CHEMISTRY

BOOKS - CENGAGE CHEMISTRY (ENGLISH)

CHEMICAL BONDING AND MOLECULAR STRUCTURE

Illustration

1. Which statement is correct for ionic bond?

(a) It is non-directional .

(b) It is not 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 $\left[A1\left(H_2O\right)_6\right]^{3+}$

(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 $\left[e.gBaSO_4, SrSO_4, Ba_3\left(PO_4\right)_2 \text{ and } Sr_3\left(PO_4\right)_2\right]$ 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. Draw the Lewis structure of CO molecule

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7. Draw the Lewis structure of NO_2^- (Nitrite ion) .

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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 $\left(CO_3^{2-}\right)$.

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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

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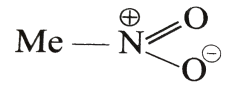
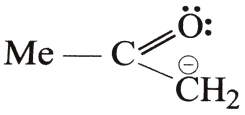
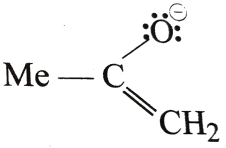
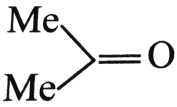
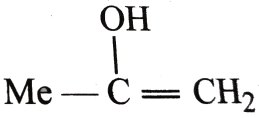
16. Which of the following pairs do not constitute resonanting structures ?

a.  and 

b.  and 

c.  and 

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

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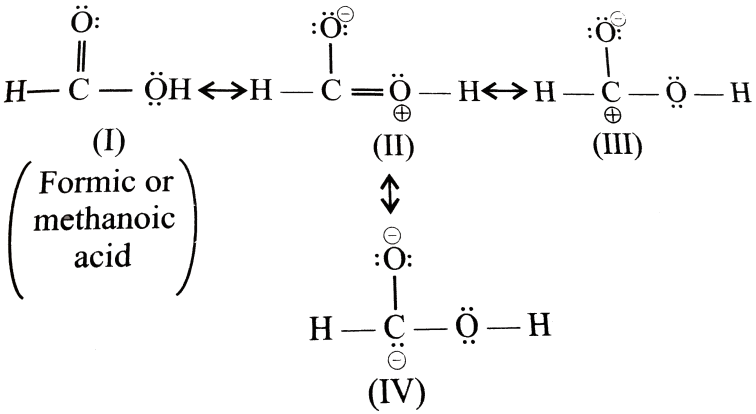
17. A arrange the following resonating structures in the order of decreasing stability



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18. Write the resonating structures of phenol in order of decreasing stabilities .

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

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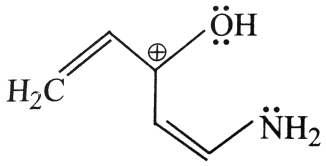
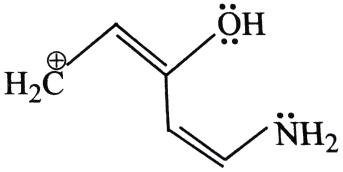
20. Which of the following is the most stable resonance structure

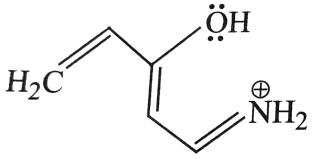
a.



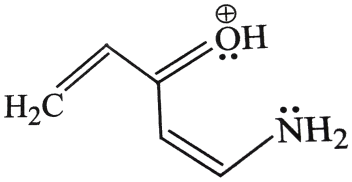
b.



c.



d.



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21. Give the stability of the following resonance structures

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

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

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

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

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22. Explain :

(i) $\mu of NH_3 > NF_3$

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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

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25. The dipole moment of CH_3F is greater than that of CH_3Cl.

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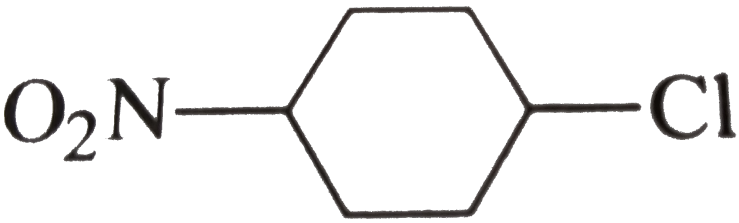
26. Calculate the dipole moment of the following compound



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

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

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

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

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28. Discuss the hybridisation of carbon atoms in allene $\left(C_3H_4\right)$ 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. In which of the following molecules, p and d orbitals of central atoms are involved in the hybridisation

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

(b) AsF_3

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32. 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 forces have a potential energy 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. Ethyl alcohol $\left(C_2H_5OH\right)$ has higher boiling point than dimethyl ether $\left(CH_3 - O - CH_3\right)$ although the molecular weight of both are same due to

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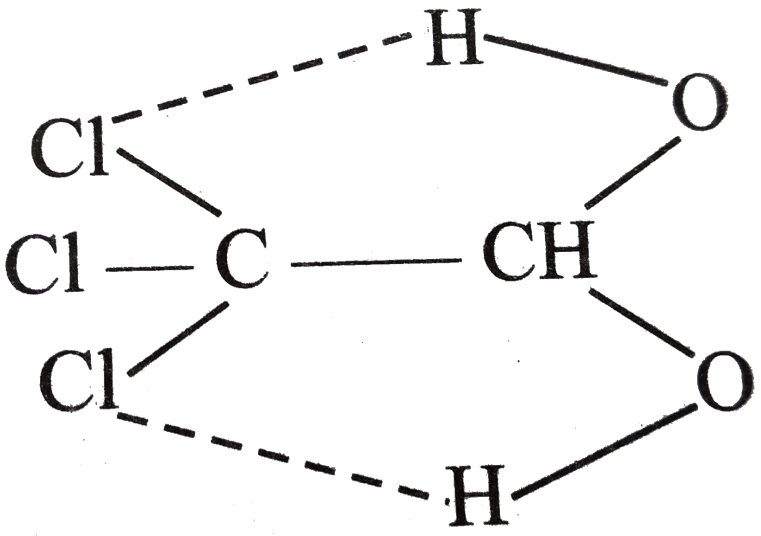
35. Explain unusual stabillity of chorohybrate thugh a compound with two or more -OH groups present on one carbon atom is usually unstabel



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36. o-Hydroxybenzaldehyde is a liquid at room temperature while p-hydroxybenzaldehyde is a high milting solid because of

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

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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

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39. Give the decreasing order of boiling points of H_2O, NH_3 and HF

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

(a) KO_2 , (b) $O_2\left[AsF_6\right]$

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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 $\left(O_2\right)$ Specify its bond order and magnetic property

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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 energy varies from N_2^{Θ} and $N_2^{\oplus}$ and why ?

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

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

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

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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. Write the formula for a compound of CI which contains Ionic bonds only

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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) ClO_2^{Θ} (d) $COCl_2$

(e) H_2CO

(f) C_2H_2 (g) HCO_2H .

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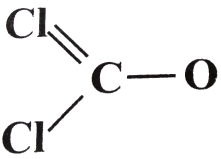
5. By completing the following structures, adding unshared e^- pairs when necessary calculate the charges

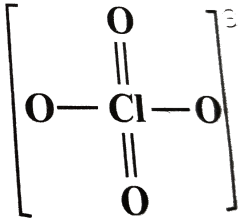
(a) $N \equiv C - \equiv N$

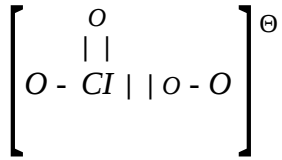
$CI - C \equiv N$

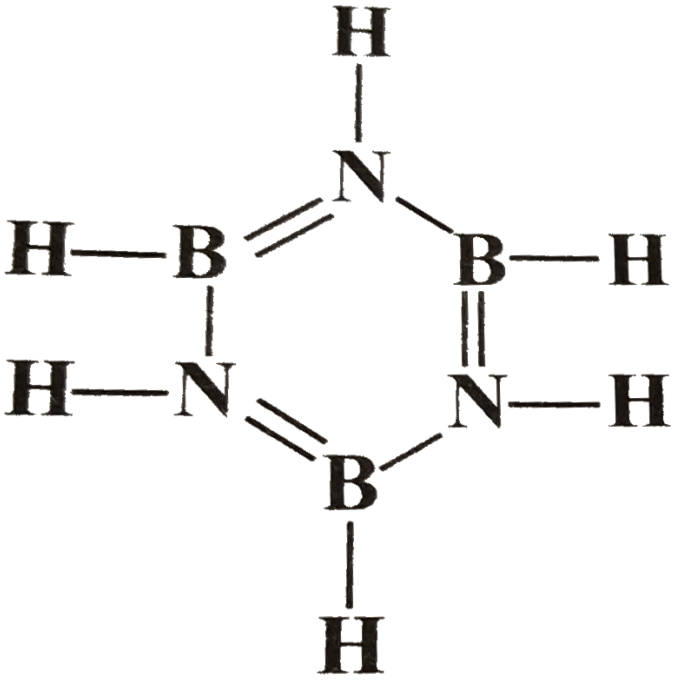
a. $N \equiv C - C \equiv N$

b. $Cl - C \equiv N$

c. 

d. 





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6. (a) In each of the following parts select the species having the greater resonance stabilisation

$H_2C = O$ and $H | O^{\Theta} C = O$

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

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8. 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 dissociation energy

(ii) Decreasing bond lengths

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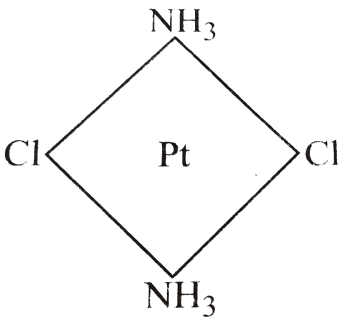
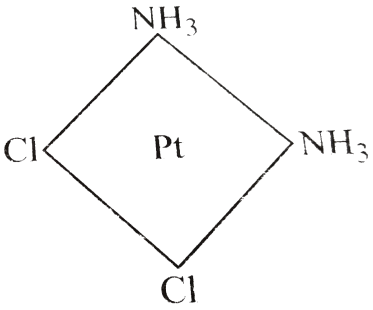
11. The Pt - Cl distance is $2.32A$ in several crystalline compounds

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



(i)



(ii)

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

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

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13. What is the hybridisation state of each C-atom in the following molecule ?

Benzene

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14. How many σ and π bonds are present in a benzene molecule ? .

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15. (a) 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

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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

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17. Which of the following molecules has the highest IE

(i) Ne (ii) F

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18. Select the species with the largest IE in each

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

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

Li, Na, Rb

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20. Distinguish using the property mentioned in brackets

(e) NF_3, NH_3 (dipole moment)

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21. Which of the following alkali metal chlorides is expected to have the highest melting point

(i) $LiCl$ (ii) KCl (iii) $RbCl$ (iv) $NaCl$.

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22. Explain

Why H_2O is liquid while H_2S is gas

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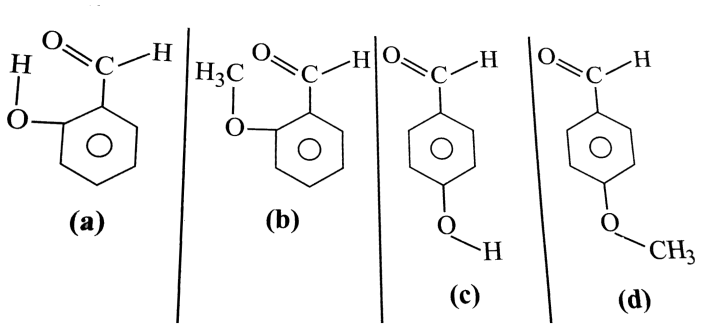
23. How do you account for the difference in melting points between (a) and (b) between (c) and (d) and between these two differences ?



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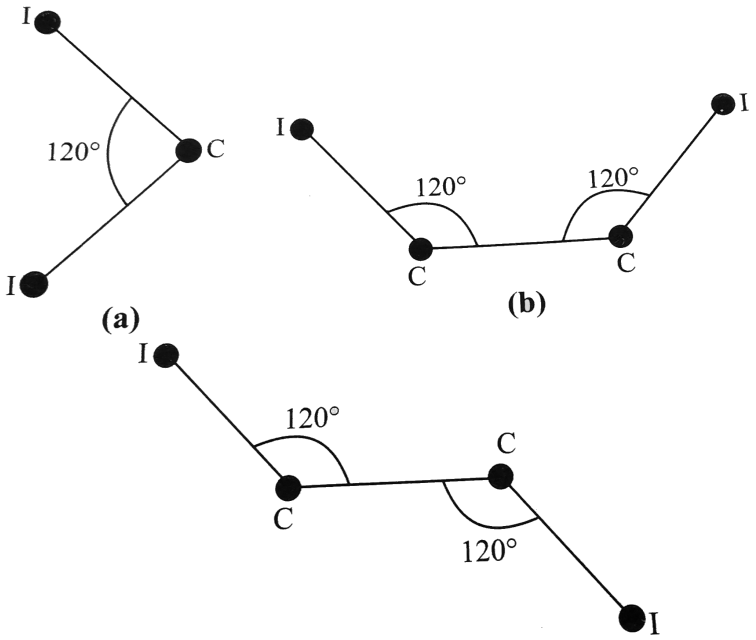
25. Calculate the I-I distance in each of the isomeric compounds $C_2H_2I_2$ as shown below

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

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



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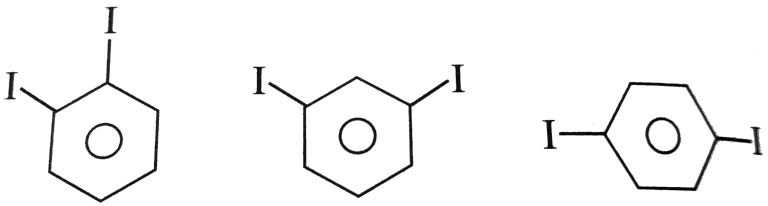
26. Calculate the I-I distance in each of the three isomeric diiodobenzenes Assume that the ring is a regular hexagon and that each C - I bonds lies on a line through the centre of the hexagon .

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 $\left(C_2H_4\right)$ and benzene $\left(C_6H_6\right)$ are -136.68 and $205.65 kJmo1^{-1}$ 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

CI, Ar, K (has the smallest IE)

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29. (a)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_2Cl_3 molecule State which isomer (s) have no dipole moment .

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31. Write 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)Br_3^{Θ} (ii) $ClO_3^{\oplus}$ (iii) $IO_2F_2^{\Theta}$

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 CCl_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 $\left(C_2H_4\right)$ the most important reactant in polymer manufacture

(b) Nitrogen $\left(N_2\right)$ the most abundant atmosheric gas

(c) Methanol $\left(CH_4O\right)$ an important industrial alcohol that is begin 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) HCl (f) $CaCl_2$ (g) Na_2S(h) $SnCl_2$

(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) $AICI_3$ (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 reason for the following

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

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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

(1) m-Dichlorobenzene

(2) o-Dichlorobenzene (3) p-Dichlorobenzene

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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 internuclear axis which out of the following will not form a sigma bond and why? (a) 1s and 1s (b) 1s and $2p_x$ (c) $2p_y$

and $2p_y$ (d) 1s and 2s.

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

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

(c) H-bonding (d) Dipole interaction

(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

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10. Predict the order 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 $\left(CH_3\right)_3N$.

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12. (a)Give the decreasing order of melting points of the following $NH_3, PH_3, \left(CH_3\right)_3N$ 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. Give the number of electrons which occupy the bonding orbitals in $H_2^{\oplus} H_2$ and $O_2^{\oplus}$

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

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

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15. Expalin

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

(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) $N_3^{\oplus}$ (b) O_3 (c) CO_2 (d) $NO_2^{\oplus}$.

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17. Which of the following is soluble in water

A. CS_2

B. $CHCl_3$

C. CCl_4

D. CH_3OH

Answer:

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

A. Liquid NH_3

B. Liquid HCl

C. Water

D. Phenol

Answer:

Watch Video Solution

19. The molecule having one unpaired electrons is .

A. O_2

B. CN^{Θ}

C. NO

D. CO

Answer:

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20. The hydrogen bond is strongest in

A. F - H.... O

B. C - H.... . O

C. O - H.... S

D. F - H.... F

Answer:

Watch Video Solution

21. Hydrogen bond is maximum in .

A. Propanol

B. Propyl chloride

C. Tripropylamine

D. Dipropyl ether

Answer:

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22. How many hydrogen bonds can be formed by a water molecule?

A. 1

B. 2

C. 3

D. 4

Answer:

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23. Number of paired electrons in O_2 molecule is .

A. 16

B. 14

C. 8

D. 7

Answer:

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24. Among KO_2, AlO_2^+, BaO_2 and NO_2^+ unpaired electron 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

Answer:

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25. The correct order of decreasing bond lengths of CO, CO_2 and CO_3^{2-} is

A. $I > III > II$

B. $I > II > III$

C. $III > II > I$

D. $II > III > I$

Answer:

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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

Answer:

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27. Which of the following species has unpaired electrons?

A. O_2^{2-}

B. F_2

C. N_2

D. O_2^{Θ}

Answer:

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28. Which of the following are iso-electronic as well as iso-structural ?

$NO_3^-, CO_3^{2-}, ClO_3^-, SO_3$

A. $CO_3^{2-}, CIO_3^{\Theta}$

B. CO_3^{2-}, NO_3^{Θ}

C. SO_3, CO_3^{2-}

D. SO_3, NO_3^{Θ}

Answer:

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29. According to MO theory which of the following statement about the magnetic character and bond order is correct regarding O_2^+ ?

A. paramagnetic and $BO > O_2$

B. paramagnetic and $BO < O_2$

C. Diamagnetic and $BO > O_2$

D. Diamagnetic and $BO < O_2$

Answer:

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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

Answer:

Watch Video Solution

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

A. N_2

B. $NO^{\oplus}$

C. $NO^{\oplus}$

D. $CN^{\ominus}$

Answer:

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

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

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

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

Answer:

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33. Using MO theory 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:

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34. Which of the following have identical bond order?

A. O_2^{Θ}

B. CN^{Θ}

C. $NO^{\oplus}$

D. $O_2^{\oplus}$

Answer:

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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-bp repulsion, which in trun is greater the bp-bp 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. PCl_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-bp repulsion, which in trun is greater the bp-bp 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. ClF_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-bp repulsion, which in turn is greater the bp-bp 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 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 bp-bp repulsion. The presence of lp causes distortion of bond angles hence, a daviation from an ideal shape THe extent of distortion depends upon 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 (σ and π) and anti-bonding (σ and π) 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. $CN^{\ominus}$

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 (σ and π) and anti-bonding (σ and π) 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 (σ and π) and anti-bonding (σ and π) 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^{+}

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 (σ and π) and anti-bonding (σ and π) 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. $N_2^{\oplus} > N_2^{\ominus}$

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

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

D. All of these

Answer: D

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9. Which is correct statement ? .

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 acid 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

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12. Hydrogen bond between two atoms is formed due to

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. Among the following which will have the lowest melting 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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(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. $I^{\Theta} > Br^{\Theta} > Cl^{\Theta}F^{\Theta}$

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

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

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

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 .

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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

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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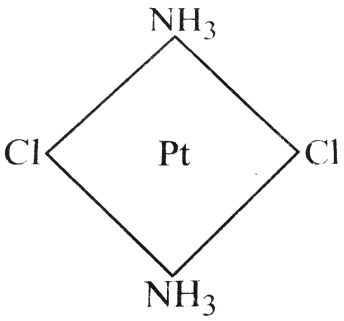
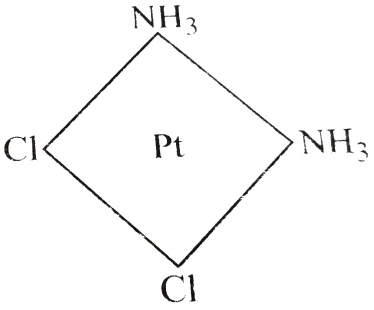
17. The Pt - Cl distance is $2.32A$ in several crystalline compounds

What is the Cl - Cl 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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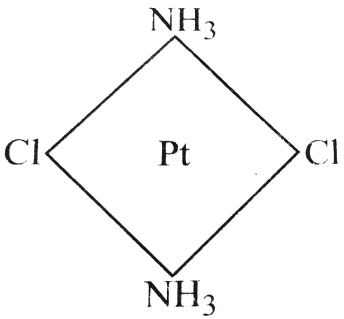
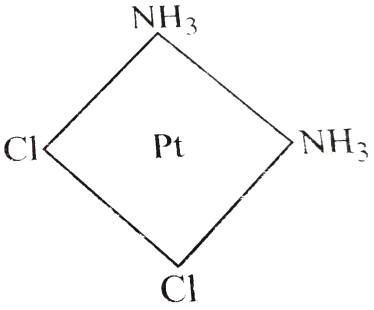
18. The Pt - Cl distance is $2.32A$ in several crystalline compounds

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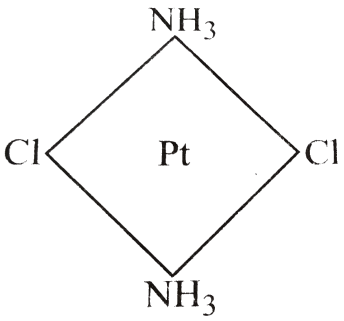
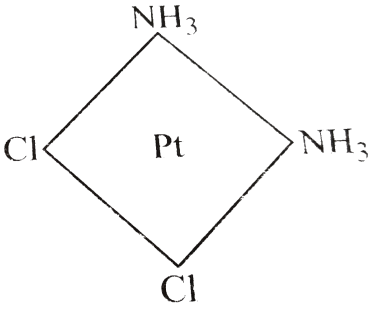
19. The Pt - CI distance is $2.32A$ in several crystaline compounds

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



(i)



(ii)

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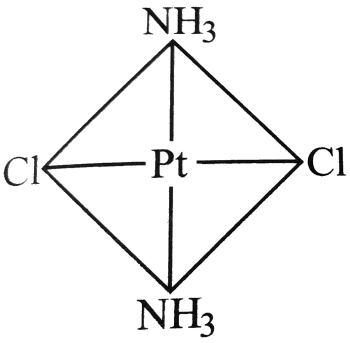
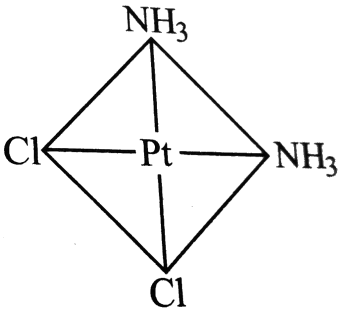
20. The platinum-chlorine distance has been found to be $2.32Å$ in several crystalline compounds This value applies to both compounds A

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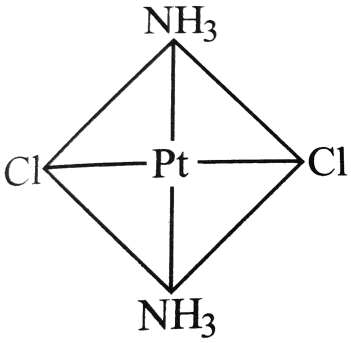
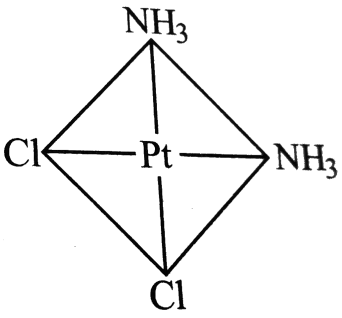
21. The platinum-chlorine distance has been found to be 2.32Å in several crystalline compounds This value applies to both compounds A and B given here



(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 requlat 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

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

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 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. Consider the following molecules .

A:Anti -pyridine -2-carboxaldoxime

B:syn pyridine -2-carboaxaldoxime

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. Consider the following molecules .

A:Anti -pyridine -2-carboxaldoxime

B:syn pyridine -2-carboaxaldoxime

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. $KK^{*}(\sigma 2s)^2, \left(\sigma^{*}2s\right)^2, \left(\sigma 2p_z\right)^2\left(\pi 2p_y\right)^2\left(\pi^{*}2p\right)^2\left(\pi^{*}2p_x\right)^1$

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

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

D. none of these

Answer: A

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32. 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. 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. 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. 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. 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. 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. Chemical 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. CCl_4

C. CHl_3

D. $CHCl_3$

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. CCl_4

C. CHI_3

D. $CHCl_3$

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. $\left[NiCI_4\right]^{2-}$

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. $\ddot{N}H_3$

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 hyberidisation of the central atom ? .

A. XeF_4

B. XeO_2F_2

C. $ClO_3^{\oplus}$

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. SCl_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 $\left(H_3BO_3\right)$ 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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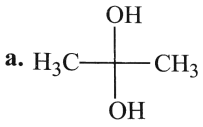
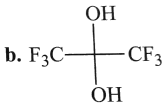
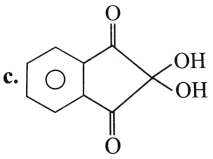
3. Which of the following gem-diol is stable ? .

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. $H_2O > NCl_3$

C. $\overset{\oplus}{N}H_4 > NH_3 > PCl_5$

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 ClO_2

B. 180°

C. Less than ClO_2

D. $> 109.5^{\circ}$

Answer: A::B

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5. Which statements (s) is (are) correct for AB_2 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 EN of atom B decreases the bond angle increases

D. If the EN 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^{Θ}

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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8. $MO's$ 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. $\sigma^{*}(2pz)$

B. $\pi\left(2p_x\right)$

C. $\pi\left(2p_y\right)$

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. $\left(SiH_3\right)_3N:$

B. $\left(CH_3\right)_3N:$

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. $\left[BaO_2, NO_2\right]$

B. $\left[KO_2, NO\right]$

C. $\left[H_2O_2, NO\right]$

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

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

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 statements .

A. The heat of hydration 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 electrostatic attaction on the oxygen of water molecule surrounding them .

D. Melting point of sodium halides is as follows $NaF > NaCl > NaBr > NaI$.

Answer: B::C::D

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7. White 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. $AlCl_3$ has higher melting point than AlF_3

D. $SbCl_3$ is more covalent than $SbCl_5$

Answer: A::B

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10. Which of the following are true ?.

A. PH_5 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 $LiCl, BeCl_2, BCl_3$ and CCl_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. Polarization 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 energy 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 phosphorous are monoprotic (mono basic) ? .

A. H_3PO_3

B. H_3PO_4

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 values of bond energy ? .

A. O_2 and H_2

B. N_2 and CO

C. F_2 and I_2

D. O_2 and Cl_2

Answer: D

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11. The ion which has the lowest ionic mobility is

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 least covalent P - H bond ? .

A. PH_3

B. P_2H_6

C. P_2H_4

D. $PH_6^{\oplus}$

Answer: D

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14. Which of the following molecule stabilizes by removal of 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 bond is nondirectional ?

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

B. $K^{\oplus}, F^{\Theta}$ and HF

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

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

Answer: C

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20. There is no 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 octet 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. $\left[ClO_3\right]^{\Theta}$

B. XeF_4

C. N_2O

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

Answer: D

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28. Among the following the electron 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 3 electrons in the outermost orbit and element B has 6 electrons in the outermost orbit . The formula of the compound formed A and B would 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. $C + Cl$

B. $H + F$

C. $Na + Br$

D. $O + H$

Answer: C

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37. Lattice energy of an ionic compound depends on

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 $347 kJmo1^{-1}$.

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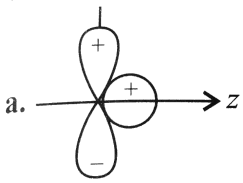
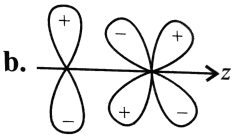
45. Which of the following is a positive overlap which leads to bonding ? .

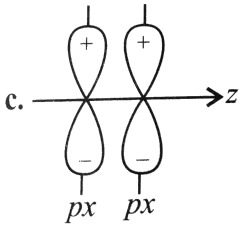
A.



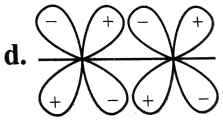
B.



C.



D.



Answer: C

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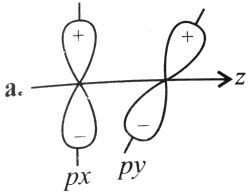
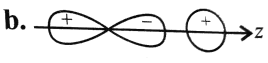
46. Which of the following is a zero overlap which leads to non-bonding?

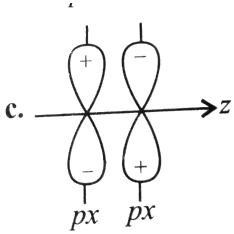
A.



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. 3.21×10^{-10} esu

D. 1.602×10^{-19} esu

Answer: C

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2. In a diatomic molecule the bond distance is 1×10^{-8} cm. Its dipole moment is 1.2.D. What is the fractional electronic charge 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 $\left(CH_2Cl_2\right)$

D. chloroform $\left(CHCl_3\right)$

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 dipolar, whereas BeF_2 is not. It is 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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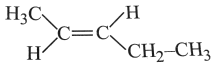
13. Which of the following hydrocarbons has the lowest dipole moment.

A. 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 moment

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

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

(III) SI unit of dipole moment 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 explain 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 are correct

Answer: D

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

(I) Trans -pent -2-ene

(II) cis-hex -3-ene

(III) 2,2-Dimethy1 propane

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

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Exercises Single Correct Hybridisation

1. The shapes of $PCI_4^{\oplus}$, $PCI_4^{\ominus}$ 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 $2PCI_5 \Leftrightarrow PCI_4^{\oplus} + PCI_6^{\Theta}$ change in hybridisation is from .

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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^{Θ} and $\overset{\oplus}{N}O_2$ have sp hybridisation on their cental atom .

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

Answer: C

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5. On 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 molecule 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 compounds in which C uses its sp^3- hybrid orbitals for bond formation are:

A. $HCOOH$

B. $\left(H_2N\right)_2CO$

C. $\left(CH_3\right)_3COH$

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. $SO_4^{2-}, ClO_4^{\oplus}$

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^3, sp^3d, sp^3d^2

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

Answer: C

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16. Two types FXF angles are presnet 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 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^3d

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 PF_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. If the geometry of $\left[PtCl_4\right]^{2-}$ -is square planar, which orbitals are involved in bonding?

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22. SeF_6 is sp^3d^2 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^3d^3 hybridised and is (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 $F - S - F$ 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 could be present in

A. $NO_3^{\oplus}$

B. $PO_3^{\oplus}$

C. CO_3^{2-}

D. NO_3^{Θ}

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. HCl

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. HCl

C. HBr

D. HI

Answer: B

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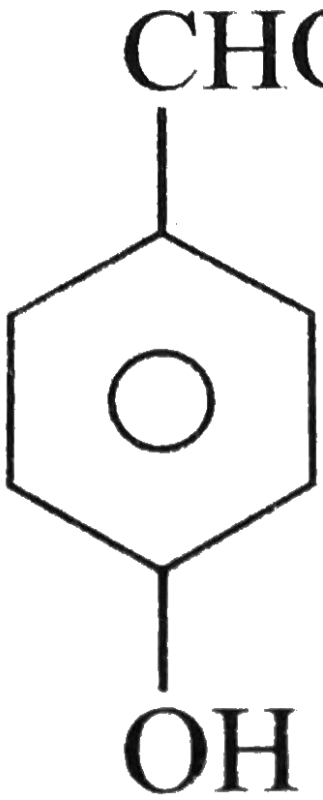
33. Out of the two compounds shown below the vapour pressure of

II at a particular temperature is expected to be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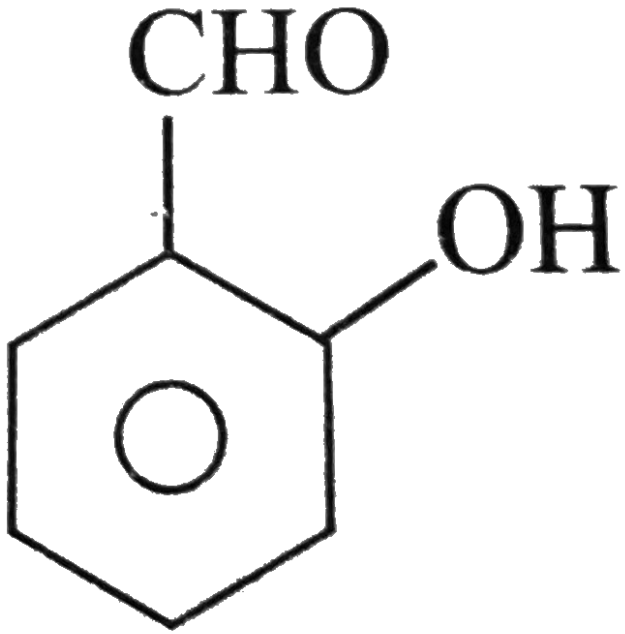
OH


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 $NH_3\left(106^\circ\right)$ to $SbH_3\left(101^\circ\right)$ 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 $109^\circ 28'$ 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. CO_2

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 $\overset{\ominus}{N}H_2$ are in the order .

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

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

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

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

Answer: B

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5. For AB_2 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 $\left(NH_3, PH_3, AsH_3\right)$ 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 NCl_3, NF_3 and NH_3

Bond angle of $NCl_3 > NF_3$

Bond angle of $NCl_3 < NF_3$

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 $\left[:\overset{\cdot\cdot}{N} = \overset{\cdot\cdot}{O}: \right]$ is .

A. 0

B. $+1$

C. -1

D. -2

Answer: A

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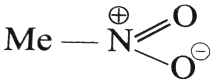
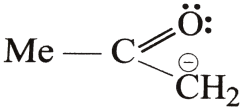
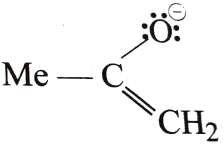
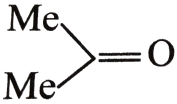
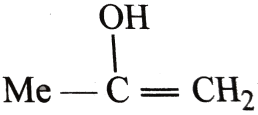
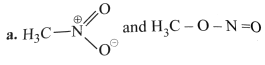
9. Which of the following pairs do not constitute resonanting structures ?

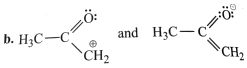
a.  and 

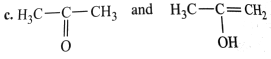
b.  and 

c.  and 

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

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

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

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

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

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^{+} and NO^{Θ} ion follows the order

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. $CN^{\oplus}$

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 $NO^{\oplus} >$ inNO

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 consist 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)π-molecular orbital

(b)σ - molecular orbital

(c)δ-molecular orbital

(d)No bond will form

A. π - MO

B. σ - MO

C. δ - 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. $\left(\sigma 2p_z\right)^1$ and $\left(\sigma^* 2p_z\right)^1$

C. $\left(\pi 2p_y\right)^1$ and $\left(\pi^* 2p_y\right)^1$

D. $\left(\sigma 2p_z\right)^1$ 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. $\sigma 2s$ 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. $F > O > N,$ first ionisation enthalpy

C. $Cl > F > I$, 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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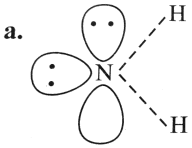
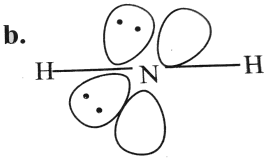
5. For NH_2^{Θ} the best three-dimensional view is .

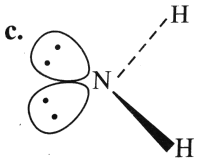
A.



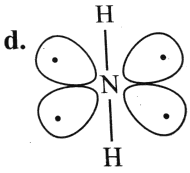
B.



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 $1.54Å C = C$ bond length is $1.33Å$ What is the circumference of benzene ring ? Bond length between single and double bonds $= 1.4Å$.

A. $(3 \times 1.54 + 3 \times 1.33)Å$

B. $(4 \times 1.54 + 2 \times 1.33)Å$

C. $(6 \times 1.4)Å$

D. $(4 \times 1.33 + 2 \times 1.54)Å$

Answer: C

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10. The correct order of the thermal stability of hydrogen halides $(H\text{-}X)$ 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. I - I

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 single bonds

B. The electron-deficient molecules act as Lewis acids

C. Every AB_5 molecule does in fact have square pyramidal structure

D. The canonical structure has no real existence

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 reactions 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 : $\left(CH_3\right)_3N$ geometry is pyramidal but in case $\left(SiH_3\right)_3N$ it is planar.

Reason :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 practically 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 molecular 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 $MgCl_2$ is more soluble as comared to $BeCl_2$

Reasoning $BeCl_2$ is covalent and $MgCl_2$ 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 precipitate 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 not 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

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13. Water has maximum density at 4°C.

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

Watch Video Solution

14. Assertion Boiling point of halogen acids are in the order $HF > HBr > HCl > HI$

Reasoning Electronegativities are in the order $F > Cl > Br > I$.

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 for covalent compounds.

Reason : Hydration energy of ions releases sufficient energy to overcome lattice energy and break hydrogen bonds in water while covalent compounds interact so weakly that even van der Waal's forces between molecules of covalent 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 molecules are polar.

Reason : In polar covalent molecule, the shared electrons 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 : Na_2SO_4 is soluble in water while $BaSO_4$ is water insoluble.

Reason :Lattice energy of $BaSO_4$ exceeds its hydration 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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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

Watch Video Solution

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. Assertion 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 not 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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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

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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 $\pi\left(2P_x\right)$ and $\pi^*\left(2P_x\right)MO's$ 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

Answer:

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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

Answer:

Watch Video Solution

26. Assertion : Bond order can assume any value including zero.

Reason : Higher the bond order, shorter is the bond length and greater is

the bond 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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27. Assertion : N_2 and NO^+ both are diamagnetic substances.

Reason : NO^+ 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

Answer:

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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 .

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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) $PCI_4^{\oplus}$.

Watch Video Solution

4. The number of hypervalent species among the following

$ClO_4^{\Theta}, BF_3, SO_4^{2-}, CO_3^{2-}$ 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 chlorine atom in ClO_2^- 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

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3. The shape of $\left[CH_3\right]^{\oplus}$ is_____ .

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4. The valence atomic orbital on C in silver acetylide 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 .....

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8. The central bond in 1,3 butadiene 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 .

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11. During the formation of a chemical bond potential energy of the system

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12. Comparatively low melting point and insolubility in water of $AlCl_3$ is explained by _____rule .

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13. The dipole moment of CH_3OH is____than that of CH_3SH .

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14. What is the correct dipole moment of NH_3 and NF_3 respectively ?

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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 distance.

Watch Video Solution

19. The angle between two covalent bonds is maximum for $\left(CH_4, H_2O, CO_2\right)$ _____ .

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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 $Ca\left(HCO_3\right)_2$ are not found in solid state .

Watch Video Solution

7. All molecules with polar bonds have dipole moment.

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8. Assertion : Ionic bonds are directional in nature whereas covalent bonds are non-directional.

Reason : According to orbital overlap concept , the formation of a covalent bond between two atoms results by pairing of electrons present in the valence shell having same spins.

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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 .

Watch Video Solution

12. Both PH_3 and PH_5 exist .

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13. $\sigma 2s, \pi^* \left(2p_x\right)$ and $\pi\left(2p_x\right)$ are gerade MO .

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14. Out of $NO, NO^{\oplus}$ and $CN^{\oplus}$ the paramagnetic species is $NO^{\oplus}$.

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15. 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) lon-induced dipole (Debye forces) .

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16. $\sigma 2s, \pi^* \left(2p_x\right)$ and $\pi\left(2p_x\right)$ are gerade MO .

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17. Predict the order of decreasing boiling points of the following H_2, He, Ne, Xe, CH_4 .

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18. (a)Give the decreasing order of melting points of the following $NH_3, PH_3, \left(CH_3\right)_3N$ 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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19. Out of CH_3OH and $\left(CH_3\right)_3N$ 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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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^{Θ} 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 orbital 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 physisorbed

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 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 a molecule MX_3 has zero dipole moment , the sigma bonding orbitals used by M 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 hybrogen bond ?

A. Phenol

B. Liquid NH_3

C. Water

D. HCI

Answer: D

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10. On hydridisation of one s and one p-orbitals , 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 indentical 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 central atom uses sp^2 hybrid orbitals 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 molecule 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 Cl-C-Cl angle is 1,1,2,2-tetrachloroethene 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 molecule 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 chlorine atom in ClO_2^- is

A. sp^3

B. sp^2

C. sp

D. None of these

Answer: A

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22. The maximum number of H-bonds a water molecule can form are

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 of types of bonds between two carbon atoms in calcium carbide is

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. Polar covalent molecules exhibit dipole moment. Dipole moment is equal to the product of charge separation , q and the bond length d for the bond. Unit of dipole moment is debye. One debye is equal to 10^{-18} esu cm.

Dipole moments is a vector quantity. It has both magnitude and direction. Hence, dipole moment of a molecule depends upon the relative orientation of the bond dipoles, but not on the polarity of bonds alone. A symmetrical structure shows zero dipole moment. Thus, dipole moment helps to predict the geometry of a molecules. Dipole moment values can be distinguish between cis- and trans- isomers, ortho, meta and pare-forms of a substance, etc.

Q. Arrange the following compounds in increasing order of dipole moments, toluene (I), o-dichlorobenzene (II), m-dichlorobenzene (III) and 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. CN^{Θ} and N_2 are isoelectronic But in contrast to CN^{Θ}, N_2 is chemically less reactive 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 $KO_2, KAlO_2, CaO_2$ and NO_2^+, unpaired electrons is present in :

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

B. KO_2 and AIO_2^{Θ}

C. KO_2 only

D. BaO_2 only

Answer: C

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29. 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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30. Among the following compounds the one that is polar and has the central atom with sp^2-hybridisation 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 bond lengths of CO, CO_2 and CO_3^{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 shapes of SF_4, CF_4, 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 types of hybrid orbitals of nitrogen in NO_2^+, NO_3^- and NH_4^+ respectively are excepted to be

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, $\left[PtCl_4\right]^{2-}$, 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. Which of the following statement is correct among the species $CN^{\ominus}$, CO and $NO^{\oplus}$.

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 species has unpaired electrons?

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 iso-electronic as well as iso-structural ?

$NO_3^-, CO_3^{2-}, ClO_3^-, SO_3$

A. $NO_3^{\oplus}, CO_3^{2-}$

B. $SO_3, NO_3^{\oplus}$

C. $ClO_3^{\oplus}, CO_3^{2-}$

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 less than O_2

C. $O_2^{\oplus}$ is diamagnetic and bond order is less than O_2

D. $O_2^{\oplus}$ is diamagnetic 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. ClO_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 molecule which has 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 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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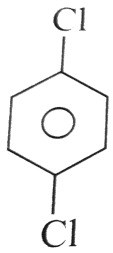
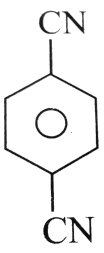
51. For which of the following molecule significant $\mu \neq 0$?

A. 

B. 

C. 

D. 

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 molecule 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 (in Å) of N^{3-}, O^{2-} and F^{-} are respectively :

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° 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 $\left[CH_3\right]^{\oplus}$ is_____ .

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2. The two types of bonds present in B_2H_6 are covalent and _____.

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3. Fill in the blanks with appropriate choice.

Bond ordr of N_2^+ *is* $\underline{P}$ while that of N_2 *is* $\underline{Q}$.

Bond order of O_2^+ *is* $\underline{R}$ while that of O_2 *is* $\underline{S}$.

N - N bond distance $\underline{T}$ when N_2 changes to N_2^+ and when O_2 changes to O_2^+, the O - O bond distance $\underline{U}$.

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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. The sigma and π-bonds present in benzene ring are

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4. Arrange the following as stated

Increasing strength of hydrogen 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 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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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 hybridization and draw the structure of OF_2 What are the oxidation states of O and F ? .

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9. Explain the non-linear shape of H_2S and non-planar shape of PCl_3 using valence shell electron pair repulsion theory.

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10. Write the molecular orbital electron distribution of oxygen $\left(O_2\right)$ 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. Explain the shape of 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 $KO_2, O_2, O_2\left[AsF_6\right]$.

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15. Predict whether the following molecules are isostructural or not Justify your answer

$N(Me)_3$ and $N\left(SiH_3\right)_3$.

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