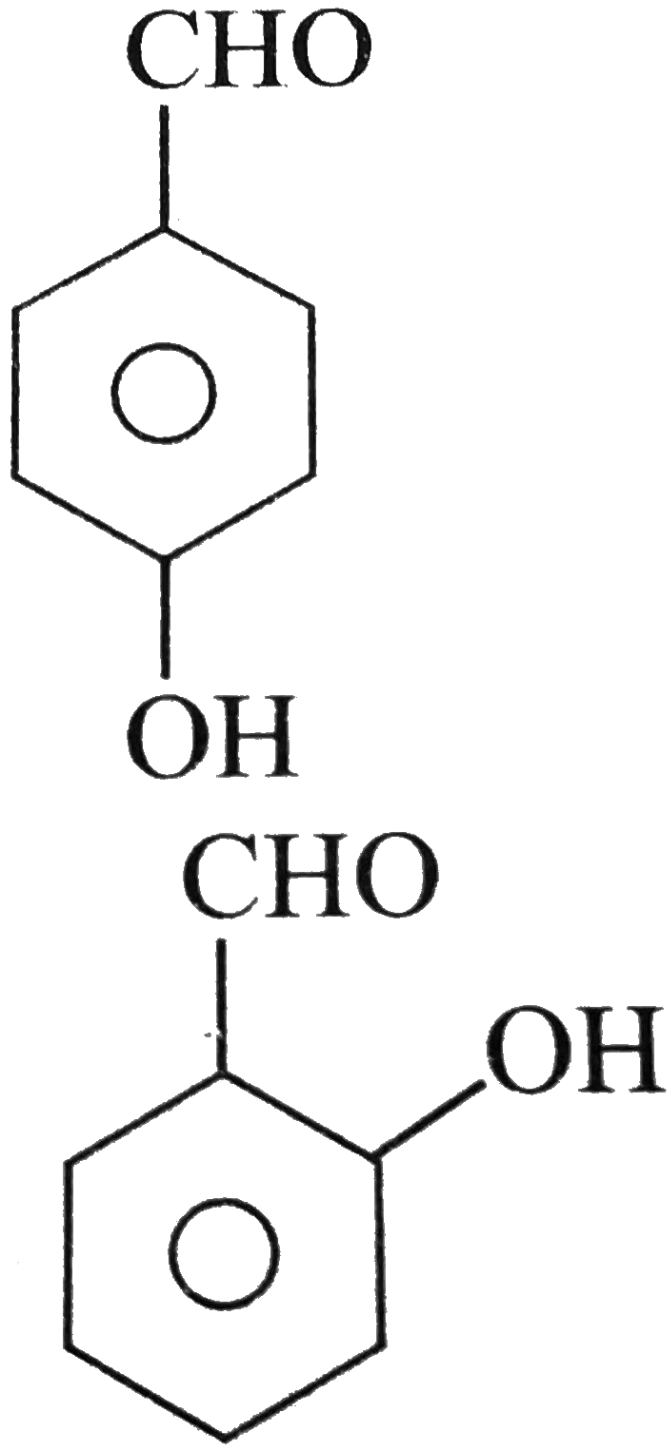
33. Out of the two compounds shown below the vapour pressure of II at a particular temperature is expected to be


CHO
OH
CHO
OH

A. Higher than that of I

B. Lower than that of I

C. Same as that of I

D. Can be higher or lower depending upon the size of vessel .

Answer: A

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Exercises Single Correct (Bond Angle)

1. The decreasing valuse of bond angles from $NH_3(106^\circ)$ to $SbH_3(101^\circ)$ down group -15 of the periodic table is due to .

A. Decreasing lp-lp repulsion

B. Decreasing electronegativity

C. Increasing bp-bp repulsion

D. Decreasing p-orbital character in sp^3 .

Answer: B

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2. in compound X all the bond angles around central atom are $109^\circ 28^\circ$ one of the following will be X ? .

A. Chloromethane

B. Carbon tetrachloride

C. Iodoform

D. Chloroform

Answer: B

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3. In which of the following molecules all the atoms lie in one plane ? .

A. CH_4

B. BF_3

C. PF_5

D. NH_3

Answer: B

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4. The bond angles of NH_3, $NH_4^{\oplus}$ and $\overset{\Theta}{N}H_2$ are in the order

.

A. $NH_2^{\Theta} > NH_3 > \overset{\oplus}{N}H_4$

B. $\overset{\oplus}{N}H_4 > NH_3 > \overset{\Theta}{N}H_2$

C. $NH_3 > \overset{\Theta}{N}H_2 > \overset{\oplus}{N}H_4$

D. $NH_3 > \overset{\oplus}{N}H_4 > \overset{\Theta}{N}H_2$

Answer: B

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5. For AB_x type molecule which statement (s) si (are) correct about bond angle $(B-A-B)$

(I) Bond angel $\propto EN$ of the central atom A

(II) Bond angle $\propto 1/EN$ of the central atom A

(III) Bond angle $\propto$ Size of central atom

(IV) Bond angle prop 1/Size of central atom .

A. I,III,III

B. II,IV

C. I,IV

D. II,III

Answer: C

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6. For AB_x type molecule which statement (s) si (are) correct about bond angle $(B-A-B)$

(I) Bond angel $\propto EN$ of atom B

(II) Bond angle $\propto EN$ of atom B

(III) Molecules or ions without non-bonding electrons on central atom add having regular geometry the change in EN of A or B has no effect on the bond angle

(IV) THe bond angle in compounds having sp, sp^2 and sp^3 hybridisation on central atom decreases as follows

$sp > sp^2 > sp^3$.

A. I,IV

B. II,IV

C. I,II,III

D. I,II,IV

Answer: B

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7. Decreasing order of bond angle of $\left(NO_2^{\oplus}, NO_2, NO_2^{\ominus}\right.$ is

A. I gt II gt III

B. II gt I gt III

C. III gt II gt I

D. IIIgt I gt II

Answer: B

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8. Decreasing order of bond angle of (NH_3, PH_3, AsH_3) is

A. I gtII gtIII

B. I gtIII gtII

C. II gtI gtIII

D. III gtII gtI

Answer: A

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9. Which statement is correct about bond angle of NCI_3, NF_3 and NH_3

Bond angle of $NCI_3 > NF_3$

Bond angle of $NCI_3 > NF_3$

Bond angle of $NH_3 > NF_3$

Bond angle of $NH_3 > NF_3$.

A. I,II

B. I,III

C. I,II,III

D. I,II,IV

Answer: B

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10. Bond order of SO_2 is .

A. 1.5

B. 1.33

C. 2.0

D. 2.5

Answer: B

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Exercises Single Correct (Resonance And Formal Charges)

1. Which of the following conditions apply to resonating structrues ?

A. The contributing structures must have the same number of unpaired electrons .

B. The contributing structures should have similar energies .

C. The contributing structures should be so written that unlike charges reside on atoms that are far apart .

D. The positive charge should be present on the electropositive element and the negative charge on the electrongative element .

Answer: C

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2. Resonance structures can be written for .

A. O_3

B. NH_3

C. CH_4

D. H_2O

Answer: A

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3. The bond length of $C = O$ bond in CO is 1.20Å and in CO_2 it is 1.34Å Then $C = O$ bond length in CO_3^{2-} will be .

A. 1.50Å

B. 1.34Å

C. 1.29Å

D. 0.95Å

Answer: C

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4. Maximum number of H-bonds that can be formed by a water molecule is .

A. 2

B. 3

C. 4

D. 6

Answer: C

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5. Which of the following resonating structures is not correct for CO_2 ? .

A. 

B. 

C. 

D. 

Answer: C

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6. In PO_4^{3-} the formal charge on each O-atom and $P-O$ bond order respectively are .

A. $-0.75, 0.1$

B. $-0.75, 1.25$

C. $-0.75, 0.6$

D. $-3, 1.25$

Answer: B

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7. The formed charge of the O-atoms in the ion $\left[:\dot{\dot{N}}=\dot{\dot{O}}:\right]$ is .

A. 0

B. $+1$

C. -1

D. -2

Answer: A

8. Which of the following statements regarding the concept of resonance is not correct?

A. The different resonting structures of a molecule have fixed arrangement of atomic nuclei .

B. The differnet resonating structures differ in the arrangement of electrons .

C. None of the individual resonating structures explains the verious characteristics of the molecule .

D. The hybrid structures have equal contribution from all the resonating structures .

Answer: D

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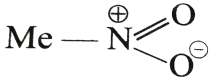
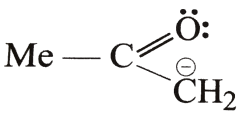
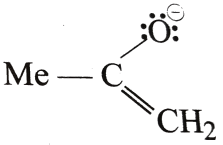
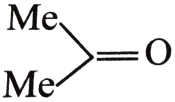
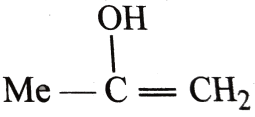
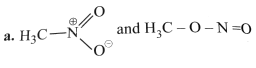
9. Which of the following pairs do not constitute resonance structures ?

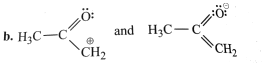
a.  and 

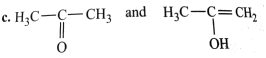
b.  and 

c.  and 

d.  and 

A. 

B. 

C. 

D. 

Answer: B

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10. Which of the following statement about resonance energy is wrong ? .

A. The different in energy of the resonance hybrid and the most stable contributing structures (having least energy) is called resonance energy .

B. The differnet in energy of the resonane hybrid and the least stable contributing structures (having highest energy) is called resonance energy .

C. The differnece in the experimental and calculated enthalpies (bond enthalpy formation or combustion or hydrogenation) is called resonance enrgy .

D. Resonance energy is the amount of energy by which the compound is stable .

Answer: B

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Exercises Single Correct (Molecular Orbital Theory (Mot))

1. During the formation of a molecular orbital from atomic orbital , the electron density is :

A. Minimum in the nodal plane

B. Maximum in the nodal plane

C. Zero in the nodal plane

D. Zero on the surface of the lobe

Answer: C

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2. Which of the following have been arranged in increasing bond order as well as bond dissociation energy ? .

A. $O_2^{-2} < O_2^{\Theta} < O_2^{\oplus} < O_2$

B. $O_2^{-2} < O_2^{\Theta} < O_2 < O_2^{\oplus}$

C. $O_2 < O_2^{\oplus} < O_2^{2-} < O_2^{\Theta}$

D. $O_2^{\oplus} < O_2^{2-} < O_2^{\Theta} < O_2$

Answer: B

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3. In forming $(i)N_2 \to N_2^{\oplus}$ and $O_2 \to O_2^{\oplus}$ the electrons respectively removed from .

A. $(\pi^* 2p_y \text{ or } \pi^* 2p_x)$ and $(\pi^* 2p_y \text{ or } \pi^* 2p_x)$

B. $(\pi 2p_y \text{ or } \pi 2p_x)$ and $(\pi 2p_y \text{ or } \pi 2p_x)$

C. $(\pi 2p_y \text{ or } \pi 2p_x)$ and $(\pi^* 2p_y \text{ or } \pi^* 2p_x)$

D. $\left(\pi^* 2p_y \text{ or } \pi^* 2p_x\right)$ and $\left(\pi 2p_y \text{ or } \pi 2p_x\right)$

Answer: C

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4. The species which does not show paramagnetism is .

A. O_2

B. $O_2^{\oplus}$

C. O_2^{2-}

D. $H_2^{\oplus}$

Answer: C

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5. Which of the following cannot exist on the basic of MO theory ? .

A. $H_2^{\oplus}$

B. $He_2^{\oplus}$

C. He_2

D. O_2

Answer: C

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6. Which one paramagnetic and has a bond order of 0.5 ? .

A. $H_2^{\oplus}$

B. F_2

C. $N_2^{\oplus}$

D. O_2

Answer: A

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7. The bond energies NO, $NO^{o=}$ and No^{Θ} ion the highest occupied orbital is .

A. $NO^{\oplus} > NO > NO^{\Theta}$

B. $NO > NO^{\oplus} > NO^{\Theta}$

C. $NO^{\Theta} > NO > NO^{\oplus}$

D. $NO^{\oplus} > NO^{\Theta} > NO$

Answer: A

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8. In the MO diagram for O_2^{Θ} ion the highest occupied orbital is .

A. πMO orbital

B. σMO orbital

C. $\pi^* MO$ orbital

D. σMO orbital

Answer: C

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9. Which of the following is not diamagnetic ? .

A. O_2^{2-}

B. Li_2

C. $N_2^{\oplus}$

D. C_2

Answer: C

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10. The bond order of CO and NO is .

A. 3 and 2

B. 3 and 2.5

C. 3 and 1.3

D. 3 and 3.5

Answer: B

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11. Combination of two AO s lead to the formation of .

A. $2MO's$

B. $1MO$

C. $3MO's$

D. $4MO's$

Answer: A

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12. The possible molecular orbital formed when two d-orbitals overlap is .

A. π

B. π^*

C. σ^*

D. δ^*

Answer: D

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13. Which of the following species exhibits the diamagnetic behaviour ?

A. NO

B. O_2^{2-}

C. $O_2^{\oplus}$

D. O_2

Answer: B

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14. Which of the following species is paramagnetic ? .

A. CO_2

B. O_2^{2-}

C. CN^{Θ}

D. NO

Answer: D

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15. The bond order in NO is 2.5 while that in $NO^{\oplus}$ is 3 Which of the following statement is true for these two species ? .

A. Bond length in $NO >$ in$NO^{\oplus}$

B. Bond length in $NO^{\oplus} =$ inNO

C. Bond length in $NO^{\oplus} =$ inNO

D. Bond length in $NO^{\oplus} > \text{in} NO$

Answer: A

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16. When two AO s combine energy of bonding MO is lowered by x while of antibonding MO is raised by y Then .

A. $x = y$

B. $x < y$

C. $x > y$

D. Can be any of these

Answer: B

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17. In Which of the following the double bond consistts of the pi bonds .

A. O_2

B. Be_2

C. C_2

D. S_2

Answer: C

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18. Which of the following MOs has more than one nodal plane?

A. $\pi 2p_y$

B. $\sigma 2s$

C. $\pi^* 2p_y$

D. $\sigma^* 2p_z$

Answer: C

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19. Which of the following $MO's$ has zero nodal planes ? .

A. $\sigma^* 1s$

B. $\sigma 1s$

C. $\pi 2p_x$

D. $\pi^* 2p_z$

Answer: B

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20. The main axis of diatomic molecule is z. The orbitals p_x and p_y overlap to form

A. $\pi - MO$

B. $\sigma - MO$

C. $\delta - MO$

D. No bond will form

Answer: D

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21. The paramagnetic property of the oxygen molecule is due to the presence of unpiared electrons present in .

A. $\left(\pi^* 2p_y\right)^1$ and $\left(\pi^* 2p_x\right)$

B. $(\sigma 2p_z)^1$ and $(\sigma^* 2p_z)^1$

C. $\left(\pi 2p_y\right)^1$ and $\left(\pi^* 2p_y\right)^1$

D. $(\sigma 2p_z)^1$ and $\left(\pi 2p_y\right)^1$

Answer: A

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22. Which of the following combination is not allowed in the $LCAO$ method for the formation of molecular orbital (consider Z-axis as the molecular axis) ? .

A. $s + p_x$

B. $s + p_z$

C. $p_x + p_x$

D. $p_z + p_z$

Answer: A

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23. The energy of σ_{2s}, is greater than that of σ^*_{1s} orbital because

A. $sigam2s$ is bigger than $\sigma^* 1sMO$

B. $\sigma 2s$ is bonding whereas $\sigma^* 1s$ is an $ABMO$

C. $\sigma 2s$ orbital has a greater value of than $\sigma^* 1sMO$

D. $\sigma 2s$ orbital is formed only after $\sigma^* 1s$.

Answer: C

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Exercises Single Correct (Miscellaneous)

1. Which of the following statement is incorrect ? .

A. NH_3 is more basic than PH_3

B. NH_3 has a higher boiling point than that of HF .

C. N_2 is less reactive than P_4

D. The dipole momnet of NH_3 is less than that of SO_2 .

Answer: B

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2. If one assume linear structure instead of bent structure for water then which on of the following properties cannot be explained ? .

A. The formation of intermolecular hybrogen bond in water

B. The high boiling point of water .

C. Solubility of polar compounds in water

D. Ability of water to form coordinate covalent bond .

Answer: C

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3. Which is the wrong order for the stated property ? .

A. $Ba > Sr > Mg$ atomic radius

B. $F > O > NN,$ first ionisation enthalpy

C. $CI > F > I,$ electron affinity

D. $O > Se > Te,$ electronegativity

Answer: B

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4. Which is a correct statement about diborane structure ? .

A. All HBH bond angles are equal

B. $All - H - B$ bond lenghts are equal

C. it has two three-center-2 electron bonds

D. All hydrogen and boron atoms are in one plane

Answer: C

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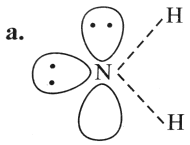
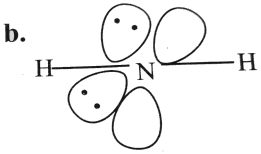
5. For $\overset{\Theta}{N}H_2$ the best three-dimensional view is .

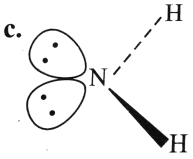
A.



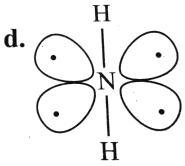
B.



C.



D.



Answer: C

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6. The set representing the correct order of ionic radius is

A. $Li^{\oplus} > Na^{\oplus} > Mg^{2+} > Be^{2+}$

B. $Mg^{2+} > Be^{2+} > Li^{\oplus} > Na^{\oplus}$

C. $Li^{\oplus} > Be^{2+} > Na^{\oplus} > Mg^{2+}$

D. $Na^{\oplus} > Li^{\oplus} > Mg^{2+} > Be^{2+}$

Answer: D

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7. Which of the following are not isoelectronic speices ?

A. $PO_4^{3-}, SO_4^{2-}, CIO_4^{\Theta}$

B. $SO_3^{2-}, CO_3^{2-}, NO_3^{\Theta}$

C. $BO_3^{3-}, CO_3^{2-}, NO_3^{\Theta}$

D. $CN^{\Theta}, N_2, C_2^{2-}$

Answer: B

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8. The $EN's$ of F, CI Br and I are 4.0 ,3.0, 2.8 and 2.5 respectively The hybrogen halide with a highest percentage of ionic character is .

A. HI

B. HBr

C. HCI

D. HF

Answer: D

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9. The $C-C$ bond length is $1.54\text{Å} C=C$ bond length is 1.33Å What is the circumference of benzene ring ? Bond length between single and double bonds $=1.4\text{Å}$.

A. $(3 \times 1.54+3 \times 1.33)\text{Å}$

B. $(4 \times 1.54+2 \times 1.33)\text{Å}$

C. $(6 \times 1.4)\text{Å}$

D. $(4 \times 1.33+2 \times 1.54)\text{Å}$

Answer: C

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10. The correct order of the thermal stability of hydrogen halides $(H-X)$ is

A. $HI > HCI < HF > HBr$

B. $HCI < HF > HBr < HI$

C. $HF > HCI > HBr > HI$

D. $HI > HBr > HCI > HF$

Answer: C

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11. Which of following statement is correct ? .

A. The bond angle of NCI_3 is greater than that of NH_3

B. The bond angle of PH_3 is greater than that of PF_5

C. CIO_3^{Θ} and SO_3^{2-} are isostructural

D. It is not necessary that in Tbp structure the lone pairs always would occupy the equatorial positions .

Answer: C

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12. The valuse of EN of atoms A and B are 1.80 and 4.0 respectively The percentage of ionic character of $A-B$ bond is .

A. $43\ \%$

B. $50\ \%$

C. $55.3\ \%$

D. $65\ \%$

Answer: D

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13. The statement true for N_3^- is

A. It has a non-linear structure

B. It is called pseudo halogens

C. The formal oxidation state of N in this anion is-1

D. It is isoelectronic with NO_2

Answer: C

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14. The decreasing $(O-O)$ bonf length order in the following is .

A. $O_2 > H_2O_2 > O_3$

B. $H_2O_2 > O_3 > O_2$

C. $O_3 > H_2O_2 > O_2$

D. $O_3 > O_2 > H_2O_2$

Answer: B

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15. Which of the following substance has the highest melting point? .

A. BaO

B. MgO

C. KCI

D. $NaCI$

Answer: B

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16. Which of the following statement is correct ? .

A. $FeCI_2$ is more covalent than $FeCI_2$

B. $FeCI_3$ is more covalent than $FeCI_2$

C. Both $FeCI_2$ and $FeCI_3$ are equally covalent

D. $FeCI_2$ and $FeCI_3$ do not have any covalent character

Answer: B

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17. Which of the following bonds is the strongest ? .

A. $F - F$

B. $1 - 1$

C. $CI - CI$

D. $O - O$

Answer: C

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18. The molecule having highest bond enegy is

A. $N - N$

B. $F - F$

C. $C - C$

D. $O - O$

Answer: C

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19. Which set is expected to show the smallest difference in IE_1 ?

A. He, Ne, Ar

B. B, N, O

C. $Mg, Mg^{\oplus}, Mg^{+2}$

D. Fe, CO, Ni

Answer: D

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20. Which of the following statement is wrong ? .

A. Multiple bonds are always shorter the corresponding sigle bonds

B. The electron-deficient molecules act as Lewis acids

C. Every AB_5 molecule does in fact have square pyramidal structure

D. The cenonical structure has no real existnece

Answer: C

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21. Which of the following is correct ?

A. According to $VSEPR$ theory $SNCI_2$ in a linear molecule

B. The number of electrons present in the valence shell in SF_6 is 12

C. The rates of ionic compounds are very slow

D. The correct order of ability form ionic compounds among $Na^{\oplus}, Mg^{2+}$, and $A1^{+3}$ is

$A1^{+3} > Mg^{+2} > Na^{\oplus}$.

Answer: B

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22. Lattice energy of $BeCO_3(I), MgCO_3(II)$ and $CaCO_3(III)$ is in order.

A. I lt II lt III

B. I gt II gt III

C. I lt III lt II

D. II lt I lt III

Answer: B

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23. Which of the following is a correct statement ? .

A. Mobility of $H^{\oplus}$ ions in ice is greater as compared to liquid water

B. Mobility of $H^{\oplus}$ ions in ice is less as compared ti liquid water

C. Mobility of $H^{\oplus}$ ions in ice is equal to that in liquid water .

D. Cannot be predicted

Answer: A

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Exercises Assetion Reasoning

1. Assertion SiF_6^{2-} anion exists but CF_6^{2-} does not

Reasoning Si atom vacnat d-orbital while C-atom has not .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: A

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2. Assertion Boiling point of $SiH_4 > CH_4$ whereas boiling point of $SiCI_4 < \mathbb{C}I_4$

Reasoning Chlorine possesses vacant d-orbitals but hydrogen does not .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: B

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3. Assertion Sulfur forms SF_6 and also SCI_6

Reasoning Sulfur has vacant d-orbitals .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: A

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4. Assertion Bond angles of NH_3, PH_3, AsH_3 and SbH_3 decrease in order as mentioned

Reasoning The central atom in each possesses a lone pair .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: B

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5. Assertion In case of $(CH_3)_3N$ geometry is pyramidal but in case of $(SiH_3)_3N$ it is planar

Reasoning The maximum covalency of Si is six but that of C is four .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: B

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6. Assertion NCI_3 reacts with water but NF_3I s inert towards hydrolysis

Reasoning Nitrogen des not possess vacant d-orbitals .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: B

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7. Assertion LiF is parctically insoluble in water

Reasoning LiF has very high lattice energy .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: A

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8. Assertion O_2 and N_2^{2-} have same number of electrons and same molecualar orbital configuration

Reasoning O_2 and N_2^{2-} have the same bond order .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: D

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9. Assertion $MgCI_2$ is more soluble as comared to $BeCI_2$

Reasoning $BeCI_2$ is covalent and $MgCI_2$ is ionic compound

.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: A

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10. Assertion : H_2 molecule is more stable than $He - H$ molecule .

Reason : The antibonding electron in $He - H$ molecule decreases the bond order thereby the stability.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: A

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11. Assertion Carbon tetrachloride dose not form a percipitate of $AgCI$ with $AgNO_3$ solution

Reasoning Carbon tetrachloride is a liquid.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: B

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12. Assertion Both NO_3^{Θ} and CO_3^{2-} ions are triangular planar

Reasoning Hybridisation of central atom in both NO_3^{Θ} and CO_3^{2-} is sp^(2)` .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: A

Watch Video Solution

13. Assertion H_2O has maximum density at $4^\circ C$ Hence in water ice will sink to the bottom at $4^\circ C$

Reasoning Up to $4^\circ C$ more and more hydrogen bonds are formed between H_2O molecules .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: D

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14. Assertion Boiling point of halogen acids are in the order $HF > HBr > HCI > HI$

Reasoning Electronegativities are in the order $F > CI > Br > I$.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: D

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15. Assertion Ionic compounds tend to be non-volatile

Reasoning Intermolecular forces in these compounds are weak .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: C

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16. Assertion : Water is a good solvent for ionic compounds but poor one for covalent compounds.

Reason :Hydrogen energy of ions realeases sufficient energy to overcome lattice energy and break hydrogen bonds in water, white covalent bonded compound interact so weakly that even van der walls force between molecule of convalent compounds cannot be broken .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: A

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17. Assertion : The atoms in a covalent molecule are said to share electrons, yet some covalent molecule are polar.

Reason :In a polar covalent molecule , the shared electron spend more time on the average near one of the atoms .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: A

Watch Video Solution

18. Assertion (A): Na_2SO_4 is soluble in water while $BaSO_4$ is insoluble.

Reason (R): Latice enthalpy of $BaSO_4$ exceeds its hydration enthalpy.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: A

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19. Assertion : The dipole moment helps to predict whether a molecule is polar or non- polar.

Reason : The dipole moment helps to predict geometry of molecule.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: A

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20. Assertion BF_3 is a weaker Lewis acid than BCI_3

Reasoning In BF_3 molecule, back bonding $(p\pi - p\pi)$ is stronger than in BCI_3 .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: A

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21. Bond order for $N_2^{\oplus}$ and N_2^{Θ} are same (i.e2.5)

Reasoning $N_2^{\oplus}$ is more stable than N_2^{Θ} .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: B

Watch Video Solution

22. Assertion Among two cations of similar size the polarising power of cation with pseudo noble gas configuration is larger than cation with noble gas configuration

Reasoning Polarising power of $Ag^{\oplus}$ is more than $K^{\oplus}$.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: A

Watch Video Solution

23. Assertion BF_3 has greater dipole momnet than H_2S

Reasoning Fluorine is more electronegative than sulphur .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: D

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24. Assertion Both $\pi(2P_x)$ and $\pi^*(2P_x)MO's$ have one nodal plane each

Reasoning All $MO's$ formed by side way overlapping of $2p$ orbitals have one nodal plane .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If both (A) and (R) are incorrect

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25. Assertion H_2, Li_2, B_2 each has a bond order of 1 and hence are equally stable

Reasoning Stability of molecule//ion depends only on bond order .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If both (A) and (R) are incorrect

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26. Assertion Bond order in a molecule can assume any value positive integral or fractional value including zero

Reasoning It depends on number of electrons in the bonding and antibonding orbitals .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: A

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27. Assetion Both N_2 and $NO^{\oplus}$ are diamagnetic

Reasoning $NO^{\oplus}$ is isoelectronic with N_2 .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If (A) is incorrect but (R) is correct

Answer: B

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28. Assertion B_2 molecule is diamagnetic

Reasoning The highest occupied molecular orbital is of sigma type .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D. If both (A) and (R)` are incorrect

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29. Asseration: $SeCl_4$, does not havea tetrahedral structure.

Reason: Se in $SeCl_4$ has two lone pairs.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D.

Answer: C

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30. Assertion : All F - S - F angle in SF_4 are greater than 90° but less than 180°.

Reason :The lone pair -bond pair repulsion is weaker than bond pair -bond pair repulsion

A. If both (A) and (R) are correct and (R) is the correct explanation of (A)

B. If both (A) and (R) are correct and (R) is the correct explanation of (A)

C. If (A) is correct but (R) is incorrect

D.

Answer: C

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Exercises Integer

1. How many molecules among the following have zero dipole moment NH_3, BF_3, NF_3, CCI_4 ? .

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2. Find the number of lone pairs of electrons preent in OF_2 .

Watch Video Solution

3. How many of the following compounds violate octet rule

(i) BrF_5 (ii) SF_6 (iii) IF_7 (iv) $XeOF_4$

(v) CIF_2 (vi) $PCI_4^{\oplus}$.

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4. The number of hypervalent species among the following

CIO_4^{Θ}, BF_3, SO_4^{2-}, CO_3^{2-} is .

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5. The number of correct options is

(a) $1^{\Theta} > Br^{\Theta} > CI^{\Theta} > F^{\Theta}$ (polarisability)

(b) $Li^{\oplus} > Na^{\oplus} > K^{\oplus} > Rb^{\oplus}$ (polarisation power)

(c) $H_2O > H_2S > H_2Se > H_2$ Te (order of b.pt)

(d) $H_2^{\Theta} < H_2^{\oplus}$ (order of stability) .

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6. How many of the following compounds have sp^3 hybridisation

(i) SO_4^{2-} (ii) SO_5^{2-} (iii) PO_4^{3-} (iv) PO_5^{3-}

(v) I_3^{Θ} (iv) CO_3^{2-} (vii) CO_4^{2-}.

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7. How many of the following compounds have $(p\pi - d\pi)$ multiple bonds

(i) SO_2 (ii) SO_3 (iii) HSO_4^{Θ} (iv) SO_4^{2-}

(v) SO_3^{3-} (vi) HSO_3^{Θ} .

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8. How many of the following oxides of nitrogen are paramangnetic ?

(i) N_2O (ii) NO (iii) N_2O_3 (iv) NO_2

(v) N_2O_4 (vi) N_2O_5 (vii) $NO_2^{\oplus}$ (viii) NO_2^{Θ}

(ix) NO_3^{Θ} .

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9. How many of the following species have bond order of 2.5 ?

$N_2^{\oplus}$ (ii) N_2^{Θ} (iii) $O_2^{\oplus}$ (iv) O_2^{Θ} (v) NO (vi) CN .

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10. The number of correct option is

(a) $P_2O_5 > ZnO > MgO > Na_2O_2$ (acidic strenght)

(b) $TI_2O_3 > TI_2O > Ga_2O_3 > AI_2O_3$ (basic strenght)

(c) $MnO > P_2O_5 > CrO_3 > Mn_2O_7$ (ionic character)

(d) $H_2O > HF > NH_3$ (melting point)

(e) $H_2O > HF > NH_3$ (boiling point) .

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Exercises Fill In The Blanks

1. The Type of hybrid orbitals used by the chlorine atom in CIO_2^{Θ} is .

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2. The cyanide ion CN and N_2 are isoelectronic, but in contrast to CN^-, N_2 is chemically inert, because of

Watch Video Solution

3. The shape of CH_3^+ is .....

Watch Video Solution

4. The valence atomic orbital on C in silver acetynide is .....hybridised.

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5. Out of $CH_3^{\oplus}, H_3O^{\oplus}, NH_3, CH_3^{\ominus}$ the species which is not isoelectronic is_____.

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6. The experimentally determined $N-F$ bond length in NF_3 is ____than the sum of the single covalent bond radii of N and F.

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7. When N_2 goes to N_2^+, the $N-N$ bond distance ....., and when O_2 goes to O_2^+ the $O-O$ bond distance.....

Watch Video Solution

8. The central bond in 1,3 butadience is_____than that of n-butane .

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9. Out of (A) toluene (B) m-dichloro benzene (C) o-dichloro benzene and (D) p-dichlorobenzene_____have highest and_____have lowest dipole moment.

Watch Video Solution

10. In BaC_2_____sigma and_____pi bonds are present between two C-atoms .

Watch Video Solution

11. During the formation of a chemical bond, the potential energy of the interacting atoms is lowered by at least _____ $kJmol^{-1}$.

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12. Comparatively low melting point and insolubility in water of $AICI_3$ is explained by _____rule .

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13. The dipole moment of CH_3OH is____than that of CH_3SH .

Watch Video Solution

14. Dipole moment of NH_3 is_____than NF_3 .

Watch Video Solution

15. In a compound A, B if the element B attracts electrons more than element A it will tend to be____charged .

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16. The strenght of covalent bond will depend on the extent to which atomic orbitals___.

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17. Salicyaldehyde involves_____hydrogen bonding .

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18. The bond multiplicity leads to_____in bond length .

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19. The angle between two covalent bonds is maximum in .....

(CH_4, H_2O, CO_2)

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20. Due to hybridisation_____hybrid orbitals are formed .

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Exercises True/False

1. Acidic strength order $CI_2O_7 > SO_3 > P_4O_{10}$.

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2. Acidic strength order $HCIO > HBrO > HIO$.

Watch Video Solution

3. Basic strength order $NH_3 > PH_3 > AsH_3 > BiH_3$.

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4. XeO_3 is a trigonal pyramidal molecule .

Watch Video Solution

5. The lanthanoid ions other than the f^0 type and f^{14} types are all paramagnetic .

Watch Video Solution

6. $LiHCO_3$ and $Ca(HCO_3)_2$ are not found in solid state .

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7. All molecules with polar bonds have dipole moment.

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8. Ionic bonds are non-directional while covalent bonds are directional.

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9. The dipole moment of CH_3F is greater than that of CH_3Cl.

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10. The presence of polar bonds in a polyatomic molecule suggests that the molecule has non-zero dipole moment.

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11. The boiling point of HCI is less than that of HF .

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12. Both PH_3 and PH_5 exist .

Watch Video Solution

13. $\sigma 2s$, $\pi^*(2p_x)$ and $\pi(2p_x)$ are gerade MO .

Watch Video Solution

14. Out of NO, $NO^{\oplus}$ and $CN^{\oplus}$ the paramagnetic species is $NO^{\oplus}$.

Watch Video Solution

15. Out of the following types of intermolecualar forces (a) Ion dipole (b) Keesom forces (c) London forces (d) Ion-induced dipole the strongest force is Keeson force .

View Text Solution

16. The number of nodal planes in $\pi 2p_x$ and $\pi^* 2p_x$ are two and one respectively .

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17. The order of decreasing boiling point is $Xe > CH_4 > Ne > He > H_2$.

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18. The decreasing order of melting points is $NH_3 > (CH_3)_3N > PH_3$.

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19. Ot of CH_3OH and $(CH_3)_3N$ both exhibit H-bonding .

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20. CO_2 and N_3^{Θ} have sane bond order and same shape .

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Archives Multiple Correct

1. CO_2 is isostructural with

A. $HgCI_2$

B. C_2H_2

C. $SnCI_2$

D. NO_2

Answer: A::B

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Watch Video Solution

2. The linear struture is assumed by :

A. $SnCI_2$

B. CS_2

C. $NO_2^{\oplus}$

D. NCO^{Θ}

Answer: B::C::D

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3. The molecule (s) that will have dipole moment is/are:

A. 2,2-dimethy1 propane

B. trans-2-pentene

C. cis-3-hexene

D. 2,2,3,3-tetramethyl butane

Answer: B::C

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4. Which of the folowing have identical bond orders ? .

A. CN^{Θ}

B. O_2^{Θ}

C. $NO^{\oplus}$

D. $CN^{\oplus}$

Answer: A::C

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5. Out of $CH_3^{\oplus}, H_3O^{\oplus}, NH_3, CH_3^{\ominus}$ the species which is not isoelectronic is_____.

A. I and II

B. III and IV

C. I and III

D. II,III,and IV

Answer: A::C::D

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6. The critical temperature of water is higher than that of O_2 because the H_2O molecule has .

A. Fewer electrons than O_2

B. Three covalent bonds

C. Two covalent bonds

D. Dipole moment

Answer: C::D

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7. The geometry and the type of hybrid orbitals present about the central atom in BF_3 is :

A. Linear,sp

B. Trigonal planar, sp^2

C. Tetrahedral,sp^3

D. Pyramidal sp^3

Answer: B

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8. The nitrogen oxide (s) that contain (s) $N-N$ bonds (s) is (are).

A. N_2O

B. N_2O_3

C. N_2O_4

D. N_2O_5

Answer: A::B::C

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9. Hydrogen bonding plays a central role in which of the following phenomena?

A. Ice floats in water

B. Higher Lewis basicity of primary than tertiary amines in aqueous solutions

C. Formic acid is more acidic than acetic acid

D. Dimersation of acetic acid in benzene .

Answer: A::B::D

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10. When O_2 is adsorbed on ametallic surface, electron transfer occurs from the metal to O_2 The TRUE statement (s) regarding this adsorption is (are)

A. O_2 is pyysisorbed

B. heat is released

C. occupancy of π_{2p} of O_2 increased

D. bond length of O_2 is increased .

Answer: A::B::C::D

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Archives Single Correct

1. In which of the following molecules does the central atom not follow the octet rule?

A. CO_2

B. H_2O

C. O_2

D. NO

Answer: D

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2. The compound which contains both ionic and covalent bonds is

A. CH_4

B. H_2

C. KCN

D. KCI

Answer: C

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3. The total number of electrons that take part in forming the bond in N_2 is .

A. 2

B. 4

C. 6

D. 100

Answer: C

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4. Element X is strongly electropositive and element Y is strongly electronegative. Both are univalent. The compound formed would be

A. X^-Y^-

B. X^-Y^-

C. $X - Y$

D. $X \rightarrow Y$

Answer: A

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5. Which of the following compounds is covalent ? .

A. H_2

B. CaO

C. KCI

D. Na_2S

Answer: A

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6. If molecule MX_3 has zero dipole moment, the sigma bonding orbitals used by M (atomic number < 21) are

A. pura$P$

B. sp-hybridised

C. sp^2-hybridised

D. sp^3 hybridised

Answer: C

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7. The ion that is isoelectronic with CO is

A. CN^{Θ}

B. $O_2^{\oplus}$

C. O_2^{Θ}

D. $N_2^{\oplus}$

Answer: A

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8. Carbon tetrachloride has no net dipole moment because of

A. Its planar structure

B. Its regular tetrahedral structure

C. Similar sizes of carbon and chlorine atoms

D. Similar electron affinities of carbon and chlorine .

Answer: B

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9. Which one among the following does not have the hydrogen bond?

A. Phenol

B. Liquid NH_3

C. Water

D. HCI

Answer: D

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10. One hybridization of one s and one p orbital we get

A. Two mutually perpendicualr orbitals

B. Two orbitals at 180° .

C. Four obitals directed tetrahedrally

D. Three orbitals in a plane

Answer: B

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11. The molecule having one unpaired electrons is .

A. NO

B. CO

C. CN^{Θ}

D. O_2

Answer: A

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12. The hybridisation of sulphur in sulphur dioxide is

A. sp

B. sp^3

C. sp^2

D. dsp^2

Answer: C

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13. The bond between two identical non-metal atoms has a pair of electrons:

A. Unqually shared between the two

B. Transferred fully between the two

C. With identical spins

D. Equally shared between them

Answer: D

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14. Which of the following compounds has a zero dipole momnet ? .

A. 1,1-Dichloroethylene

B. cis-1,2Dicloroehtylene

C. trans-1,2-Dichloroethylene

D. None of these

Answer: C

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15. The species in which the cantral atom uses sp^2 hybrid orbital in its bonding is:

A. PH_3

B. NH_3

C. $CH_3^{\oplus}$

D. SbH_3

Answer: C

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16. The melecule that has linear structure is:

A. CO_2

B. NO_2

C. SO_2

D. SiO_2

Answer: A

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17. The $CI - C - CI$ angle in $1, 1, 2, 2,$ tetrachloroethone and tetrachloromethane respectively will be about:

A. 120° and 109.5°

B. 90° and 109.5°

C. 109.5° and 90°

D. 109.5° and 120.5°

Answer: A

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18. The species which has pyramidal shape is

A. PCI_3

B. SO_3

C. CO_3^{2-}

D. NO_3^{Θ}

Answer: A

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19. Which of the following is paramagnetic?

A. O_2^{Θ}

B. CN^{Θ}

C. CO

D. $NO^{\oplus}$

Answer: A

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20. The molecule which has zero dipole moment is

A. CH_2CI_2

B. BF_3

C. NF_3

D. CIO_3

Answer: B

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21. The Type of hybrid orbitals used by the chlorine atom in CIO_2^{Θ} is .

A. sp^3

B. sp^2

C. sp

D. None of these

Answer: A

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22. The maximum possible number of hydrogen bonds a water molecule can form is

A. 2

B. 4

C. 3

D. 1

Answer: B

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23. Which one of the following molecules is planar?

A. NH_3

B. NCI_3

C. PH_3

D. BF_3

Answer: D

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24. The number and type of bonds between two carbon atoms in CaC_2 are:

A. One sigma and one pi-bond

B. One sigma and one pi-bonds

C. One sigma and one -half pi-bond

D. One sigma -bond

Answer: B

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25. Among the following species, identify the isostuctural pairs

$NF_3. NO_3^-, BF_3, H_3O, HN_3$

A. $\left[NF_3, NO_3^{\Theta}\right]$ and $\left[BF_3, H_3O^{\oplus}\right]$

B. $\left[NF_3, N_3H\right]$ and $\left[NO_3^{\Theta}, BF_3\right]$

C. $\left[NF_3, H_3O^{\oplus}\right]$ and $\left[NO_3^{\Theta}, BF_3\right]$

D. $\left[NF_3, H_3O^{\oplus}\right]$ and $\left[N_3H, BF_3\right]$

Answer: C

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26. Arrange the following compounds in order of increasing dipole moment .

Toluene (I) m-dichlorobenzene (II)

o-dichlorobenzene (III) . P-dichlorobenzene (IV) .

A. I ltIV lt II ltIII

B. I lt I lt II lt III

C. IV lt I lt III lt II

D. IV lt II lt I lt III

Answer: B

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27. The cyanide ion CN and N_2 are isoelectronic, but in contrast to CN^-, N_2 is chemically inert, because of

A. Low and energy

B. Absence of bond polarity

C. Usymmetrical electron distribution

D. Presence of more number of electrons in bonding orbitals

Answer: B

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28. Among KO_2, ALO_2^{Θ}, BaO_2 and NO_2^+, unpaired electrons is present in .

A. $NO_2^{\oplus}$ and BaO_2

B. KO_2 and $AIO_2^{\ominus}$

C. KO_2 only

D. BaO_2 only

Answer: C

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29. Which of the following compounds has sp^2-hybridisation?

A. CO_2

B. SO_2

C. N_2O

D. CO

Answer: B

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30. Among the following the compounds , the one that is polar and has central atom with sp^2 hydridisation is

A. H_2CO_3

B. SiF_4

C. BF_3

D. $HCIO(2)$

Answer: A

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31. Which contains both polar and non-polar bonds?

A. NH_4CI

B. HCN

C. H_2O_2

D. CH_4

Answer: C

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32. The correct order of decreasing $C - O$ bond length of (1) CO, $(II)CO_3^{2-}$ $(III)CO_2$ is .

A. $CO_3^{2-} < CO_2 < CO$

B. $CO_2 < CO_3^{2-} < CO$

C. $CO < CO_3^{2-} < CO_2$

D. $CO < CO_2 < CO_3^{2-}$

Answer: D

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33. The geometry of H_2S and its dipole moment are :

A. Angular and non-zero

B. Angular and zero

C. Linear and non-zero

D. Linear and zero

Answer: A

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34. Molecular shape of SF_4, CF_4 and XeF_4 are

A. The same with 2,0 and 1 lone pair of electrons, respectively .

B. The same with 1,1 and 1 lone pair of electrons, respectively .

C. The same with 0,1 and 2 lone pair of electrons, respectively .

D. The same with 1,0 and 2 lone pair of electrons, respectively .

Answer: D

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35. The hybridization of atomic orbitals of nitrogen is NO_2^+, NO_3^-, and NH_4^+ respectively are

A. sp, sp^3 and sp^2, respectively

B. sp, sp^2 and sp^3, respectively

C. sp^2, sp and sp^3, respectively

D. sp, sp^2, sp^3 and sp,respectively

Answer: B

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36. The correct order of hybridisation of the central atom in the following species NH_3, $[PtCl_4]^{2-}$, PCl_5 and BCl_3 is :

A. dsp^2, dsp^3, sp^2 and sp^3

B. sp^3, dsp^3, sp^3d and sp^2

C. dsp^2, dsp^2, sp^3 and dsp^3

D. dsp^2, sp^3, sp^2 and dsp^3

Answer: B

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37. The common features among the species CN^-, CO and NO^+ are :

A. Bond order three and isoelectronic

B. Bond order three and weak field ligands

C. Bond order two and pi acceptors

D. Isoelectronic and weak field ligands

Answer: A

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38. Specify the coordination geometry around and the hybridisation of N and B atoms in $1:1$ complex of BF_3 and NH_3.

A. N: tetrahedral sp^3, B: tetrahedral sp^3

B. N: pyramidal, sp^3, B : pyramidal sp^2

C. N: pyramidal, sp^3 , B : planar sp^2

D. N: pyramidal, sp^3 , B : tetrahedral, sp^3 .

Answer: A

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39. The least stable ion among the following is

A. Li^{Θ}

B. Be^{Θ}

C. Be^{Θ}

D. C^{Θ}

Answer: B

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40. Which of the following molecular species has unpaired electrons(s) ? .

A. N_2

B. F_2

C. O_2^{Θ}

D. O_2^{2-}

Answer: C

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41. Which of the following are isolectronic and iso-structural ?

NO_3^{Θ} ,CO_3^{2-}, CIO_3^{Θ} ,SO_3 .

A. NO_3^{Θ}, CO_3^{2-}

B. SO_3, NO_3^{Θ}

C. CIO_3^{Θ}, CO_3^{2-}

D. CO_3^{2-}, SO_3

Answer: A

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42. Which of the following oxoacids of sulpher has -O-O- linkage ?

A. $H_2S_2O_6$

B. $H_2S_2O_8$

C. $H_2S_2O_3$

D. $H_2S_4O_6$

Answer: B

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43. According to MO theory,

A. $O_2^{\oplus}$ is paramagnetic and bond order is greater than O_2

B. $O_2^{\oplus}$ is paramagnetic and bond order is greater than O_2

C. $O_2^{\oplus}$ is paramagnetic and bond order is greater than O_2

D. $O_2^{\oplus}$ is paramagnetic and bond order is more than O_2

Answer: A

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44. Number of lone pairs (s) in $XeOF_4$ is/are

A. 0

B. 1

C. 2

D. 3

Answer: B

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45. Which species has the maximum number of lone pair of electrons on the central atom ?

A. CIO_3^{Θ}

B. XeF_4

C. SF_4

D. I_3^{Θ}

Answer: D

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46. The species having bond order differnet from that in CO is .

A. NO^{Θ}

B. $NO^{\oplus}$

C. CN^{Θ}

D. N_2

Answer: A

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47. Among the following , the paramagnetic compound is :

A. Na_2O_2

B. O_3

C. N_2O

D. KO_2

Answer: D

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48. The percentage of p-character in the orbitals forming $p-p$ bonds in P_4 is

A. 25

B. 33

C. 50

D. 75

Answer: D

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49. The species having pyramidal shape is

A. SO_3

B. BrF_3

C. SiO_3^{2-}

D. OSF_2

Answer: D

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50. Which one of the following properties is not shown by NO ? .

A. It is a neutral oxide

B. It combines with oxygen to form nitrogen dioxide

C. Its bond order is 2.5 .

D. It is diamagentic in gaseous state .

Answer: D

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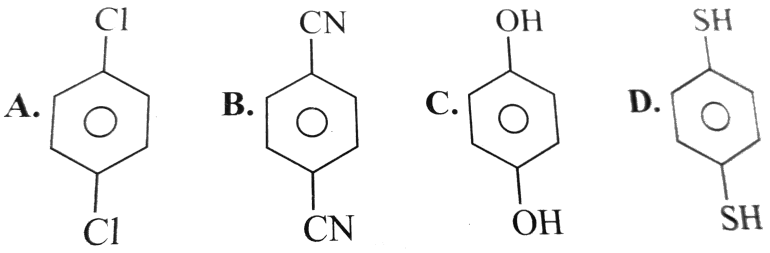
51. For which of the following molecule significant $\mu \neq 0$?



A. (A) and (B)

B. $Only(C)$

C. (C) and (D)

D. $Only(A)$

Answer: C

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52. The correct statement for the molecule csI_3 is .

A. It contains $Cs^{\oplus}$ and I_3^{Θ} ions .

B. It contains Cs^{3+} and I^{Θ} ions

C. It contains $Cs^{\oplus}$, I^{Θ} and lattice I_2 molecule.

D. it is covalent molecule

Answer: A

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53. Assuming $2s - 2p$ mixing is NOT operative, the paramagnetic species among the following is .

A. Be_2

B. B_2

C. C_2

D. N_2

Answer: C

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54. The intermolecular interaction that is dependent on the inverse cube of distance between the molecules is

A. ion-ion interaction

B. ion-dipole interaction

C. London force

D. hydrogen bond

Answer: B

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55. The ionic radii of N^{3-}, O^{2-} and F^{-} are respectively given by:

A. $1.36, 1.40$ and 1.71

B. $1.36, 1.71$ and 1.40

C. $1.71, 1, 40$ and 1.36

D. $1.76, 1.36$ and 1.40

Answer: C

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Archives Integer

1. Based on $VSEPR$ theory the number of $90^\circ F-Br-F$ angles in a molecules of BrF_5 is_____.

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2. Among the triatomic molecules/ions $BeCl_2, N_3^-, N_2O, NO_2^+, O_3, SCl_2, lCl_2^-, l_3^-$ and XeF_2, the total number of linear molecules (s)/ion(s) where the hybridisation of the central atom does not have contribution from the d- orbitals (s) is [atomic number of $S=16, Cl=17, I=53$ and $Xe=54$]

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Archives Fill In The Blanks

1. The shape of $[CH_3]^{\oplus}$ is_____ .

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2. The two types of bonds present in B_2H_6 are covalent and _____.

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3. When N_2 goes $N_2^{\oplus}$ the $N-N$ bond distance_____and when O_2 goes to $O_2^{\oplus}$ the $O-O$ bond distance _____.

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4. Among N_2O, SO_2, I_3^+ and I_3^-, the linear species are .....and.....

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Archives True/False

1. Linear overlap of two atomic p-orbitals leads to a sigma bond .

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2. All molecules with polar bonds have dipole moment.

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3. $SnCI_2$ is a non-linear molecule .

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4. In benzene, carbon uses all the three p-orbitals for hybridisation .

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5. sp^3 hybrid orbitals have equal s and p characters .

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6. The presence of polar bonds in a polyatomic molecule suggests that the molecule has non-zero dipole moment.

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7. H_2O moleule is linear

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Archives Subjective

1. State four major physical properties that can be used to distinguish between covalent and ionic compounds. Mention the distinguishing features in each case.

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2. Write the Lewis dot structural formula for each of the following Also give the formula of a neutral moleule which has the same geometry and the same arrangement of the bonding electrons as in each of the following

(a) O_2^{2-} (b) O_3^{2-} (c) CN^{Θ} (d) NCS^{Θ} .

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3. How many sigma bonds and pi bonds are present in a benzene molecules ? .

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4. Arrange the following as stated

Increasing strenght of hybrogen bonding $(X-H-X)'O, S, F, CI, N$.

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5. Given reasons in two or there sentences only for the following Hydrogen peroxide acts as an a reducing agent .

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6. The dipole momnet of KCI is $3.336 \times 10^{-29} Cm$ which indicates that it is a highly polar molecules. The inter atomic distance between $K^{\oplus}$ and CI^{Θ} in this molecules is 2.6×10^{-10} m Calculate the dipole moment of KCI

molecule if there were opposite charges of one fundamental unit located at each nucleus Calculate the ionic character percentage of KCI .

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7. Explain the difference in the nature of bonding in LiF and LiI .

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8. Using the $VSEPR$ theory, identify the type of hybisation and draw the structure of OF_2 What are the oxidation states of O and F ? .

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9. Interpret the non-linear shape of H_2S molecule and non-planar shape of PCl_3 using valence shell electron pair repulsion (VSEPR) theory.

(Atomic number : $H = 1, P = 15, S = 16, Cl = 17$)

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10. Write the MO electron distribution of O_2 Specify its bond order and magnetic property .

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11. Which one is more soluble in diethyl ether : anhydrous $AlCl_3$ or hydrated $AlCl_3$? Explain in terms of bonding.

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12. Using $VSEPR$ theory draw the shape of PCI_5 and BrF_5 ?.

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13. Draw the shape of XeF_4 and $OSF(4)$ according to $VSEPR$ theory Show the lone pair of electrons on the central atom .

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14. One the basic of ground electronic configuration, arrange the following molecules in the oder of increasing $O-O$ bond lengths $KO_2, O_2, O_2[AsF_6]$.

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15. Predict whether the following molecules are isostructural or not Justify your answer

$N(Me)_3$ and $N(SiH_3)_3$.

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