

**CET**

**ON**

**Chemical Bonding-I & II**

1. The number of  $\pi$  - electrons present in 2.6 g of ethyne is

1) 0.1 mol

2) 0.2 mol

3) 0.3 mol

4) 0.4 mol

$\pi$  - electrons in one molecule of ethyne = 4

$\pi$  - electron in 2.6 g ( $= 2.6/26 = 0.1$  mol) molecules =  $0.1 \times 4 = 0.4$  mol (Mol. Mass of ethyne = 26 g)

Ans : 4)

2)  $\text{N}_2$  and  $\text{O}_2$  are converted monovalent cations  $\text{N}_2^+$  and  $\text{O}_2^+$  respectively. Which is wrong ?

- 1) in  $\text{N}_2^+$ , the N – N bond weakens
- 2) in  $\text{O}_2^+$ , the O – O bond order increases
- 3) in  $\text{O}_2^+$ , paramagnetism decreases
- 4)  $\text{N}_2^+$  becomes diamagnetic

The number of unpaired electrons decreases in going from  $\text{O}_2 \rightarrow \text{O}_2^+$ . The loss of electrons occurs from anti-bonding  $\pi^*_{2px}$  orbital

Ans : 4)

3) The ground state electronic configuration of  $N_2$  molecule is written as  $KK(\sigma_{2s})^2 (\sigma^*_{2s})^2 (\pi 2p_x)^2 (\pi 2p_y)^2 (\sigma 2p_z)^2$ . The bond order of mono-valent ion  $N_2^+$  is

1) 3.5

2) 2.5

3) 2

4) 1.5

$$\text{Bond order} = \frac{1}{2} (7 - 2) = 2.5$$

Ans : 2)

4) Given electronic configuration of four elements as (I)  $1s^2$  , (II)  $1s^2 2s^2 2p^2$ , (III)  $1s^2 2s^2 2p^5$  and (IV)  $1s^2 2s^2 2p^6$ . Which of them is/ are capable of forming ionic as well as covalent bonds?

1) I and III

2) II and III

3) III only

4) IV and II

Element ( $1s^2, 2s^2 2p^5$ ) can form ionic as well as covalent bond  
(halogens)

**Ans : 3)**

5)  $C_2-C_3$ , sigma single bond in vinyl acetylene is due to overlapping of

1)  $sp-sp$

2)  $sp^2-sp^2$

3)  $sp-sp^2$

4)  $sp^2-sp$



Ans : 4)

**6) Which of the following process involve cleavage of Hydrogen bonds ?**

- 1) Sublimation of dry ice**
- 2) Melting of ice**
- 3) Dissociation of Hydrogen molecules**
- 4) Condensation of Ammonia**

Melting of ice involve the cleavage of some H-bonds

**Ans : 2)**

**7) Which of the following will have maximum covalent character ?**

**1) NaCl**

**2) NaBr**

**3) NaI**

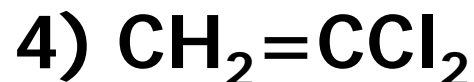
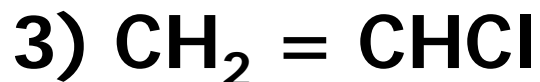
**4) NaF**

According to Fajan's rule, the polarisability of  $I^-$  ion is maximum amongst halide ions

**Ans : 3)**



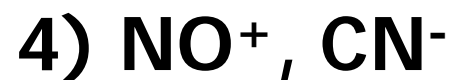
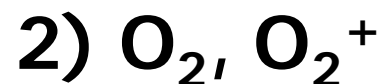
8) Out of the four planar molecules given below which one has dipole moment equal to zero ?



In trans molecules, the bond moments cancel each other

Ans : 2)

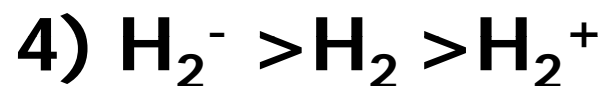
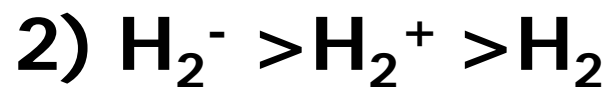
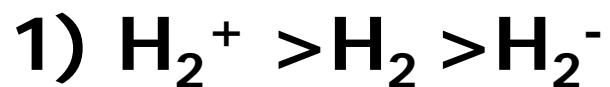
9) Which pair among the following have identical bond order ?



Both  $\text{CN}^-$  and  $\text{NO}^+$  have 14 electrons and the configuration same as nitrogen molecule with bond order equal to 3

Ans: 4)

10) The bond length of  $H_2^+$ ,  $H_2^-$  and  $H_2$  are in the order



The BO of  $H_2^+$  and  $H_2^-$  is same (1/2). But  $H_2^-$  is less stable than  $H_2^+$ . Because one electron is present in ABMO which causes repulsion.

Ans : 1)

**11) The hybrid states of carbon and oxygen in methanol molecule are respectively**

**1)  $sp^3, sp^3$**

**2)  $sp^3, sp^2$**

**3)  $sp^3, sp$**

**4)  $sp^3, sp$**

In  $CH_3 - O - H$ , both C and O atoms assume  $sp^3$  hybrid state

**Ans :1)**

12) The correct order of decreasing polarisability of ions is

1)  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$ ,  $\text{F}^-$

2)  $\text{F}^-$ ,  $\text{I}^-$ ,  $\text{Br}^-$ ,  $\text{Cl}^-$

3)  $\text{F}^-$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$

4)  $\text{I}^-$ ,  $\text{Br}^-$ ,  $\text{Cl}^-$ ,  $\text{F}^-$

Ans :4)

**13) Which of the following has unpaired electrons in anti bonding molecular orbital ?**

**1) C<sub>2</sub>**

**2) O<sub>2</sub>**

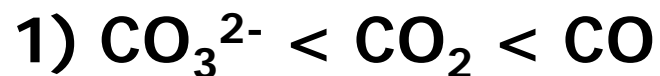
**3) He<sub>2</sub>**

**4) N<sub>2</sub>**

**O<sub>2</sub> has 2 unpaired electrons. One each in  $\pi^*_{2px}$  and  $\pi^*_{2py}$  molecular orbitals**

**Ans : 2)**

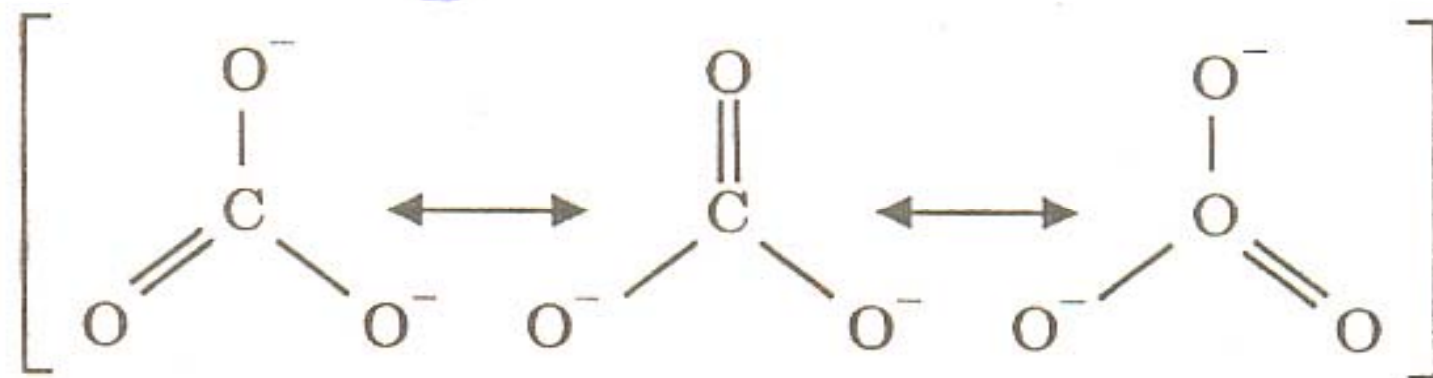
14) The correct increasing order of C-O bond lengths among CO, CO<sub>3</sub><sup>2-</sup> and CO<sub>2</sub> is



$[C \equiv O \leftrightarrow \overset{+}{C} = \overset{-}{O}]$  Bond order is  $\frac{5}{2} = 2.5$ .

$[O \equiv C = O \leftrightarrow O^+ \equiv C - O^- \leftrightarrow O^- - C \equiv O^+]$ .

Bond order =  $\frac{6}{3} = 2$ .



Bond order =  $\frac{4}{3} = 1.33$ .

Ans : 4)



**15) In metals the lattice points are occupied by**

**1) Atoms**

**2) Electrons**

**3) Metal ions**

**4) Molecules**

**Ans : 3)**

**16) Which of the following metals will exhibit photoelectric effect most easily?**

**1) Sodium**

**2) Magnesium**

**3) Caesium**

**4) Lithium**

Caesium is having lowest ionization energy.

**Ans : 3)**

17) The orbital configuration of a certain homo nuclear species is  $(\sigma_{1s})^2 (\sigma^*_{1s})^2 (\sigma_{2s})^2 (\sigma^*_{2s})^2 (\pi_{2pz})^1$  . The bond order will be

1) 0.5

2) 2

3) 3

4) 0

$$\text{Bond order} = (5 - 4) / 2 = 0.5$$

Ans : 1)

**18) According to LCAO method, the combination of two atomic orbital of adjacent atoms results in the formation of**

- 1) A single molecular orbital**
- 2) Two molecular orbitals**
- 3) Three molecular orbitals**
- 4) Hybrid molecular orbitals**

Combination of two atomic orbital gives two resultant molecular orbital, one of which is bonding MO and other one is ABMO

**Ans : 2)**

19) Which of the following represents in a non-polar molecule with polar bonds ?



In  $\text{CCl}_4$  the C-Cl bonds are polar but result in dipole moment is zero. Because 4 C-Cl bond momenta cancel one another

Ans : 4)

**20) Which bond is not present in Lewis formula of CO molecule ?**

**1) pi bond**

**2) Electrovalent bond**

**3) sigma bond**

**4) dative bond**

The Lewis formula of CO is  $C \equiv O$  which does not contain electrovalent bond

**Ans : 2)**

## 21) Metallic lustre is due to

- 1) High density of metals
- 2) Crystalline structure of metals
- 3) Reflection of light by mobile electrons
- 4) High polish on the surface

The mobile electrons will reflect the light hence especially freshly cut metals have lustrous property.

Ans : 3)

**22) Pressing of two ice cubes together results in the formation of a single block. The forces responsible for their union are**

- 1) Van der Waal's forces**
- 2) Intra molecular H-bonds**
- 3) intermolecular H-bonds**
- 4) covalent bonds**

**Intermolecular H bonds are responsible for their combination**

**Ans : 3)**



**23) Which pair of molecules are having two sigma and two pi bonds ?**

**1) N<sub>2</sub> and HCN**

**2) HCN and CO<sub>2</sub>**

**3) C<sub>2</sub>H<sub>2</sub> and CO<sub>2</sub>**

**4) CO<sub>2</sub> and CO**

**Both in H – C ≡ N and O = C = O molecules, there are 2 sigma bonds and 2 pi bonds**

**Ans : 2)**

24) The hybrid state of C atom in  $C_2H_2$  is same as that of C in

1) HCHO

2) Graphite

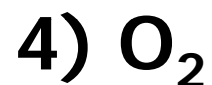
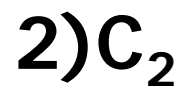
3)  $C_2H_4$

4) HCN

Hybrid state of C in  $C_2H_2$ ,  $CO_2$  and HCN is sp

Ans : 4)

25) Bond dissociation energy is least in



Due to low bond order (1) of chlorine molecule .

Ans : 1)

**26) Glycerol is more viscous than ethanol because**

- 1) Hydrogen bonding is more extensive in ethano**
- 2) Hydrogen bonding is more extensive in glycerol**
- 3) Glycerol has higher molecular mass**
- 4) Intramolecular H – bonding occurs in glycerol**

It is due to 3 polar -OH groups per molecule of glycerol where as ethanol contains only one -OH group.

**Ans : 2)**

**27) Which of the following molecule is paramagnetic ?**

**1) F<sub>2</sub>**

**2) O<sub>2</sub>**

**3) N<sub>2</sub>**

**4) H<sub>2</sub>**

Oxygen molecule has 2 unpaired electrons.

**Ans : 2)**

28) Which among the following species is most stable ?



Bond order of  $\text{H}_2$  is 1 while other species have bond order less than 1

Ans : 4)

29) A molecule  $AB_3$  exhibits a dipole moment = 0, then the hybrid state of A ( $Z < 21$ ) should be

1)  $sp^2$

2)  $sp$

3)  $sp^3d$

4)  $sp^3$

The molecule  $AB_3$  must be trigonal planar for which  $\mu = 0$ .  
Hence its hybrid state is  $sp^2$

Ans :1)

**30) According to MOT, the species  $O_2^+$  possesses**

**1) Bond order of 2.5**

**2) three unpaired electrons**

**3) diamagnetic character**

**4) stability lower than  $O_2$**

**Ans : 1)**



31) The two atoms X and Y lie at the top of group 2 and group 16 respectively. On combination, they form compound of the type



Both X and Y are bivalent. Hence the compound is XY.

Ans : 2)

**32) Which of the following pairs of compound will not form hydrogen bonds with each other?**

**1) Ethanol-methanol**

**2) Ethanol – water**

**3) Chloroform – acetone**

**4) Carbon tetrachloride-acetone**

$\text{CCl}_4$  and  $(\text{CH}_3)_2\text{C}=\text{O}$  will not form H – bonds with each other due to larger size of Cl atom.

**Ans : 4)**

**33) Which one among the following has highest bond order according to MO theory ?**

1)  $O_2$

2) CO

3)  $F_2$

4)  $Ne_2$

Bond order of  $O_2 = 2$ , CO = 3,  $F_2 = 1$  and  $Ne_2 = 0$

**Ans : 2)**

**34) Higher the bond order, greater is the**

- 1) Bond length**
- 2) Covalent character**
- 3) Bond dissociation energy**
- 4) paramagnetism**

**Ans : 3)**

35) The configuration  $KK (\sigma_{2s})^2 (\sigma_{2s}^*)^2 (\pi_{2px})^1 = (\pi_{2py})^1$  represents which of the following molecule ?

1)  $B_2$

2)  $C_2$

3)  $N_2$

4)  $Be_2$

The given configuration represents boron molecule

Ans : 1)

**36) Which of the following statement is correct ?**

- 1) Dihydrogen is paramagnetic**
- 2) Dinitrogen is diamagnetic**
- 3) Dioxygen is diamagnetic**
- 4) Dihelium is paramagnetic**

**N<sub>2</sub> molecule does not have any unpaired electrons**

**Ans : 2)**

**37) Helium molecule is monoatomic because**

- 1) No electrons are present in  $\sigma_{1s}$  and  $\sigma^*_{1s}$  orbital**
- 2) Two electrons are present in both  $\sigma_{1s}$  and  $\sigma^*_{1s}$  orbital**
- 3)  $\sigma_{1s}$  has 2 electrons and  $\sigma^*_{1s}$  has no electrons**
- 4)  $\sigma_{1s}$  has no electrons and  $\sigma^*_{1s}$  has 2 electrons**

**Ans : 2)**

**38) Molecular orbitals are different from atomic orbitals in that**

- 1) A molecular orbital is polycentric.**
- 2) A molecular orbital is monocentric**
- 3) A molecular orbital has higher energy**
- 4) A molecular orbital has lower energy**

In a MO the electrons are moving around all the nuclei where as the electrons are moving around a single nucleus in an atomic orbital

**Ans : 1)**



39) In carbon monoxide, the number of electrons in 2p anti bonding orbital is

1) 0

2) 1

3) 2

4) 3

$\text{KK}(\sigma_{2s})^2(\sigma_{2s}^*)^2(\pi_{2pz})^2(\pi_{2py})^2\sigma_{(2px)}^2$ . Hence no electrons are present in 2p antibonding MO

Ans : 1)

40) Which one of the following species is paramagnetic ?

1)  $C_2$

2) CO

3) NO

4)  $O_2^{2-}$

NO is paramagnetic due to presence of unpaired electrons

Ans : 3)

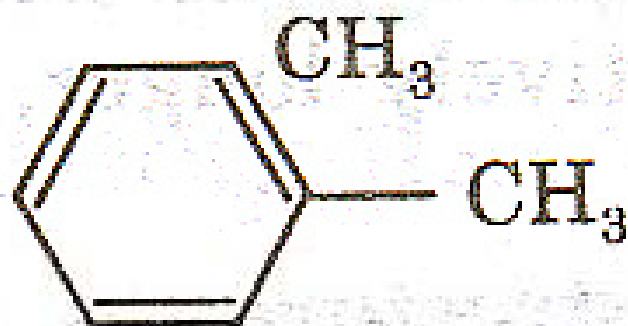
**41) The number of sigma and pi electrons in o-xylene are**

**1) 18, 6**

**2) 36, 6**

**3) 6, 36**

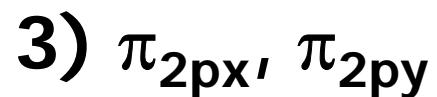
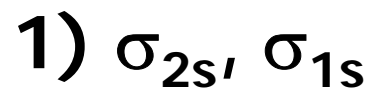
**4) 6, 18**



$\sigma$  bonds = 18.

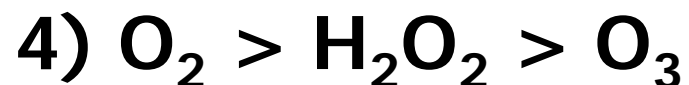
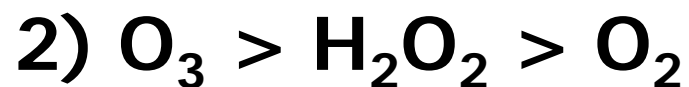
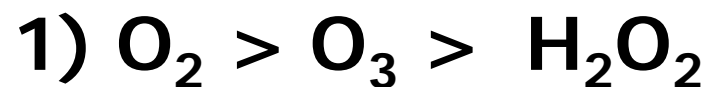
Ans : 2)

42) Which of the following pair contains a set of degenerate orbitals ?



Ans : 3)

43) The order of O–O bond length in  $O_2$ ,  $H_2O_2$  and  $O_3$  is



O – O bond length in  $H_2O_2 > O – O$  bond length in  $O_3 > O = O$  bond length in  $O_2$

Ans : 3)

**44)  $\text{AlCl}_3$  is covalent but  $\text{AlF}_3$  is ionic, this fact can be explained on the basis of**

**1) Fajan's rule**

**2) Octet rule**

**3) Electron affinity of halogen**

**4) molecular orbital theory**

According to Fajan's rule,  $\text{Al}^{+3}$  causes polarisation of large  $\text{Cl}^-$  ions but no polarisation occurs in  $\text{F}^-$  ions due to its relatively small size.

**Ans : 1)**

**45) According to molecular orbital theory, noble gases exist as monoatomic gases because their hypothetical diatomic molecules have**

- 1) No unpaired electrons**
- 2) Very high bond order**
- 3) Bond order zero**
- 4) Very low energy**

**Ans : 3)**



**46) Which of the following is not true about sigma bond ?**

**1) It involves axial overlap**

**2) It is non directional**

**3) Electron cloud has cylindrically symmetry about inter nuclear axis**

**4) It can be formed by hybrid orbitals as well as pure atomic orbitals**

Covalent bond is directional due to this they have definite geometry.

**Ans : 2)**

**47) The number of unpaired electrons in a paramagnetic diatomic molecule of an element with an atomic number 16 is**

**1) 3**

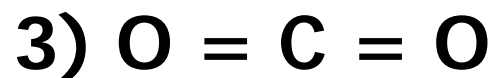
**2) 4**

**3) 1**

**4) 2**

**Ans : 4)**

48) In which of the following compound Carbon uses  $sp^2$  hybrid orbital for bonding ?



In Urea Carbon atom uses  $sp^2$  hybrid orbitals for bonding

Ans : 1)

**49) The half of the difference between the number of electrons in bonding and anti bonding Molecular orbitals of diatomic homo-nuclear molecule is called**

**1) Molecular order**

**2) Bond order**

**3) Bonding capacity**

**4) Electronic order**

$\frac{1}{2} (N_b - N_a) = \text{Bond order. This is according to MOT}$

**Ans : 2)**

**50) Which overlap would result the strongest bond ?**

**1) s-s**

**2) sp-sp**

**3) s-p**

**4) p-p**

Among the given overlaps, sp – sp overlap forms strongest sigma bonds. It is because hybrid orbitals affords stronger overlap as compare to pure atomic orbitals

**Ans : 2)**

**51) What is not true about the metallic crystal ?**

- I. There is a de-localised cloud of  $\pi$  - electrons**
- II. The position of metal kernels is fixed**
- III. Valence electrons of metal atoms are mobile**
- IV. The mobile electrons are essentially sigma electrons**

**1) I, IV**

**2) II, IV**

**3) III, IV**

**4) II, III**

**Ans : 1)**

**52) The total number of electrons that take part in forming bonds in nitrogen molecule are**

**1) 2**

**2) 4**

**3) 6**

**4) 10**

Three pair of electrons are shared between two nitrogen atoms

**Ans : 3)**

**53) Nucleus of an atom contains 17 protons, its maximum covalency should be**

**1) 1**

**2) 3**

**3) 5**

**4) 7**

The configuration should be  $1s^2 2s^2 2p^6 3s^2 3p^5$  . Its maximum covalency = (3s + 3p) electrons. ie.,  $2 + 5 = 7$

**Ans : 4)**



**54) In which of the following group of species, the hybrid state of Carbon is same ?**

**1)  $\text{CH}_4$ ,  $\text{C}_2\text{H}_2$  , Charcoal**

**2)  $\text{C}_2\text{H}_4$ , graphite,  $\text{CO}_2$**

**3)  $\text{CO}_2$ ,  $\text{C}_3\text{H}_8$ , diamond**

**4)  $\text{CH}_4$ , diamond,  $\text{C}_6\text{H}_{12}$**

**$\text{CH}_4$  , Diamond and cyclohexane have  $\text{sp}^3$  hybridisation.**

**Ans : 4)**

55) The decreasing values of bond angles from  $\text{NH}_3$  ( $107^\circ$ ) to  $\text{SbH}_3$  ( $101^\circ$ ) down group-15 of the periodic table is due to

a) Increasing bp-bp repulsion

b) Increasing p-orbital character in  $sp^3$

c) decreasing lp-lp repulsion

d) Decreasing electro negativity

Decreasing electronegativity down the group causes decrease in the repulsive interaction between bond pair around central atom

Ans : 4)

**56) Based on lattice energy and other consideration, which of the following alkali metal chloride is expected to have the highest melting point ?**

**1) RbCl**

**2) KCl**

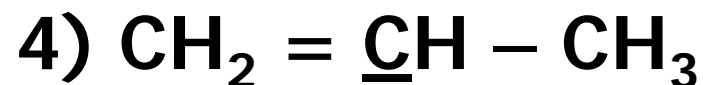
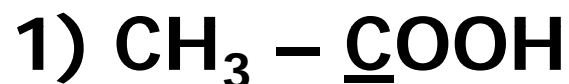
**3) NaCl**

**4) LiCl**

LiCl is largely covalent in character due to high polarisation of  $\text{Cl}^-$  ion. Among others, NaCl has smallest ionic size ( $\text{Na}^+$ ) and thus its lattice energy is maximum

**Ans : 3)**

57) In which of the following species the underlined carbon atom is  $sp^3$  hybridised?



Ans : 2)

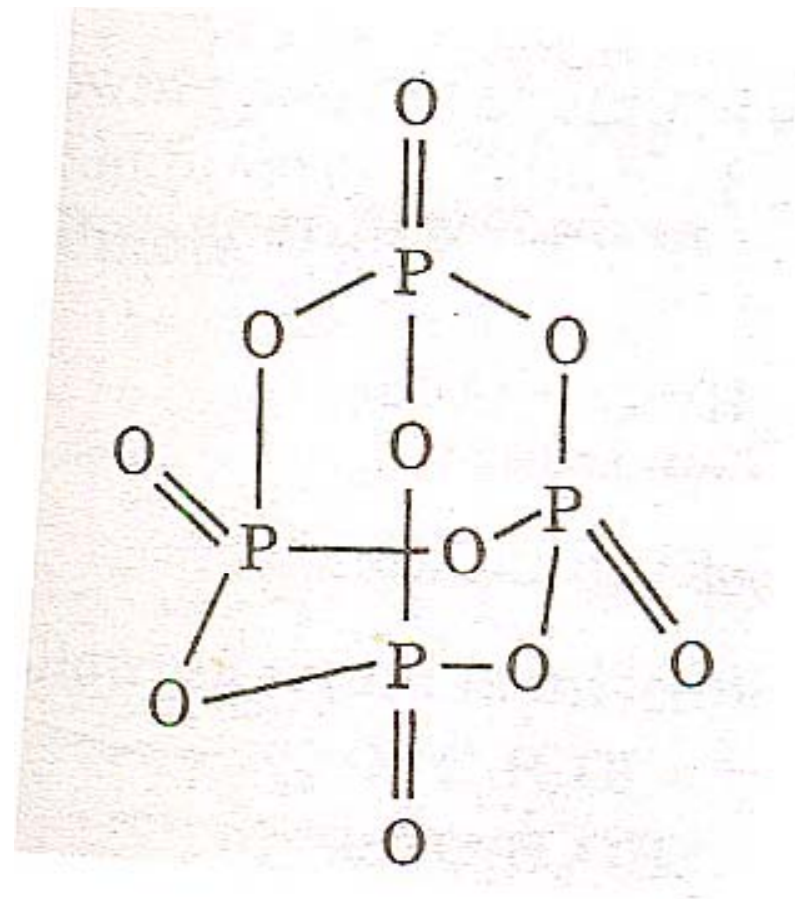
**58) Number of sigma bonds in  $P_4O_{10}$  is**

**1) 6**

**2) 7**

**3) 17**

**4) 16**



Ans : 4)

59) The maximum number of  $90^\circ$  angles between bond pair of electrons is observed in

- 1)  $sp^3 d^2$  hybridisation      2)  $sp^3d$ - hybridisation  
3)  $sp^3$  - hybridisation      4)  $dsp^2$  – hybridisation

$sp^3d^2$  hybridisation has maximum number of  $90^\circ$  angles i.e., 8

Ans : 1)

**60) The species having bond order different from that of CO is**

**1) NO<sup>-</sup>**

**2) NO<sup>+</sup>**

**3) CN<sup>-</sup>**

**4) N<sub>2</sub>**

**Ans : 1)**



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