



# CHEMISTRY

## BOOKS - MTG IIT JEE FOUNDATION

### CHEMICAL BONDING

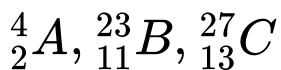
#### Illustrations

1. Name a noble gas which has less than 8 electrons in its valence shell. What is the atomic number of this gas?



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2. Which of the following elements would you expect to be stable and why?



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3. Name the cation and anion present in  $MgCl_2$  compound.



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4. What are the two pure factors on which the formation of ionic bond depends?



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5. Show the formation of  $\text{MgO}$  by the transfer of electrons.



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6. Arrange the following bonds in order of increasing ionic character giving reason.

N-H, F-H, C-H and O-H



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7. (a) Define the dipole moment with mathematical expression.

(b) Why is dipole moment of HF higher than that of HCl ?



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8. Which of the following molecule/molecules will not have zero dipole moment?

$CO_2$ ,  $H_2O$ ,  $BeF_2$ ,  $NH_3$



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9. Account for the following:

The structure of  $NH_3$  is pyramidal.



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10. On the basis of VSEPR theory, predict the shape of the following: (a)  $SF_4$  (b)  $XeF_2$



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11. Can a  $\pi$  – bond be formed without the formation of a  $\sigma$  – bond. How many  $\sigma$  – and  $\pi$  – bonds are formed in acetylene?



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12. What is the state of hybridisation of nitrogen in  $NH_4^+$  ion?



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13. Considering x-axis as the internuclear axis which of the following form sigma bond:

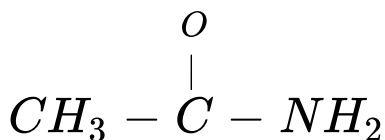
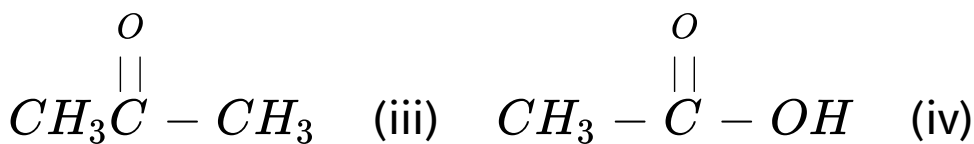
(i) 1s and 1s (ii) 1s and  $2p_x$

(iii)  $2p_y$  and  $2p_y$  (iv)  $2p_x$  and  $2p_y$



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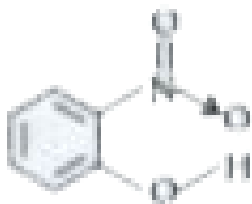
14. Which of the following substances exhibit bonding? Draw the hydrogen bonds between two molecules of the substance where appropriate : (i)  $CH_3CH_2OH$  (ii)



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15. Which of the above two compounds will show higher melting point?





(I)



(II)



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## Solved Examples

1. Draw Lewis dot structure of  $CO_3^{2-}$  ion and find the formal charge on each oxygen atom.



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2. What is the necessary condition for the formation of covalent bond between two atoms of an element to form a molecule?



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3. Sodium chloride is an ionic compound, while hydrogen chloride is a covalent compound. But, both form ions in their aqueous solutions. Explain how it happens.



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4. (a) Show the formation of  $Na_2O$  and  $MgO$  by the transfer of electrons.

(b) What are the ions present in these compounds?



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5. Answer the following:

(a) Define lattice enthalpy.

(b) What are the important consequences of lattice enthalpy?



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6. Give Lewis structures and formulae for the ionic compounds formed between the following pairs of elements:

(i) Ba, Cl (ii) Na, S (iii) Mg, F (iv) Na, P



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7. Why is sigma bond stronger than  $\pi$  -bond?



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8. Why do ionic compounds have high melting points?



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9. An element has the electronic configuration (2,8, 7). Write down the electronic

configuration of an element:

(a) Which forms an ionic compound with it.

(b) Which forms a covalent compound with it.



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**10.** Distinguish between ionic and covalent compounds.



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[Exercise Multiple Choice Questions](#)

1. The electrons in a non-polar covalent bond are

A. gained

B. lost

C. shared equally

D. shared unequally

**Answer: C**



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2. What is the charge on the ions formed by the alkaline earth metals?

A. + 1

B. + 2

C. - 1

D. - 2

**Answer: B**



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3. What is the most correct name for the ionic compound formed by  $Fe^{2+}$  and  $Cl^{-}$  ?

- A. Iron chloride
- B. Iron (I) chloride
- C. Iron (II) chloride
- D. Iron (III) chloride

**Answer: C**



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4. What type of bonds are formed in  $N_2O_4$  and what is the name of this compound?

A. Covalent, dinitrogen tetraoxide

B. Covalent, nitrogen tetraoxide

C. Ionic, nitrogen oxide

D. Ionic, dinitrogen oxide

**Answer: A**



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5. The bond between hydrogen and chlorine would be

A. not formed

B. ionic

C. polar covalent

D. non-polar covalent

**Answer: C**



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6. What is the formula for the ion which has 17 protons and 18 electrons?

A. Cl

B.  $Cl^{-}$

C.  $Ar^{+}$

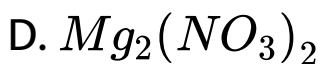
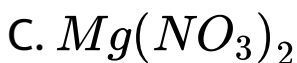
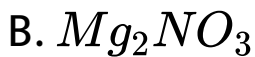
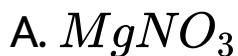
D.  $Ar^{-}$

**Answer: B**



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7. Ionic compounds may contain polyatomic ions, which consists of groups of atoms having an electrical charge. An example is magnesium nitrate. The formula of magnesium nitrate is



**Answer: C**



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8. How many electrons are gained/lost by magnesium and what is the charge on the ion that it forms?

A. Loses 2 electrons to form a magnesium ion with a 2- charge

B. Gains 2 electrons to form a magnesium ion with a 2- charge

C. Loses 2 electrons to form a magnesium ion with a 2+ charge

D. Gains 2 electrons to form a magnesium ion with a 2+ charge

**Answer: C**



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**9. The valency of carbon is**

A. 2

B. 4

C. 6

D. 8

**Answer: B**



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**10.** Which one of the following statements about positive ions is incorrect?

A. They are also known as cations.

B. They are formed when electrons are removed from atoms.



C. They are larger than the atom from which they were formed.

D. They are smaller than the atom from which they were formed.

**Answer: C**



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**11.** Which one of the following statements about negative ions is incorrect?

A. They are also known as anions.

B. They are formed when atoms gain electrons.

C. They are larger than the atom from which they were formed.

D. They are smaller than the atom from which they were formed.

**Answer: D**



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12. Which one of the following pairs, atoms is most likely to form an ionic bond?

A. Na and Cl

B. C and F

C. N and F

D. O and F

**Answer: A**



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**13.** Which of the following statements about sodium chloride is incorrect?

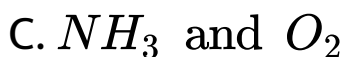
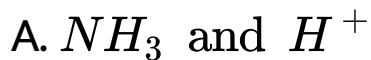
- A. It has high melting point
- B. It conducts electricity in molten state
- C. It is soluble in water.
- D. It is soluble in ether.

**Answer: D**



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14. Which of the following pair form a dative bond?



**Answer: A**



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15. Covalent bond is formed between the atoms of

A. metals

B. non-metals

C. metals and non-metals

D. metals and metalloids.

**Answer: B**



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**16.** Ions are formed from neutral atoms by

A. loss of electrons only

B. gain of electrons only

C. sharing of electrons

D. loss or gain of electrons

**Answer: D**



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17. The amount of enthalpy required to remove the most loosely bound electron from an isolated gaseous atom to form a positive ion is known as

A. ionization enthalpy

B. electron affinity

C. lattice enthalpy

D. electrolysis.

**Answer: A**



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18. Sideways overlap of  $p - p$  orbitals forms

- A. sigma-bond
- B. pi-bond
- C. coordinate bond
- D. H-bond

**Answer: B**



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19. Magnesium bromide is a (an) \_\_\_\_\_ compound.

A. metallic

B. covalent

C. ionic

D. dative

**Answer: C**



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**20.** Valency expresses

- A. total electrons in an atom
- B. atomicity of an element
- C. oxidation number of an element
- D. combining capacity of an element.

**Answer: D**



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21. The combination of atoms occur because they want

A. to decrease number of electrons in the outermost orbit

B. to attain inert gas configuration

C. to increase number of electrons in the outermost orbit

D. to attain 18 electrons in the outermost orbit.

**Answer: B**



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**22.** An electrovalent bond is formed between

A. two electronegative atoms

B. two metals

C. electropositive and electronegative  
atoms

D. two electropositive atoms

**Answer: C**



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**23.** Most favourable conditions for electrovalent bonding are

A. low ionization potential of one atom and

high electron affinity of the other atom

B. high electron affinity and high ionisation

potential of both the atoms

C. low electron affinity and low ionisation potential of both the atoms.

D. high ionisation potential of one atom and low electron affinity of the other atom.

**Answer: A**



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**24.** Hydrogen bonding is maximum in

A. ethanol

B. diethyl ether

C. ethyl chloride

D. triethyl amine.

**Answer: A**



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**25.** The electronegativity of cesium is 0.7 and that of fluorine is 4.0. The bond formed between the two is:



A. covalent

B. electrovalent

C. coordinate

D. metallic

**Answer: B**



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**26.** The electrovalent linkage is present in

A.  $O_2$  molecule

B.  $\text{CCl}_4$  molecule

C.  $\text{CHCl}_3$  molecule

D. NaBr molecule

**Answer: D**



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27. Lattice energy of an ionic compound

depedns upon :

A. charge on the ion only

B. size of the ion only

C. packing of the ion only

D. both charge and size of the ion

**Answer: D**



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**28.** In covalency

A. transfer of electrons takes place

B. one atom acts as donor and other acts  
as acceptor

C. the electrons are shared by only one  
atom

D. equal sharing of electrons takes place  
between two atoms.

**Answer: D**



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**29.** A covalent bond is formed between

A. similar atoms

B. dissimilar atoms

C. similar and dissimilar atoms

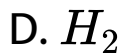
D. similar molecules.

**Answer: C**



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30. Multiple covalent bonds exist in a molecule of



**Answer: B**



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31. Which of the following statements is not true about covalent compounds?

A. They are soluble in organic solvents.

B. They have low melting and boiling points.

C. They show ionic reactions.

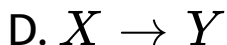
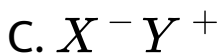
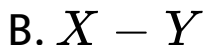
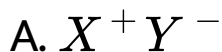
D. They show molecular reactions.

**Answer: C**



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32. Element  $X$  is strongly electropositive and element  $Y$  is strongly electronegative. Both are univalent. The compound formed would be



**Answer: A**



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33. The number of lone pair of electrons on the central atom of  $XeF_4$  molecule is

A. 1

B. 2

C. 3

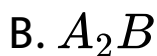
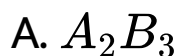
D. 4

**Answer: B**



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34. Element A has 2 electrons in the outermost orbit and element B has 6 electrons in the outermost shell. The formula of the compound formed between A and B would be

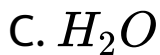


**Answer: D**



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35. Which of the following has the highest dipole moment?

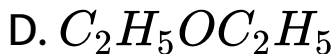
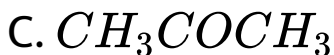
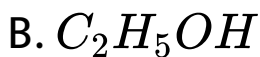
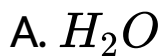


**Answer: C**



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36. In which solvent NaCl has maximum solubility?



**Answer: A**



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37. Lattice energy of  $BeCO_3(I)$ ,  $MgCO_3(II)$  and  $CaCO_3(III)$  is in order.

A.  $I < II < III$

B.  $I > II > III$

C.  $I < III < II$

D.  $II < I < III$

**Answer: B**



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**38.** Electronegativity values of elements help in predicting :

- A. strength of the element
- B. polarity of the molecules
- C. size of the molecules
- D. valency of the elements.

**Answer: B**



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**39.** The pair of elements that would likely to form an ionic bond is

A. K, Br

B. C, H

C. K, Ar

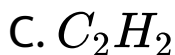
D. K, K

**Answer: A**



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40. Which of the following compounds has a linear structure?



**Answer: C**



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41. The hybridisation of carbons involved in C-C single bond in  $CH \equiv C - CH = CH_2$  is

A.  $sp^3 - sp^2$

B.  $sp^3 - sp^3$

C.  $sp - sp^2$

D.  $sp - sp^3$

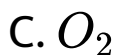
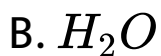
**Answer: C**



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42. The octet rule is not valid for the molecule

.



**Answer: D**



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**43.** How is the bond in  $F_2$  different from the bond in KCl?

A.  $F_2$  is covalent and KCl is ionic.

B.  $F_2$  is polar covalent and KCl is non-polar covalent.

C.  $F_2$  is ionic and KCl is covalent.

D.  $F_2$  is ionic and KCl is non-polar covalent.

**Answer: A**



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44. When a Cl atom gains an electron, it gets a charge of

A.  $-1$

B.  $+1$

C.  $0$

D.  $+2$

**Answer: A**



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45. An ionic bond is formed between two atoms if the sum of their lattice enthalpy and electron gain enthalpy is greater than

A. ionization enthalpy

B. electron affinity

C. electronegativity

D. resonance energy

**Answer: A**



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**46.** When electrons are contributed by one atom but shared by both the atoms so as to complete their octets, the bond formed is called

A. covalent bond

B. ionic bond

C. dative bond

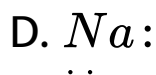
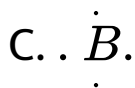
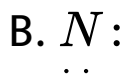
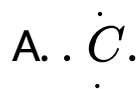
D. both (a) and (b)

**Answer: C**



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47. Identify the correct Lewis symbol from the following



**Answer: A**



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**48.** The total number of electrons that take part in forming bond in  $O_2$  is

A. 2

B. 3

C. 4

D. 5

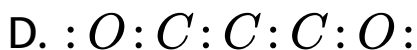
**Answer: C**



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49. Carbon suboxide ( $C_3O_2$ ) has recently been shown as a component of the atmosphere of Venus. Which of the following formulations represents the correct ground state Lewis structure of carbon suboxide?



**Answer: C**





50. Which of the following statements is incorrect?

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

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

C. pi bond is strong bond.

D. pi bond does not affect the shape of the molecule.

**Answer: C**



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**Exercise Match The Following**

1. Match the following columns

List-I	List-II
(P) Ionic compound	1. $N_2$
(Q) Covalent compound	2. HF
(R) Polar covalent compound	3. $O_3$
(S) Coordinate compound	4. $MgCl_2$

A.  $P - 4, Q - 1, 2, R - 2, S - 3$

B.  $P - 1, Q - 4, R - 2, S - 3$

C.  $P - 3, Q - 2, R - 1, 2, S - 4$

D.  $P - 4, Q - 3, R - 4, S - 1, 2$

**Answer: A**



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- | List-I                              | List-II               |
|-------------------------------------|-----------------------|
| (P) High melting and boiling points | 1. Covalent compounds |
| (Q) Soluble in organic solvents     | 2. Ionic compounds    |
| (R) $\text{Na}^+$                   | 3. 2, 8, 8            |
| 2. (S) $\text{Cl}^-$                | 4. 2, 8               |

A.  $P - 1, Q - 3, R - 2, S - 4$

B.  $P - 2, Q - 1, R - 4, S - 3$

C.  $P - 3, Q - 4, R - 2, S - 1$

D.  $P - 4, Q - 3, R - 1, S - 2$

**Answer: B**



3. Match the following columns

**List-I**

- (P) KCl
- (Q)  $\text{CCl}_4$
- (R) Cation
- (S) Anion

**List-II**

- 1. Positively charged
- 2. Negatively charged
- 3. Soluble in water
- 4. Insoluble in water

A.  $P - 3, Q - 4, R - 1, S - 2$

B.  $P - 2, Q - 4, R - 1, S - 3$

C.  $P - 4, Q - 3, R - 2, S - 1$

D.  $P - 1, Q - 2, R - 3, S - 4$

**Answer: A**



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**4. Match the following columns**

**List-I**

(P)  $N_2$

(Q)  $C_2H_2$

(R)  $C_2H_4$

(S)  $O_2$

**List-II**

1. 2 single and 1 triple bond

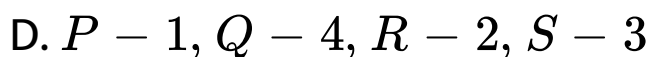
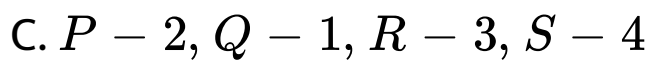
2. only triple bond

3. 4 single and 1 double bond

4. only double bond

A.  $P - 1, Q - 2, R - 4, S - 3$

B.  $P - 2, Q - 1, R - 4, S - 3$



**Answer: C**



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5. Match the following columns

**List-I**

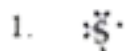
(P) Lewis dot symbol for S

(Q) Lewis dot symbol for  $S^{2-}$

(R) Lewis dot symbol for Al

(S) Lewis dot symbol for  $Al^{3+}$

**List-II**





A.  $P - 3, Q - 1, R - 2, S - 4$

B.  $P - 1, Q - 3, R - 4, S - 2$

C.  $P - 3, Q - 1, R - 4, S - 2$

D.  $P - 1, Q - 3, R - 2, S - 4$

**Answer: D**



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**Exercise Assertion Reason Type**

1. Assertion : Generally, covalent compounds are gases, liquids or soft solids at room temperature.

Reason : Between covalent compounds weak forces of attraction exist.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of

assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

**Answer: A**



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2. Assertion : Ionic compounds are good conductors of electricity in molten state.

Reason : In ionic compounds mobile electrons exists.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

**Answer: C**



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**3. Assertion :** Ionic compounds are usually soluble in water.

**Reason :** Ionic compounds dissolve in water because water has a high dielectric constant.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of

assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

**Answer: A**



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**4. Assertion :** Octet rule is based upon the chemical inertness of noble gases.

**Reason :** Octet rule can explain the shape and relative stability of the molecule.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

**Answer: C**



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5. Assertion : Ionic compounds have high melting and boiling points.

Reason : In ionic compounds, there are strong forces of attraction between oppositely charged ions.

A. If both assertion and reason are true and reason is the correct explanation of assertion.



B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

**Answer: A**



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6. Assertion :The crystal structure gets stabilized even though the sum of electron gain enthalpy and ionization enthalpy is positive.

Reason : Energy is absorbed during the formation of crystal lattice

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

**Answer: C**



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7. Assertion : In change from  $PCl_3 \rightarrow PCl_5$  ,  
the hybridisation state of P changes.

Reason : d-orbitals are not available for P to  
expand its octet.

A. If both assertion and reason are true  
and reason is the correct explanation of  
assertion.

B. If both assertion and reason are true but  
reason is not the correct explanation of  
assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

**Answer: C**



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**8. Assertion :** The dipole moment in case of  $BeF_2$  is zero.

**Reason :** The two equal bond dipoles point in opposite directions and cancel the effect of each other.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

**Answer: A**



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**9. Assertion :** Value of lattice energy depends on charge and size of ions.

**Reason :** As lattice energy increases, stability of ionic compounds increases.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of

assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

**Answer: B**



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**10.** Assertion : An ion is stable as it possess minimum state of energy.

Reason : The valence shell of an ion has a and duplet or octet configuration.



A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

**Answer: A**



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## Exercise Comprehension Type

1. The compounds containing ionic bonds are known as ionic compounds. They are formed by the transfer of electrons from one atom to another. The ionic compounds are made up of positively charged ions (cations) and negatively charged ions (anions).

Ionic compounds are made up of

A. positively charged ions.

B. negatively charged ions.

C. oppositely charged ions.

D. molecules.

**Answer: C**



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2. The compounds containing ionic bonds are known as ionic compounds. They are formed by the transfer of electrons from one atom to another. The ionic compounds are made up of

positively charged ions (cations) and negatively charged ions (anions).

Cations and anions present in sodium hydroxide are



**Answer: C**



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3. The compounds containing ionic bonds are known as ionic compounds. They are formed by the transfer of electrons from one atom to another. The ionic compounds are made up of positively charged ions (cations) and negatively charged ions (anions).

Which one of the following is an ionic compound?



C.  $KCl$

D.  $CO_2$

**Answer: C**



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4. When a covalent bond is formed between two similar atoms, the shared pair of electrons is equally attracted by the two atoms. As a result of this, the electron pair is situated exactly in between two identical nuclei. The

bond is known as non-polar covalent bond. On the other hand, if the atoms forming bonds are different, the electron attracting powers of the two atoms in a bond may differ. Consequently, the shared pair will be displaced towards the atom having more electronegativity.

Which one of the following is a polar covalent compound?

A. HCl

B.  $H_2$

C.  $O_2$

D. both (b) and (c)

**Answer: A**



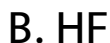
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5. When a covalent bond is formed between two similar atoms, the shared pair of electrons is equally attracted by the two atoms. As a result of this, the electron pair is situated exactly in between two identical nuclei. The bond is known as non-polar covalent bond. On



the other hand, if the atoms forming bonds are different, the electron attracting powers of the two atoms in a bond may differ. Consequently, the shared pair will be displaced towards the atom having more electronegativity.

Which one of the following is a non-polar covalent compound?



D. *HI*

**Answer: C**



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6. When a covalent bond is formed between two similar atoms, the shared pair of electrons is equally attracted by the two atoms. As a result of this, the electron pair is situated exactly in between two identical nuclei. The bond is known as non-polar covalent bond. On

the other hand, if the atoms forming bonds are different, the electron attracting powers of the two atoms in a bond may differ. Consequently, the shared pair will be displaced towards the atom having more electronegativity.

Covalency of carbon in  $CO_2$  is

A. 1

B. 6

C. 4

D. 3

**Answer: C**

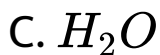


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7. Sidgwick proposed that an atom contributes both the electrons for mutual sharing and that electron pair is shared by the two atoms. Such a covalent bond is called coordinate covalent bond or dative bond. The atom or ion or molecule, which donates the electron pair, is called donor. The atom or ion or molecule, which accepts the electron pair, is called

acceptor.

Molecule in which coordinate bond is present is



D. both (a) and (b)

**Answer: D**



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8. Sidgwick proposed that an atom contributes both the electrons for mutual sharing and that electron pair is shared by the two atoms. Such a covalent bond is called coordinate covalent bond or dative bond. The atom or ion or molecule, which donates the electron pair, is called donor. The atom or ion or molecule, which accepts the electron pair, is called acceptor.

Coordinate bond is represented by arrow pointing from

A. acceptor to donor atom

B. donor to acceptor atom

C. neutral to charged atom

D. none of these.

**Answer: B**



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9. Sidgwick proposed that an atom contributes both the electrons for mutual sharing and that electron pair is shared by the two atoms. Such a covalent bond is called coordinate

covalent bond or dative bond. The atom or ion or molecule, which donates the electron pair, is called donor. The atom or ion or molecule, which accepts the electron pair, is called acceptor.

The melting and boiling points of coordinate compound are \_\_\_\_ ionic compounds and covalent compound.

A. in between

B. higher than

C. lower than



D. equal to

**Answer: A**



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## Exercise Integer Numerical Value Type

1. The number of electrons present in 'L' shell of neon is



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2. The total number of covalent bonds present in methane is



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3. The number of electrons present in outermost shell of halogen is



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4. Number of lone electron pairs around central atom in  $BrF_5$  is



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5. The number of electrons sulphur require to acquire octet structure is



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