



## **CHEMISTRY**

# AIMED AT STUDENTS PREPARING FOR IIT JEE EXAMS

## **CHEMICAL BONDING & MOLECULAR STRUCTURE**

## Illustration

1. Anhydrous  $AlCl_3$  is covalent, From the data given below, predict whether if would remain covelent or become ionic in aqueous sobittion [Inization energy for Al  $= -5137kJmol^{-1}, \Delta H_{Hydration}$  for  $Al^{3+} = -4665kJmol^{-1}$ , for  $Cl = -381kJmol^{-1}$ ]

## **2.** Calculate the lattice enthalpy of $MgBr_2$ from the given

date:

$Mg(s)+Br_2(l) ightarrow MgBr_2(s)$	$\Delta_f H^{\circ} = -524 k Jmol^{-1}$
Mg(s)  ightarrow Mg(g)	$\Delta_1 H^{\circ} = +148 k Jmol^{-1}$
$Mg(g)  ightarrow Mg^{2+}(g) + 2e^{-}$	$\Delta_2 H^{\circ} = +2187 k Jmol^{-1}$
$Br_2(l)  o Br_2(g)$	$\Delta_3 H^{\circ} = +31 k Jmol^{-1}$
$Br_2(g)  ightarrow 2Br(g)$	$\Delta_4 H^{\circ} = +193 k Jmol^{-1}$
$2Br(g)+2e^- ightarrow 2Br(g)$	$\Delta_5 H^{\circ} = -662 k Jmol^{-1}$

Strategy : The thermochemical equation corresponding to lattice enthalpy of  $MgBr_2$  is

 $Mg^{2\,+}(g)+2Br^{\,-}(g)
ightarrow Mgr_2(s) \qquad \Delta_{
m Lattice}H^{\,\circ}=~?$ 

Add the last five thermochemical equations to the thermochemical equation corresponding to lattice enthalpy to get the thermochemical equation for the formation of  $MgBr_2(s)$  from its constituent element. Finally, calculate  $\Delta_{Laice}H^{\circ}$ , using the concept of Hess's law.



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**4.** Writing Lewis Struchures for Molceules with more than One central atom. Write the Lewis structure for methanol (molecular farmula  $CH_4O$ ), on important industrical alcohol tht is being used as a gasoline alternative in car engines.



5. Write the Lewis dot structure of CO molecule .



## manufacture

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

(c) Methanol  $(CH_4O)$  an important industrial alcohol that

is beign used as a gasoline alternative in car engines .



8. Arrange the following in increasing order of bond angle

 $PH_3, SbH_3, AsH_3, NH_3$ 



have same hybridization at oxygen yet they have different bond angles. Which one has greater bond angle? Give reason.



10. Explain why the bond angle of  $H_2O$  is  $104.5^\circ$  while that of  $F_2O$  is  $102^\circ$ .



**11.** Explain why bond angle of  $NH_3$  is greater than  $NF_3$  while

bond angle of  $PH_3$  is less than that of  $PF_3$ ,



12. Why is that in the  $SF_4$  molecule, the lone pair of electrons occupies an equatorial position in the overall trigonal pyramidal arrangement in preference to an axial position ?



**13.** Calculate formal charge (F) on nitrogen and Oxygen atoms marked 'a' and 'b' in the following Lewis structure of  $NHO_3$ ,



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**14.** Calculate the formal charge on each in the following electron-dot structure of  $SO_2$ .

**17.** Why is that Lithium salts have a greater degree of covalent character than other halides of the alkali

**18.** Arrange the following in the increasing order of their (a)  $CaCO_3$ ,  $BaCO_3$ ,  $MgCO_3$ ,  $BeCO_3$  (Thermal stability) (b)  $CaMnO_4$ ,  $BaMnO_4$ ,  $MgMnO_4$ ,  $BeMnO_4$  (Solubility in water)

(c )  $NaCl, MgCl_2, SiCl_4, AlCl_3$  (ionic character)

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19. Write down the hybridization of central atom and shape

of  $SF_4$ .

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**20.** Write the geometry of  $XeF_4$  and  $SOF_4$  and clearly indicate the position of lone pair of electrons and hybridization of the central atom.

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21. Write down the hybridization of central atom and shape

of  $XeF_2$ .

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22. Draw the Lewis structures for the following molecules

and ions:

 $H_2S$ , $SiCl_4$ , $BeF_2$ , $CO_3^{2-}$ ,HCOOH

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**23.** In the following which central atom has different hybridisation than others.

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**24.** Draw Lewis structure for  $CH_3COOH$ 

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**25.** Is there any change in hybridisation of the B and N atom

as a result of the following reaction?

 $BF_3 + NH_3 
ightarrow F_3B. NH_3$ 

**26.** Write the resonance structures of  $(1)CH_3COO^{\Theta}$  and

 $(2)CH_2 = CH - CHO$ . Indicate the relative stability of the

contributing structures.

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**27.** Explain the structure of  $CO_3^{2-}$  ion in terms of resonance

(b) Explain the resonance structures of  $CO_2$  molecule .

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**28.** In trimethylamine, the nitrogen has a pyramidal geometry whereas in trisilylamine  $N(SiH_3)_3$ , it has a planar geometry. What is the reaons behind this ?



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**30.** Which of the following structures for  $N_2O$  gives a more accurate representation of the molecule ?

$$:N\equiv \stackrel{+}{\overset{N}{(T)}}-\stackrel{\cdot\cdot-}{\overset{\cdot}{O}}:\stackrel{\cdot}{\overset{\cdot}{N}}=\stackrel{\oplus}{\overset{N}{(II)}}=\stackrel{\cdot\cdot}{\overset{\cdot}{O}}$$

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**31.** Give reasons why the following two Resonance structures cannot be the major cantributors to the real structures of  $CH_3COOCH_3$ ,  $O^- O^ | + CH_3 - C - O - CH_3 \leftrightarrow CH_3 - C = O - CH_3$ (I) (II)**Watch Video Solution** 

**32.** Both  $CO_2$  and  $N_2O$  are linear but dipole moment of

 $CO_2$  is zero but for  $N_2O$  it is non-zero, Why?



**33.** Comment on dipole moment of  $H_2CO_3$ ,



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**35.** Dipole moment of  $NH_3$  is more than that of  $NF_3$ , Explain.



**36.** Diatomic molecule has a dipole moment of 1.2D If its bond  $1.0\text{\AA}$  what fraction of an electronic charge exists on each atom ? .

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**37.** The bond length of H-X molecule is 1. 2Å and the dipole moment of the molecule is 1.1D. Calculate % inonic character of the bond.

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**38.** Out of  $CS_2$  and OCS which have higher dipole moment

and why?

**39.** (a) A diatomic moleculae has a dipole moment of 1.2D. If the bond distance is 1.0Å, What fraction of an electronic charge 'e' exists on each atom ?

(b) The dipole moment of LiH is  $1.964 \times 10^{-29}$  C-m and the interatomic distance between Li and H in this molecule is 1.596Å. What is the per cent ionic character in LiH?



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



**41.** (a) How does bond energy vary from  $N_2^{\,+}$  and  $N_2^{\,-}$  and

why?

(b) On the basis of the molecular orbital theory, what is the similarly between :

 $(i)F_2, O_2^{2-} \qquad (ii)CO, N_2, NO^+.$ 

(c) Like CO why its analong SiO is not so stable?



**42.** How the bond energey varies from  $N_2^{\,\Theta}$  and  $N_2^{\,\oplus}$  and why

## ?

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

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

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43. On the basis of molecular orbital theory what is similarity

between

 $CO, N_2, NO^+$ 

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**44.** Arrange the following compounds in the icreasing order of bond length of O-O bond  $O_2$ ,  $O_2[AsF_6]$ ,  $KO_2$  and peroxide ion. Explain on the basis of ground state electronic configuration of dioxygen in these molecules.



Solved Examples

**1.** Which of the following substance has the highest melting point? .

A. NaCl

B. KCl

C. MgO

D. BaO

Answer: C

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2. Zeise's salt contains which type of bonds ?

A. Ionic

B. Ionic and covalent

C. Hydrogen bonds

D. Ionic, covelent and coordinate bonds

#### Answer: D



3. Which is distilled first?

A. liquid  $H_2$ 

B.  $NHO_3$ 

 $\mathsf{C}. H_2 SO_3$ 

D.  $HNO_2$ 

## Answer: A

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**4.** Which factor is most responsible for the increase in boiling points of noble gases from He to Xe?

A. decrease in I.E.

B. monoatomic nature

C. decrease in polarisability

D. increase in polarisability

Answer: D

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5. Which of the following resonating structures is not correct

## for $CO_2$ ?

A. 
$$\ddot{O} = C = \dot{O}$$
  
B.  $: \ddot{C} - O$ :  
C.  $: \overset{+}{O} - C \equiv \bar{O}$ :  
D.  $: \overset{+}{O} = C - \dot{O}$ :

## Answer: C

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**6.** Which of the following does not contain any coordinate bond ?

A.  $H_3O^+$ 

B.  $BF_4^{-}$ 

 $\mathsf{C.}\,HF_2^{\,-}$ 

D.  $NH_4^+$ 

Answer: C

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7. In which of the following species the angle around the central atom is exactly equal to  $109^{\circ}28$  ?

A.  $SF_4$ 

 $\mathsf{B.}: NH_3$ 

C.  $NH_4^+$ 

D. None of the above

### Answer: C



**8.** The dipole moment of o, p and m-dichlorobenzene will be in the order :

A. 0>p>mB. p>o>mC. m>o>p

 $\mathsf{D.0} > m > p$ 

#### Answer: D



**9.** In which of the following diatomjic molecules/ions is the bond order of each molecule/ion=2.5?

A.  $N_2^+$ , NO,  $O_2^+$ B.  $O_2^+$ , NO,  $CN^-$ C.  $N_2^+$ , NO,  $CN^-$ 

D. 
$$cn^-, n_2^+, n_2$$

Answer: A



10. Bond order of N-O bonds in nitrate ion is

 $A.\,1.0$ 

 $\mathsf{B}.\,1.25$ 

 $C.\,1.33$ 

 $D.\,1.50$ 

Answer: C

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**11.** Which one of the following is paramagnetic ?

A. *NO* <sup>+</sup>

 $\mathsf{B.}\,O_2^{\,-}$ 

C.  $CN^{-}$ 

 $\mathsf{D}.\,CO$ 

## Answer: B

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**12.** Amongst  $LiCl, RbCl, BeCl_2$  and  $MgCl_2$ , the compounds whith the greatrest and the least ionic character respecitely are :

A. LiCl and RbCl

**B**. RbCl and  $BeCl_2$ 

C. RbCl and  $MgCl_2$ 

D.  $MgCl_2$  and  $BeCl_2$ 

Answer: B



13. Which of the following molecular orbitals has two nodal

planes ?

A.  $\sigma_{2s}^{*}$ 

B.  $\pi^*_{2py}$ 

C.  $\pi_{2py}$ 

D.  $\pi_{2px}$ 

#### Answer: B



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

A. - 0.75, 0.6

B. - 0.75, 1.0

$$\mathsf{C.-0}rac{\cdot}{75}$$
 , 1. 25

D. -3, 1.25

Answer: C

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15. Among the following ions the p  $\pi\text{-}\operatorname{d}\pi$  overlap could be

present in

A.  $NO_3^{-}$ 

 $\mathsf{B.}\,PO_4^{3\,-}$ 

C.  $CO_3^{2-}$ 

 $\mathrm{D.}\,NO_2^{\,-}$ 

### Answer: B



16. Which of the following molecules is linear?

- A.  $Icl_{2}^{-}$ B.  $SO_{3}^{2-}$ C.  $SO_{3}$
- D.  $SO_2$

Answer: A



17. Which of the following hydride is ionic?

A.  $H_2O$ 

B.  $NH_3$ 

 $\mathsf{C}. CaH_2$ 

D.  $H_2S$ 

Answer: C



18. A covalent molecole  $AB_4$  (not a complex) will have which

of the following hybridisation if it is square planar.

A. 
$$sp^3$$

 $\mathsf{B.}\, sp^3d$ 

 $\mathsf{C.}\, sp^3d^2$ 

D.  $dsp^2$ 

Answer: C

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**19.** How many type of bond lengths are there in  $SO_3^{2-}$  ?

A. one

B. two

C. three

D. four

## Answer: A

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**20.** A molecule  $XY_2$  contains two  $\sigma$ , two  $\pi$  and one lone pair of electron in valence shell of X. The arrangement of lone pair as well as bond pairs is

A. square pyramidal

B. linear

C. trigonal planar

D. unpredictable

Answer: C



**1.** Out of  $\sigma$  and  $\pi$  – bonds, which one is stronger and why?

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2. Why are pi-bonds formed in a molecule ? Can d-orbitals

also form pi-bonds ?

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**3.** What are the nature of bonds in the  $SO_3$  molecule ?

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**7.** What will be the formal charges on the three oxygen atoms in ozone ?



8. Structures of which of the following have coordinate bond

in them

(i)  $NO_3^-$  (ii)  $O_3$  (iii) R-NC (iv)CO

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**9.** Explain the general properties of solid covalent compounds ?



10. Explain why Na tends to form ionic compounds while B

forms covalent compounds ?



**13.** What are the sHapes of  $ClF_3$ ,  $XeO_2F_2$  and  $BrF_5$ ?





**16.** What will be the shape of  $XeF_6$  molecule ?







18. What is the hybridization of nitrogen in the azide ion?

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19. The alkali metals are soft due to-



**20.** Why do the transition element have higher boiling & melting points?



22. Explain why enthanol is a liquid where as dimenthyl ether

is a gas ?

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23. What happens when benzoic acid is added to benzene ?

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24. Can chlorine exceptionally show hydrogen bonding in a	
compound ?	
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<b>25.</b> Draw all the resonating strucutres of the carbonate ion.	
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**26.** Which of one resonating structures of an isocyanide is most stabilizing ?

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27. Vinyl chloride shows resonance. Draw all of its resonating

strucutres.



28. Which has higher dipole moment, alkyl cyanides or alkayl

isocyanides ?



29. Why does p-hydroxyphenol not have zero dipole moment



**32.** Why does  $CO^+$  have an exceptional bond order of 2.5 ?



35. In soft drinks and soda water carbon-di oxide dessolves in

water under high pressure, why?



36. Chlorine molecule is non-polar but the gas is still soluble

in a polar solvent such as water. Why?

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In Chapter Exercise A

**1.** Which of the following statements concerning a covalent bond is FALSE ?

A. The electrons are shared between atoms

B. The bond is non-directionsl

C. The strength of the bond depends upon the extent of

overlapping

D. The bond formed may or may not be polar

## Answer: B



2. The interatomic distance in  $H_2$  and  $CI_2$  molecules are 74 an d198 pm respectively. The bond length of HCI is

A. 272pm

B. 136pm

C. 127pm

D. 248pm

Answer: C



3. The number of sigma and pi bonds in benzene are

A.  $3\sigma, 2\pi$ 

B.  $6\sigma$ ,  $3\pi$ 

C.  $12\sigma$ ,  $3\pi$ 

D.  $9\sigma$ ,  $3\pi$ 

Answer: C

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4. In a sigma bond

A. Sidewise as well as end to end overlap of orbitals take

place

- B. Sidewise overlap of orbitals takes place
- C. End to end overlap of orbitals takes place
- D. Opposite changes attract each other

Answer: C



**5.**  $\pi$  bond is formed by

A. overlapping of atomic orbitals on the axis of nuclei

B. mutual sharing of pi electron

C. sidewise over lapping of half filled p-orbitals

D. overlapping of s-orbitals with p-orbitlas

## Answer: C



**6.** The double bond between the two carbon atoms in ethylene consists of

A. Two  $\sigma-$  bonds at right angles to each other

B. One sigma bond one pi bond

C. Two pi bonds at right angles to each other

D. Two pi bonds at an angle of  $60^{\,\circ}$  to each other

#### Answer: B



7. The bond in the formation of fluorine molecule will be

A. Due to s-s overlapping

B. Due to s-p overlapping

C. Due to p-p overlapping

D. Due to hybridization

Answer: C

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8. The number and type of bonds between two carbon atoms

in calcium carbide are

A. one  $\sigma$ , one  $\pi$ 

B. One  $\sigma$ , two $\pi$ 

C. Two  $\sigma$ , one  $\pi$ 

D. Two  $\sigma$ , two $\pi$ 

#### Answer: B

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**9.** Which of the following has  $p\pi - d\pi$  bonding?

A.  $NO_3^-$ B.  $CO_3^{-2}$ C.  $BO_3^{-3}$ D.  $SO_3^{-2}$ 

# Answer: D Watch Video Solution 10. Number of sigma bonds in propyne will be A. 6 B. 7 C. 17 D. 16 Answer: A

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# 1. Which has maximum XCX bond angle ? (X=F,Cl,Br)

A.  $CHF_3$ 

B.  $CHCl_3$ 

 $\mathsf{C.}\,CHBr_3$ 

D. All have similar bond angle

Answer: C



**2.** The bond angle in  $PH_3$  would be expected to be close to

A.  $90^{\,\circ}$ 

B.  $105\,^\circ$ 

C.  $109^{\circ}$ 

D.  $120^{\,\circ}$ 

Answer: A

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3. Which of the least bond angle ?

A.  $NH_3$ 

B.  $BeF_2$ 

 $\mathsf{C}.\,H_2O$ 

D.  $CH_4$ 

## Answer: C

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4. Which of the following is the correct order of bond-angle ?

A.  $NH_3 < CH_4 < C_2H_2 < H_2O$ 

 $\operatorname{B.} C_2 H_2 < N H_3 < H_2 O < C H_4$ 

 $\mathsf{C.}\,NH_3 < H_2O < CH_4 < C_2H_2$ 

D.  $H_2O < NH_3 < CH_4 < C_2H_2$ 

#### Answer: D

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5. Which one of the following compounds has bond angle close to  $90^{\circ}$  ?

A.  $H_2O$ 

 $\mathsf{B}.\,H_2S$ 

 $\mathsf{C}.NH_3$ 

D.  $CH_4$ 

Answer: B

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6. The correct sequence of decrease in the bond angles of

the following hydrides is

A.  $NH_3 > PH_3 > AsH_3 > SbH_3$ 

 $\mathsf{B}.\, NH_3 > AsH_3 > PH_3 > SbH_3$ 

 $\mathsf{C}.\,SbH_2 > AsH_3 > PH_3 > NH_3$ 

 $\mathsf{D}.\, PH_3 > NH_3 > AsH_3 > SbH_3$ 

Answer: A

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7. True order of bond angle among group -16 hydrides is

A.  $H_2O>H_2S>H_2Se>H_2Te$ 

 $\mathsf{B}.\,H_2Te>H_2Se>H_2S>H_2O$ 

C.  $H_2S > H_2O > H_2Se > H_2Te$ 

 $\mathsf{D}.\,H_2O>H_2S>H_2Te>H_2Se$ 

## Answer: A

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8. In  $BrF_3$  molecule , the lone pairs occupy equatorial positions to minimise

A. Lone pair-lone pair repulsion and lone pair-bond pair repulsion

B. Lone pair-lone pair repulsion only

C. Lone pair-bond pair repulsion only

D. Bond pair-bond pair repulsion only

Answer: C

**9.** The maximum number of  $90^{\circ}$  angles between bond pairbond pair of electrons is observed in

A.  $dsp^2$  hybridization

B.  $sp^3d$  dhbridization

C.  $sp^3$  hybridization

D.  $sp^2d^2$  hybridization

Answer: D



10. According to VSEPR theory, the most probable shape of

the molecule having 4 electrons pairs in the outer shell of

the central atom is

A. Linear

**B.** Tetrhedral

C. Hexahedral

D. Octahedral

Answer: B



In Chapter Exercise C

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

A.  $CO_2$ 

 $\mathsf{B.}\,H_2O$ 

 $\mathsf{C}.\,CO$ 

 $\mathsf{D.}\,O_2$ 

Answer: C



2. Which of the following is electron deficient?

A. Icl

 $\mathsf{B.}\,NH_3$ 

 $C. BCl_3$ 

D.  $PCl_3$ 

# Answer: C

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3. Which of the following substances is covalently bonded ?

A. KBr

B. Sodium chloride

C. Solid neon

D. Copper

Answer: D

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**4.** The table shown below gives the bond dissociation energies  $(E_{\rm diss})$  for single covalent bonds of carbon (C) atom with element A,B,c and D. Which element out of these has the smallest atoms ?

Bond	E <sub>diss</sub> (kJ mol <sup>-1</sup> )
C – A	240
C – B	328
C – C	276
C – D	485

A. A

B. B

C. C

D. D

## Answer: D

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**5.** If molecule  $X_2$  has a triple bond, then X will have the electronic configuratin.

A.  $1s^22s^22p^5$ 

B.  $1s^2 2s^2 2p^3$ 

 $\mathsf{C}.\,1s^22s^1$ 

D.  $1s^2 2s^2 2p^1$ 

Answer: B



**6.** Which of the following compounds does not follow the octet rule the electron distribution

A.  $PCl_5$ 

B.  $PCl_3$ 

 $\mathsf{C}.\,H_2O$ 

D.  $PH_3$ 

Answer: A

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7. The major binding force of diamond, silicon and quartz is

A. Electrostatic force

**B.** Dipole Interaction

C. Covalent bond

D. Hydrogen bonds

## Answer: C



**8.** Which of the following statements is correct for covalent bonds ?

A. These assign a geometry to molecule

B. Triple bonds are stronger than double bonds

C.  $\sigma$  – bonds are stronger than  $\pi$  – bonds

D. All of these

## Answer: D

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**9.** Among  $CaH_2$ ,  $NH_3$ , and  $B_2H_6$  which are covalent hydrides?

A.  $NH_3$  and  $B_2H_6$ 

**B**. NaH and  $CaH_2$ 

C. NaH and  $NH_3$ 

D.  $CaH_2$  and  $B_2H_6$ 

Answer: A



10. Covalent compounds have low melting points because

A. Covalent bond is less exothermic

B. Covalent molecules have definite shape

C. Covalent bond is weaker than ionic bond

D. Cavalent molecules are held by weak Vander Waal's

forces

Answer: D

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In Chapter Exercise D

1. Which one id least ionic in the following compounds?

A. AgCl

 $\mathsf{B}.\,KCl$ 

C.  $BaCl_2$ 

D.  $CaCl_2$ 

Answer: A

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**2.** The electronic configuration of four elements L, P, Q and

R are given in brackets

 $Lig(1s^2, 2s^2, 2p^4ig), Pig(1s^2, 2p^6, 3s^1ig)$ 

 $Qig(1s^2,2s^22p^6,3s^23p^5ig),Rig(1s^2,2s^22p^6,3s^2ig)$ 

The formula of ionic compounds that can be formed between elements are

A.  $L_2P$ . RL, and  $R_2Q$ 

B. LP, RL, PQ and RQ

 $C. P_2L, RL, PQ$  and  $RQ_2$ 

 $D. LP, R_2L, P_2Q$  and RQ

Answer: B

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3. Many ionic crystals dissove in water because

A. Water is an amphiprotic solvent

B. Water is a high boiling liquid

C. The process is accompoanied by a positive heat of

solution

D. Water decreases the inter-ionic attractions in the

crystal lattice due to solvation

Answer: D

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4. The electronic structure of four elements A, B, C, D are (a)  $1s^2$  (b)  $1s^2, 2s^2, 2p^2$ (c)  $1s^2, 2s^2, 2p^5$  (d)  $1s^2, 2s^22p^6$ 

The tendency to form electrovalent bond is largest in

A. P

B.Q

C. R
## Answer: C



5. Favourable conditions for electrovalency are

A. Low charge on ions, large cation, small anion

B. High charge on ions, small cation, large amino

C. High charge on ions, large cation, small anion

D. Low charge on ions, small cation large amino

Answer: A



6. Which of the following is an electrovalent linkage?

A.  $CH_4$ 

 $\mathsf{B.}\,MgCl_2$ 

C.  $SiCl_4$ 

D.  $BF_3$ 

**Answer: B** 

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7. A number of ionic compounds are insoluble in water. This

is because

A. Ionic compounds do not dissolve in water

B. Water has a high dielectric constant

C. Water is not a good ionizing solvent

D. These molecules have high lattice energy

Answer: D



8. Two elements whose electronegativities are 1.2 and 3.0 the bond formed between them would be

A. Ionic

B. Polar covalent

C. Co-ordinate

D. Methallic

# Answer: B

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9. Which of the following is least ionic?

A.  $C_2H_5Cl$ 

 $\mathsf{B.}\,KCl$ 

 $C. BaCl_2$ 

D.  $C_6H_5N^+Cl^-$ 

Answer: A

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**10.** Which of the following statements is not true for ionic compounds ?

A. High melting point

B. Less lattice energy

C. Less solubility in organic compounds

D. Soluble in water

#### Answer: B

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In Chapter Exercise E

1. Which one of the following molecules is linear?

A.  $BeF_2$ 

 $\mathsf{B}.\,BeH_2$ 

 $\mathsf{C}.CO_2$ 

D.  $H_2O$ 

Answer: D

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**2.** Which of the following molecule has trigonal planner geometry?

A.  $IF_3$ 

B.  $PCl_3$ 

 $\mathsf{C.}\,NH_3$ 

D.  $BF_3$ 

#### Answer: D



**3.**  $PCl_5$  on heating dissociates to  $PCl_3$  and  $Cl_3$  because :

A. P can expand its octet

B. It is polar covelent compound

C. It has unsymmetrical geometry

D. None of these

Answer: D



**4.** In which of the following the central atom does not use  $sp^3$  hybrid orbitals in its bonding

A.  $BeF_{3}^{-}$ B.  $OH_{3}^{+}$ C.  $NH_{2}^{-}$ 

D.  $NH_3$ 

Answer: A

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**5.** Which among the following possesses an sp hybridized carbon in its structure ?

A.  $CH_2 = CCl - CH = CH_2$ 

$$\mathsf{B.} C. Cl_2 = C. Cl_2$$

 $\mathsf{C}.\,CH_2=C=CH_2$ 

 $\mathsf{D}.\, CH_2 = CH - CH = CH_2$ 

Answer: C

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**6.** The shape of  $XeF_4$  molecule is

A. Linear

**B.** Pyramidal

C. Tetrahedral

D. Square planar

# Answer: D

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7. The compound 1, 2- butadiene has :

A. Only sp hybridized carbon atoms

B. Only  $sp^2$  hybridized atoms

C. Both sp and  $sp^2$  hybridized carbon atoms

D. sp,  $sp^2$  and  $sp^3$  hybridized carbon atoms

#### **Answer: B**

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**8.** The shape of  $XeF_4$  molecule is

A. Tetrahedral

B. Trigonal bipyramidal

C. Square pyramidal

D. Pentagonal bipyramidal

Answer: C



9. Which one is false in the following statements ?

A. Each carbon in ethylene is in  ${{\mathfrak{sp}}^2}$  hybridization

B. Each carbon in acetylene is in  $sp^3$  hybridization

C. Each carbon in benzene is in  ${\it sp}^3$  hybridization

D. Each carbon in ethane is in  ${\it sp}^3$  hybridization

#### Answer: B

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10. The structure and hybridization of  $NO_2^+$  is

A. Linear, sp

B. Trigonal,  $sp^2$ 

C. Octahedral,  $sp^3d$ 

D. Tetrahedral, $sp^3$ 

#### Answer: A





In Chapter Exercise F

1. As the s-character of hybridisation orbital increase, the

bond angle

A. Increase

**B.** Decreases

C. Becomes zero

D. Does not change

Answer: A

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**2.**  $d\pi - p\pi$  bond is present in :

A.  $CO_3^{2-}$ B.  $PO_4^{3-}$ C.  $NO_3^{-}$ D.  $NO_2^{-}$ 

Answer: B



3. Which of the following pair has same structure?

A.  $PH_3$  and  $Cl_2$ 

 $B.SO_2$  and  $NH_3$ 

 $\mathsf{C}. PCl_3$  and  $SF_6$ 

D.  ${NH_4^+} ans SO_4^{2\,-}$ 

#### Answer: D

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**4.** Among the following compounds the one that is polar and has central atom with  $sp^3$  hybridisation is :

A.  $H_2CO_3$ 

B.  $BF_3$ 

C.  $SiF_4$ 

D.  $HClO_2$ 

# Answer: A Watch Video Solution 5. The molecule which is pyramidal in shape is

A.  $PCl_3$ B.  $CO_3^{2-}$ C.  $SO_3$ 

 $\mathrm{D.}\,NO_2^{\,-}$ 

Answer: A

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**6.** In a regular octahedral molecule  $MX_6$  the number of

X-M-X bonds at  $180^\circ\,$  is

A. Six

B. Four

C. Three

D. Two

## Answer: C

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7. Which of the following ions show a bonds order of 1.75:

A. 
$$NO_3^-$$

 $\operatorname{B.} CO_3^{2\,-}$ 

 ${\rm C.}\, ClO_4^{\,-}$ 

D. None of these

Answer: C



**8.** Which of the following has the regular tetrahedral structure?

A.  $BF_4^{-}$ 

B.  $SF_4$ 

 $\mathsf{C.}\, CeF_4$ 

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

# Answer: A

9. Among the coimpounds,  $BF_3$ ,  $NH_3$ ,  $H_2O$ ,  $SF_4$  and  $BeCl_2$ , identify the ones in which the central atom has the same type of hybridization.

A.  $BF_3$  and  $NCl_3$ 

 $B. NH_3$  and  $H_2O$ 

 $C. BF_3, NCl_3 \text{ and } H_2O$ 

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D.  $SF_4$  and  $BeCl_2$ 

Answer: B



10. If molecule  $MX_3$  has zero dipole moment, the sigma bonding orbitals used by M (atomic number  $\,<\,21$ ) are

A. sp hybrid

B.  $sp^2$  hybrid

C.  $sp^3$  hybrid

D.  $sp^3d^2$  dybrid

Answer: B



In Chapter Exercise G

**1.** In the following metals which one has lowest probable inter-atomic forces ?

A. Copper

B. Silver

C. Zinc

D. Mercury

Answer: D

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2. The enhanced force of cohesion in metals is due to

A. The covalent linkage between atoms

B. The electrovalent linkages between atoms

C. The lack of exchange of valency electrons

D. The exchange energy of mobile electrons

Answer: A



3. Which of the following does not apply to metallic bond?

A. Overlapping valence orbitals

B. Mobile valence electrons

C. Delocalized electrons

D. Highly directed bonds

# Answer: D

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4. Which of the following has the highest melting point

A. Pb

B. Diamond

C. Fe

D. Na

**Answer: B** 

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- **5.** Matals are all good electrical conductors, Which of the following statements is correct ?
  - A. Metals are soft and hence allow electrons to pass

through

- B. Metals possess small value of band gap
- C. Metals have large void spaces in their lattices that

accommodate electrons

D. metals are high melting solid so electrons can

translate on their surface

**Answer: B** 



**6.** Sodium metal is soft but Iron is a hard metal. This difference arises due to.

A. Sodium has lesser atomic mass than iron

B. Sodium has only one valence electron where as iron

has more

C. There is one unpaired electron is sodium but four

unpired electrons in iron

D. Sodium reacts readily with air and moisture but iron is

resistanct to action of water

Answer: C

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7. Which is not true regarding silicones?

A. It has a value of 111 kJ/mole

B. Value of  $E_g$  is intermediate between metals and non-

metals

C. Its  $E_g$  value is higher than that of Germanium

D. All of these are correct

Answer: D

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8. Which of these are true regarding metallic bonds?

A. Luster of metals is due to oscillation of electrons on

the surface of the metal

B. The best electric conductor is silver among all metals

C. Diamond is not a conductor of electricity and has a

high value of energy gap

D. All of these are correct

Answer: D

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9. A metal 's ability to conduct electricity

A. The positive metal ions pass charge to each other

B. Electrons pass charges through the positive metal ions

C. The sea of electrons helps pass charges through the

metal

D. conductance shown by metals is due to positive

kernels and not electrons

Answer: C

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**10.** Attractive forces between metal ions and mobile electrons can be weaken or overcome by

A. hummeer

B. high temperature

C. water

D. All of these

#### Answer: D



In Chapter Exercise H

**1.** Compounds showing hydrogen bonding among  $HF, NH_3, H_2S$  and  $PH_3$  are

A. only HF,  $NH_3$  and  $PH_3$ 

B. onlyHF and  $NH_3$ 

C. Only  $NH_3$ ,  $H_2S$  and  $PH_3$ 

D. All four show hydrogen bonding

# Answer: B

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2. The high density of water compared to ice is due to

A. Hydrogen bonding interactions

B. Dipole-dipole interactions

C. Dipole-induced dipole interactions

D. Induced dipole-induced dipole interactions

Answer: A

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**3.** The maximum possible number of hydrogen bonds in which an  $H_2O$  molecule can participate is

A. 1 B. 2 C. 3 D. 4

#### Answer: D

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**4.** B.P of  $H_2O(100\,^\circ\,C)$  and  $H_2S(\,\equiv 42\,^\circ\,C)$  is explained by

A. Vander Waal's forces

B. Colvalent bonding

C. Hydrogen bonding

D. Ionic bonding

Answer: C



5. Which one has the highest boiling point?

A. Acetone

B. Ethyl alcohol

C. Diethyl ether

D. Chloroform

# Answer: A

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**6.** When two ice cubes are pressed over each other, they unite to form one cube. Which of the following forces is responsible to hold them together ?

A. Vander Waal's forces

B. Hydrogen bond formation

C. Covalent attraction

D. Dipole-dipole attraction

Answer: B



- 7. Hydrogen bond energy is equal to
  - A.  $3-7\,\mathrm{cals}$
  - ${\rm B.}\,30-70\,{\rm cals}$
  - ${\rm C.}\,3-10\,\rm kcals$
  - $\mathrm{D.}\,30-70\,\mathrm{kcals}$

#### Answer: C

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8. Hydrogen bonding is not shown by

A. Water

**B.** Glycerol

C. Hydrogen fluoride

D. Hydrogen Sulphide

Answer: D



9. Maximum extent of hydrogen bonding is observed in

A.  $C_6H_5OH$ 

B.  $C_6H_5COOH$ 

 $\mathsf{C.}\,CH_3CH_2OH$ 

D.  $CH_3COCH_3$ 

## Answer: B

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**10.** Which among the following compounds does not show hydrogen bonding ?

A. Water

B. Ethyl alcohol

C. Acetic acid

D. diethyl ether

Answer: D


1. Resonance occurs due to the :

A. Delocalization of sigma electrons

B. Delocalization of pi electrons

C. Migration of H atoms

D. Migration of protons

Answer: B



2. Resonating structures have different \_\_\_\_\_.

- A. Atomic arrangments
- B. Electronic arrangements
- C. Functional groups
- D. Alkyl groups

## Answer: B



3. Which does not show resonance ?

A. Benzene

B. Aniline

C. Ethyl amine

D. Toluene

# Answer: C

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4. The enolic form of acetone contains

A. 9 sigma bonds, 1 pi bond and 2 lon pairs

B. 8 sigma bonds, 2 pi bonds and 2 lone pairs

C. 10 sigma bonds, 1 pi bond and 1 lone pair

D. 9 sigma bonds, 2 pi bonds and 1 lone pair

Answer: A

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5. Point out incorrect statement about resonance

A. Resonance structures should have equal energy

B. In resonance strucutres, the constituent atoms should

be in the same position

C. In resonance strucutes, there should not be the same

number of electron pairs

D. Resonance structures should differ only in the location

of electrons around the constituent atoms

Answer: C

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## 6. Resonance Hybrid of nitrate ion is :



#### Answer: D



7.  $CO_3^{2-}$  anion has which of the following characterstics

- A. Bonds of unequal length
- B.  $sp^3$  hybridization of C atom
- C. Resonance stabilization
- D. Different bond angles

## Answer: C



8. In the dichromate dianion,

- A. 4Cr O bonds are equivalent
- B. 6Cr O bonds are equivalent
- C. All Cr O bonds are equivalent
- D. All Cr O bonds are non-equivalent

## Answer: B



- 9. The correct order of increasig C-O bond length of  $CO, CO_3^{2-}, CO_2$  is
  - A.  $CO_2^{2-} < CO_2 < CO$ B.  $CO_2 < CO_3^{2-} < CO$ C.  $Co < CO_3^{2-} < CO_2$
  - D.  $CO < CO_2 < CO_3^{2-}$

### Answer: C



10. Which of these molecules does not exhibit resonance ?

A. Ozone

B. Phenol

C. But -1,3-diene

D. ethanol

Answer: D



In Chapter Exercise J

1. Which bond angle,  $\theta$  would result in the maximum dipole

moment for the triatomic molecule  $XY_2$  ?

A.  $heta=90^\circ$ B.  $heta=120^\circ$ C.  $heta=150^\circ$ 

D.  $heta=180^\circ$ 

Answer: A

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**2.** Which of the following would have a permanent dipole moment ?

A.  $BF_3$ 

B.  $SiF_4$ 

 $\mathsf{C.}\,SF_4$ 

# $\mathsf{D.}\, XeF_4$

### Answer: B



3. In the following which one will have zero dipole moment?

A.  $BF_3$ 

B.  $CCl_4$ 

C.  $BeCl_2$ 

D. All of these

Answer: D



4. Which of the following will show least dipole character ?

A. Water

B. Ethnol

C. Ethane

D. Ether

Answer: C



5. Carbon tetrachloride has no net dipole moment because

of

A. Its planar struture

B. Its regular tetrahedral structure

C. Similar sizes of carbon and chlorine atoms

D. Similar electron affinities of carbon and chlorine

Answer: B



6. Zero dipole moment is present in

A.  $NH_3$ 

 $\mathsf{B.}\,H_2O$ 

C. cis1,2-dichloroethene

D. trans 1,2-dichloroethene

## Answer: D

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7.  $N_2$  is less reactive than  $CN^{\,-}\,$  due to

A. Presence of more electrons in orbitals

B. Absence of dipole moment

C. Difference in spin quantum no

D. A trpile bond between nitrogen atoms

### Answer: C

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8. In a polar molecule , the ionic charge is  $4.8 imes 10^{-10}$  esu. If the interatomic distance is 1Å unit, then the dipole moment is

A. 41.8 debey

B. 4.18 debye

C. 4.8 debye

 $\mathsf{D}.\,0.48\,\mathsf{debye}$ 

Answer: B



**9.** The dipole moment of HBr is  $1.6 \times 10^{-30} cm$  and interatomic spacing is 1Å. The % ionic character of HBr is

A. 7

B. 10

C. 15

D. 27

Answer: A

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10. Which of the following is having zero dipole moment?

A.  $CCl_4$ 

 $\mathsf{B.}\,CH_3Cl$ 

 $\mathsf{C}. CH_3F$ 

D.  $CHCl_3$ 

## Answer: B

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In Chapter Exercise K

1. Which of the following species is the least stable ?

A.  $O_2$ B.  $O_2^{-2}$ C.  $O_2^{+1}$ D.  $O_2^{-1}$ 

**Answer: B** 



# 2. The bond order is maximum in

A.  $O_2$ B.  $O_2^{-1}$ C.  $O_2^{+1}$ 

 $\mathsf{D}.\,O_2^{\,-\,2}$ 

## Answer: C

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3. Out of the following which has smallest bond length ?

A. 
$$O_2$$

 $\mathsf{B.}\,O_2^{\,+}$ 

 $\mathsf{C}.\,O_2^{\,-}$ 

D.  $O_2^{2\,-}$ 

## Answer: B



# 4. The molecule which has highest bond order is

A.  $N_2$ 

 $\mathsf{B.}\,Li_2$ 

 $\mathsf{C}.He_2$ 

 $\mathsf{D}.\,O_2$ 

# Answer: A

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**5.** The bond order of individual carbon-carbon bond in benzene is

A. One

B. Two

C. Between 1 and 2

D. 1 and 2 alternately

Answer: C

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6. The molecular orbital configuration of a diatomic molecule

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

Its bond order is \_\_\_\_\_.

A. 3

is

B. 2.5

C. 2

D. 1

Answer: A



7. According to molecular orbital theory, the paramagnetism of  $O_2$  molecule is due to the presence of

A. Unpaired electrons in the bonding  $\sigma$  molecular orbital

B. Unpaired electrons in the anti-bonding  $\sigma$  molecular

orbital

- C. Unpaired electron in the bonding  $\pi$  molecular orbital
- D. Unpaired electrons in the anti-bonding  $\pi$  molecular orbital

Answer: D

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**8.** The bond order in  $N_2^-$  is

A. 2

B. 2.5

 $C.\,1.5$ 

D. 3

#### **Answer: B**



**9.** If  $N_x$  is the number of bonding orbitals of an atom and  $N_y$  is the number of antibonding orbitals, then the molecule/atom will be stable if

A.  $N_x > N_y$ B.  $N_x = N_y$ C.  $N_x < N_y$ D.  $N_x \le N_y$ 

Answer: A

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10. Which of the following molecular orbitals has two nodal

planes ?

A.  $\sigma 2s$ 

B.  $\pi 2 p_y$ 

C.  $\pi^* 2p_y$ 

D.  $\sigma^* 2p_z$ 

## Answer: C



In Chapter Exercise L

1. In solid argon , the atoms are held together by

A. Ionic bonds

B. Hydrogen bonds

C. Vander Waals forces

D. Hydrophobic forces

Answer: C
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2. Which of the following exhibits the weakest intermolecular
forces?
A. He
B. HCl
$C. NH_3$
D. $H_2O$
Answer: A
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3. Among the following the weakest force of interaction is

A. Metallic bond

B. Ionic bond

C. Van der Waal's force

D. Covalent bond

Answer: C



**4.** Pure covalent molecules are ususlly held in a crystal structure by

A. Dipole-dipole attractin

B. Electrostatic attraction

C. Hydrogen bonds

D. Vander Waal's attraction

Answer: D

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5. Which of the noble gas has highest polarizability

A. He

B. Ne

C. Ar

D. Xe

## Answer: D

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**6.** Dissoution of iodine crystals in carbon tetrachlorides solvent can be attributed to

A. Hydeogen bonding between them

B. dipole-induced dipole interactin between them

C. London dispersion force between them

D. Large molecular mass of iodine and hence large van-

der waals forces

Answer: C

**7.** If NaCl dissolves in water then the nature of interaction between them is

A. Dipole-Dipole interaction

B. Dipole-Induced dipole interaction

C. Ion-dipole interaction

D. Hydrogen Bonding

#### Answer: C



8. The attractive forces that exist between non polar molecules such as  $O_2, N_2$  or mono-atomic gases like He, Ne

### are called

- A. hydrogen bond forces
- B. dispersion forces
- C. dipole-dipole forces
- D. ion-dipole forces

## Answer: B



9. Which of these is correct regarding a hydrogen bond ?

A. These have a reasonable effect on the structure and

properties of a compound

B. Hydrogen atoms attached to N. O or F is able to inter-

pose itself between electronaegative atoms bonding

them together

C. The heat of a hydrogen bond can be 40 kJ/mole

D. All fo these are correct

Answer: D



**10.** Which of these can explain the unusual contraction of water when heated between  $0^{\circ}C$  to  $4^{\circ}C$ ?

A. Hydrogen bonding

B. Covalent nature of water

C. permanent dipole moment in water

D. Lesser density of ice as compound to water

Answer: A

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