9. CHEMICAL BONDING - III

COVALENT BOND FORMATION AND PROPERTIES
SOLUTIONS
TEACHING TASK

JEE MAIN LEVEL QUESTION

1. Which of the following statements best describes the formation of a covalent bond?

a) Transfer of electrons from one atom to another
b) Sharing of electrons between atoms
c) Donation of electrons from one atom to another
d) Exchange of protons between atoms

Answer:B

Solution:

Covalent bonds involve the sharing of electrons between atoms

2. In a covalent bond, electrons are shared between atoms to:

a) Achieve a complete octet **b) Achieve a complete valence shell**
c) Achieve a negative charge **d) Achieve a positive charge**

Answer:B

Solution:

Atoms share electrons to achieve a complete valence shell (octet for most atoms)

3. Which of the following has a tendency to form covalent compounds

1. Ba **2. Be** **3. Na** **4. Ca**

Answer:2

Solution:

Be (Beryllium) has a small size and high charge density, leading to high polarizing power and covalent character (e.g., $BeCl_2$ is covalent).

4. Which of the following pairs of elements is most likely to form a covalent bond?

a) Sodium and chlorine **b) Lithium and fluorine**
c) Carbon and hydrogen **d) Magnesium and oxygen**

Answer:C

Solution:

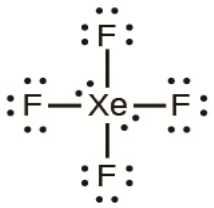
Covalent bonds form between nonmetals with similar electronegativities.

a) Sodium and chlorine (ionic)

b) Lithium and fluorine (ionic)

c) Carbon and hydrogen (covalent, both nonmetals)

d) Magnesium and oxygen (ionic)

5.  **What is the formal charge for each of the Fluorine atoms**

1. -1 **2. +1** **3. 0** **4. +2**

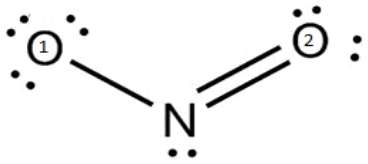
Answer:3

Solution:

FC=Valence electrons-(Nonbonding electrons+1/2×Bonding electrons)

For F in XeF4:

FC=7-6-1/2(2)=0

6.  **Calculate the Formal Charge for the Oxygen Labeled 1**

1. -1 **2. +1** **3. 0** **4. -2**

Answer:1

Solution:

FC=Valence electrons-(Nonbonding electrons+1/2×Bonding electrons)

Formal Charge for the Oxygen Labeled 1

FC=6-6-1/2(2)=-1

7. In the molecule NH_4^+, what is the formal charge on the nitrogen atom?

a) +1 **b) -1** **c) 0** **d) +2**

Answer:A

Solution:

Nitrogen valence = 5

In NH_4^+, N has 4 bonds (so 8 bonding electrons $\rightarrow$ 8/2 = 4) and no lone pairs.

Formal charge = 5 - 0 - 4 = +1

8. What is the formal charge on the sulfur atom in the molecule H_2SO_3?

a) +1 **b) -1** **c) 0** **d) +2**

Answer:C

Solution:

Structure: H-O-S(=O)-O-H (S has one double bond to O, two single bonds to O, and one lone pair).

Sulfur valence = 6

Bonding: 3 bonds (2 single + 1 double $\rightarrow$equivalent to 4 bonds) $\rightarrow$ bonding electrons = 8 $\rightarrow$ 8/2 = 4

Lone pairs: 1 (2 electrons)
Formal charge = 6 - 2 - 4 = 0

9. Molecule which contains only bonded pairs of electrons on the central atom is

1. H_2O 2. NH_3 3. $BeCl_2$ 4. BrF_3

Answer:3

Solution:

$BeCl_2$ (beryllium chloride) has no lone pairs on Be (linear, sp hybridized).
H_2O has 2 lone pairs on O, NH_3 has 1 lone pair on N, BrF_3 has 2 lone pairs on Br.

10. The number of electron pairs involved in the formation of hydrogen cyanide molecule are

1. two 2. eight 3. three 4. four

Answer:4

Solution:

HCN: H–$C \equiv N$

Total bonds: 1 single (C–H) + 1 triple ($C \equiv N$) $\rightarrow$ 4 bonds $\rightarrow$ 4 electron pairs.

11. Compound having maximum number of bonded pairs of electrons in its molecule is

1. Ethane 2. Ammonia
3. Sulphur hexafluoride 4.Bromine Pentafluoride

Answer:1

Solution:

Ethane (C_2H_6): 7 bonds (6 C–H + 1 C–C) $\rightarrow$ 7 bonded pairs.
Ammonia (NH_3): 3 bonded pairs.
SF_6: 6 bonded pairs.
BrF_5: 5 bonded pairs.

12. The number of electron pairs present in the valency shell of central atom in SF_6 molecule are

1. 4 2. 6 3. 8 4. 7

Answer:2

Solution:S in SF_6 has 6 bonds $\rightarrow$ 6 electron pairs (all bonded, no lone pairs).

13. Molecule having maximum number of lone pairs of electrons on central atom is

1. PH_3 2. H_2S 3. CH_4 4. BrF_5

Answer:2

Solution:

PH_3: P has 1 lone pair.
H_2S: S has 2 lone pairs.
CH_4: C has 0 lone pairs.
BrF_5: Br has 1 lone pair.

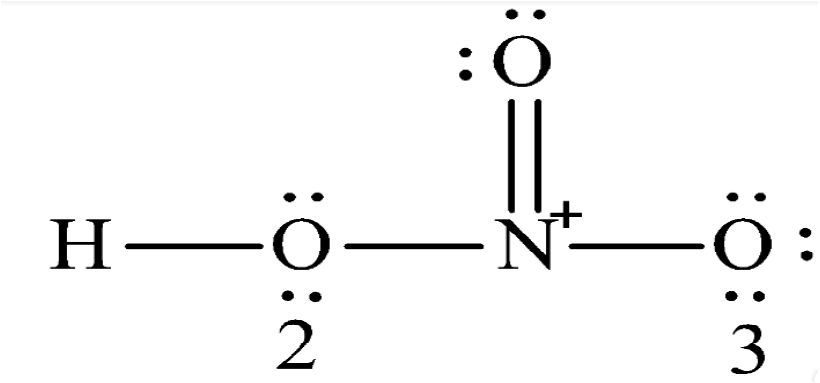
14. Number of bonded pairs and lone pairs of electrons present in the central atom of ammonia molecule are

1. 3,1 2. 2,2 3. 1,3 4. 4,0

Answer:1
Solution:N has 3 bonds and 1 lone pair.

15. The Lewis structure of HNO_3 shows formal charges of:
A) Hydrogen: +1, Nitrogen: +1, Oxygen: -1
B) Hydrogen: +1, Nitrogen: +2, Oxygen: -1
C) Hydrogen: +1, Nitrogen: 0, Oxygen: -1
D) Hydrogen: 0, Nitrogen: +1, Oxygen: -1
Answer:D

Solution: $FC = ValenceElectrons - No.OfnonbondingElectrons - \frac{No.ofbondingElectrons}{2}$



Formal charge on oxygen (1) is 6-4-2=0
Formal charge on oxygen (2) is 6-4-2=0
Formal charge on oxygen (3) is 6-6-1=-1
Formal charge on nitrogen is 5-0-4=+1
Formal charge on hydrogen is 1-0-1=0

JEE ADVANCED LEVEL QUESTIONS

MULTI CORRECT ANSWERS

1. Which of the following are correct about covalent bond?
1. It is formed by sharing of the electrons
2. It is stronger than ionic bond
3. Its study was done by Kossel
4. When two non-metals are combined, then a covalent bond is formed
Answer:1,4
Solution:
1. It is formed by sharing of the electrons $\rightarrow$ (True)
2. It is stronger than ionic bond $\rightarrow$ (Not always; some covalent bonds are strong, but ionic bonds can be strong too, e.g., in NaCl. It depends on the specific compounds.)
3. Its study was done by Kossel $\rightarrow$ (Kossel contributed to ionic bond theory; Lewis developed covalent bond theory.)
4. When two non-metals are combined, then a covalent bond is formed $\rightarrow$ (True)

2. Which of the following are correct?

1. The bond formed between two non-metallic elements is covalent bond.

2. The bond formed between two inert gas elements is van der Wall's bond.

3. The bond formed between a metal and a non-metal is electrovalent bond.

4. The bond formed between two metallic elements is an ionic bond.

Answer:1,2,3

Solution:

1. The bond formed between two non-metallic elements is covalent bond. → (True)

2. The bond formed between two inert gas elements is van der Wall's bond. → (Inert gases form weak van der Waals bonds due to temporary dipoles.)

3. The bond formed between a metal and a non-metal is electrovalent bond. → (True, ionic bond.)

4. The bond formed between two metallic elements is an ionic bond. → (Metallic bonds form between metals, not ionic.)

REASON AND ASSERTION TYPE

A) Both (A) and (R) are true and (R) is the correct explanation of(A)

B) Both (A) and (R) are ture and (R) is not the correct explanation of (A)

C) (A) is true but (R) is false D) (A) is false but (R) is true

3. Assertion: In a covalent bond, the shared pair of electrons is attracted by both nuclei.

Reason: This sharing of electrons leads to the formation of a stable bond be tween the atoms.

Answer:A

Solution:

(A) is true: The shared electrons are attracted to both nuclei, forming the bond.

(R) is true: Sharing electrons allows both atoms to achieve stability (e.g., octet).

(R) correctly explains (A): The mutual attraction stabilizes the bond.

4. Assertion: Covalent bonds are typically formed between non-metallic elements.

Reason: Non-metallic elements have high electronegativity, facilitating the sharing of electrons.

Answer:A

Solution:(A) is true: Nonmetals share electrons to form covalent bonds.

(R) is true: High electronegativity (similar values) promotes sharing rather than transfer.

(R) correctly explains (A): Similar electronegativity leads to covalent bonding.

5. Assertion: Carbon atoms can form multiple covalent bonds with other atoms.

Reason: Carbon has four valence electrons, allowing it to form multiple bonds and achieve a stable electron configuration.

Answer:A

Solution:(A) is true: Carbon forms single, double, and triple bonds.

(R) is true: With 4 valence electrons, carbon can share to achieve an octet.

(R) correctly explains (A): The valence electron count enables multiple bonding.

6. Assertion: In polar covalent bonds, electrons are equally shared between atoms.

Reason: Polar covalent bonds involve unequal sharing of electrons due to differences in electronegativity between atoms.

Answer:D

Solution:(A) is false: In polar covalent bonds, electrons are unequally shared.

(R) is true: Electronegativity difference causes unequal sharing.

7. Assertion: Covalent compounds generally have low melting and boiling points.

Reason: Covalent compounds consist of discrete molecules held together by weak intermolecular forces.

Answer:A

Solution:(A) is true: Covalent molecular compounds have low m.p./b.p.

(R) is true: Weak forces (e.g., van der Waals) require less energy to break.

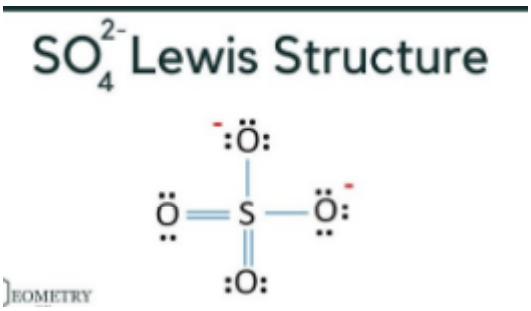
(R) correctly explains (A): Weak intermolecular forces lead to low melting/boil ing points.

8. Assertion: In the sulfate ion SO_4^{2-}, the formal charge on each oxygen atom is -1.

Reason: Oxygen atoms in the sulfate ion each have six valence electrons and are surrounded by four bonds and no lone pairs.

Answer:D(both incorrect)

Solution:



$$FC = ValenceElectrons - No.OfnonbondingElectrons - \frac{No.ofbondingElectrons}{2}$$

FC of Sulphur=6-0-6=0
FC of Oxygen having Double Bond=6-4-2=0
FC of Oxygen having single Bond=6-6-1=-1
(A) is false: In SO_4^{2-}, two O atoms have formal charge -1 (single bonds with lone pairs), and two O atoms have formal charge 0 (double bonds).
(R) is false: Oxygen atoms in SO_4^{2-} have either:
2 bonds + 2 lone pairs (formal charge 0) or
1 bond +3 lone pairs (formal charge -1)

9. Assertion: Formal charge is a measure of the charge assigned to an atom in a molecule.

Reason: It is calculated by the difference between the number of valence electrons of an atom and the number of electrons assigned to it in the Lewis structure.

Answer:A

Solution:(A) is true: Formal charge estimates charge distribution.

(R) is true: Formula: FC = valence e^- - (lone pairs + bonds/2).

(R) correctly explains (A): The calculation defines the formal charge.

STATEMENT TYPE

1) Statement-I, Statement-II both are true
2) Statement-I, Statement-II both are false
3) Statement-I is true, Statement-II is false.
4) Statement-I is false, Statement-II is true.

10. Statement I:The covalent bond between a pair of two atoms is represented by a small line (–).
Statement II : G.N.Lewis explained covalent bond foundation by the electron dot structure.

Answer:1

Solution:Statement I is true: A single line represents a covalent bond (e.g., H–H).

Statement II is true: Gilbert N. Lewis introduced the electron dot (Lewis) struc tures to explain covalent bonding.

Both are true, and Statement II supports Statement I.

11. Statement-I : BeF_2 is predominantly a covalent compound.

Statement-II: Electronegativity difference between Be and F is too small

Answer:3

Solution:Statement-I is true, and Statement-II is false. While BeF2 is predominantly covalent due to the high polarizing power of the small, highly charged Be^{2+} ion, the electronegativity difference between Be and F is not small enough to be considered the reason for its covalent nature

12. Statement-I : In H_2 molecule one electron pair is shared between two H- atoms

Statement-II :Hydrogen atom requires one electron to acquire the stable electronic cofiguration of helium

Answer:1

Solution:Statement I is true: H_2 has a single covalent bond (one shared pair).

Statement II is true: Each H atom has 1 electron; sharing gives each H_2 elec trons (like He).

COMPREHENSION TYPE

The number of covalent bonds in which an atom involves is equal to the number unpaired electrons present in it. Pure covalent bond is formed by the sharing of electron pairs between two like atoms having same electro negativity value. Polar covalent bond is formed by the mutual sharing of electron pairs between two dissimilar atoms having different electro negativity value.

13. Among the following the molecules having polar covalent bond is

1.H_2 2.F_2 3.N_2 4.HF

Answer:4

Solution:1. H_2: Nonpolar (identical atoms, equal sharing).

2. F_2: Nonpolar (identical atoms, equal sharing).

3. N_2: Nonpolar (identical atoms, equal sharing).

4. HF: Polar (H and F have different electronegativities, ΔEN = 1.78, so unequal sharing).

14. Among the following the non polar molecule is

1.BCl_3 2.Cl_2 3.KF 4.H_2O

Answer:1,2

Solution:BCl_3 $\rightarrow$non-polar molecule (though B–Cl bonds are polar, the trigonal planar geometry cancels the dipoles).

Cl_2 $\rightarrow$ non-polar molecule (same atoms, no polarity).

KF $\rightarrow$ ionic compound, not covalent (so not "non-polar molecule").

H_2O $\rightarrow$ polar molecule (bent geometry, net dipole).

So non-polar molecules = BCl_3 and Cl_2

MATRIX MATCH TYPE

15.

List-I	**List-II**
A) Pure covalent bond	**1) Lone pair**
B) Polar covalent bond	**2) H_2**
C) multiple bonds	**3) HCl**
D) co-ordinate covalent bonds	**4) Double and triple bonds**
	5) Lewis

Answer:A-2,B-3,C-4,D-1,5

Solution:

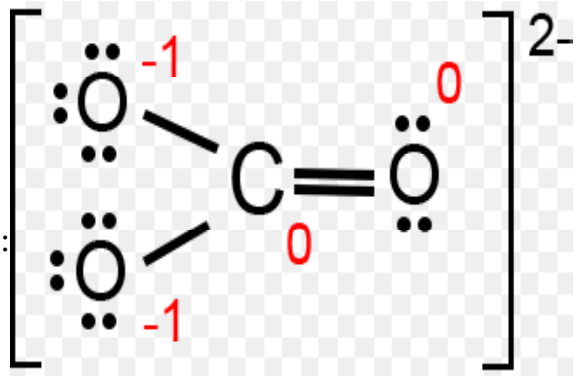
A) Pure covalent bond	2) H_2
B) Polar covalent bond	3) HCl
C) multiple bonds	4) Double and triple bonds
D) co-ordinate covalent bonds	1) Lone pair
	5) Lewis

INTEGER TYPE

16. In the molecule CO_3^{2-}, determine the formal charge on each oxygen atom.

Answer:0,-1

Solution:



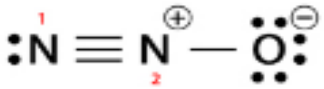
FC for Carbon=4-0-4=0

FC for single bonded Oxygen=6-6-1=-1

FC for double bonded Oxygen=6-4-2=0

17. Calculate the total formal charge on the phosphorus atom in the molecule PF_5.
Answer:0
Solution:FC of P=5-0-5=0

18. Determine the formal charge on each nitrogen atom in the molecule N_2O.
Answer:0,1

Solution: 

FC of N1=5-2-3=0
FC of N2=5-0-4=1
FC of O=6-6-1=-1

LEARNER'S TASK
CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ'S)

1. The compound having least covalent nature is
1. $AlCl_3$ 2. $MgCl_2$ 3. NaCl 4. KCl
Answer:4
Solution:Covalent character decreases with larger cation size and smaller anion size.
NaCl and KCl are ionic; KCl has larger K^+ ion, so more ionic than NaCl.
But among options, KCl has the least covalent nature.

2. Maximum covalent nature can be seen in
1. CsCl 2. RbI 3. MgF_2 4. LiI
Answer:4
Solution:Covalent character increases with smaller cation and larger anion.
LiI has small Li^+ and large I^-, so highest covalent character.

3. Maximum covalency of nitrogen is
1. 4 2. 5 3. 3 4. 6
Answer:1
Solution:Nitrogen has 5 valence electrons; it can form 4 bonds (e.g., in NH_4^+) by using its lone pair

4. Only triple bond is present in
1. N_2O 2. CO_2 3. HCN 4. N_2
Answer:4
Solution:N_2 has a triple bond between two N atoms.

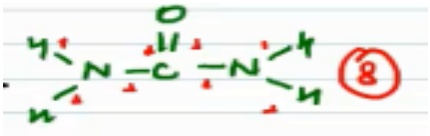
5. Pure covalent double bond is present in
1. acetylene 2. carbon dioxide 3. ethylene 4. Ethane
Answer:3
Solution:Ethylene (C_2H_4) has a pure C=C double bond (same electronegativity).
Acetylene has triple bond, CO_2 has polar double bonds, ethane has single bonds.

6. Molecule having maximum number of covalent bonds is

1. NH_4OH 2. NH_4Cl 3. $CO[NH_2]_2$ 4. CH_3OH

Answer:3

Solution:$CO(NH_2)_2$ (urea) has 8 covalent bonds



7. The molecule which contains maximum number of electrons is

1. CH_4 2. CO_2 3. NO_2 4. N_2O

Answer:3

Solution:CH_4: 6 + 4 = 10 electrons

CO_2: 6 + 8 + 8 = 22 electrons

NO_2: 7 + 8 + 8 = 23 electrons

N_2O: 7 + 7 + 8 = 22 electrons

8. Among the following,molecules which have non-directional bonds is

1.NCl_3 2.RbCl 3.$Becl_2$ 4.BCl_3

Answer:2

Solution:Ionic bonds are non-directional. RbCl is ionic.

Others are covalent (directional).

9. Which of the following is a highly polar molecule

1. HCl 2. HF 3. H_2S 4. NH_3

Answer:2

Solution:HF has the highest electronegativity difference ($_{\Delta}$EN = 1.78) and is highly polar.

10. In which of the following molecule, the central atom has three lone pairs of electrons

1. Ammonia 2. Xenon difluoride

3. Chlorine trifluoride 4. Hydrogen sulphide

Answer:2

Solution:Xenon difluoride (XeF_2) has Xe with 3 lone pairs (linear shape).

Ammonia (N has 1 lone pair), ClF_3 (Cl has 2 lone pairs), H_2S (S has 2 lone pairs).

JEE MAINS LEVEL QUESTIONS

1. Which of the following best describes a covalent bond?

a) Transfer of electrons from one atom to another

b) Sharing of electrons between atoms

c) Exchange of ions between atoms

d) Donation of electrons from one atom to another

Answer:B

Solution:Covalent bonds involve the sharing of electrons between atoms.

2. In a covalent bond between two atoms, the bond length is determined by:

a) Electronegativity of the atoms b) Atomic radii of the atoms

c) Ionization energy of the atoms d) Nuclear charge of the atoms

Answer:B

Solution:Bond length is primarily determined by the sum of the atomic radii of the bonded atoms.

3. How many shared electron pairs are there in a double covalent bond?

a) One b) Two c) Three d) Four

Answer:B

Solution:A double bond consists of two shared electron pairs.

4. In a covalent bond, how are electrons shared between atoms?

a) Electrons are completely transferred from one atom to another

b) Electrons are equally shared between the atoms

c) Electrons are shared, but one atom retains more of the electron density

d) Electrons are not shared at all

Answer:B,C

Solution:Electrons are shared between atoms in a covalent bond. This sharing can be equal or unequal, depending on the electronegativity difference between the bonded atoms.

5. Molecule which contains 4 bonded pairs and 2 lone pairs of electrons on the central atom is

1. XeF_2 2. CO_2 3. XeF_4 4. SF_6

Answer:3

Solution:XeF_4 has xenon with 4 bonded pairs and 2 lone pairs (square planar).

6. The molecules which does not obey octet rule are

1. PF_5 2.SF_6 3.SO_2 4.CO_2

Answer:1,2,3

Solution:Except CO_2 in remaining all cases there is excess of electrons than octet on central atom in the molecules

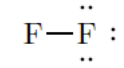
7. Among the following, non-polar covalent compounds are soluble in

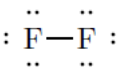
1. Water 2.Benzene 3.Ether 4.Acetone

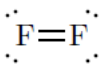
Answer:2,3,4

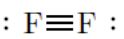
Solution:The solubility of compounds depend on like dissolves like. That means ionic compounds dissolved in ionic solvents and covalent compounds dissolved in covalent solvents. Here Benzene, acetone and Ether are non polar.

8. Which of the following is the correct Lewis structure for the molecule fluorine (F_2)?

A) 

B) 

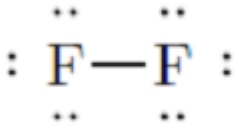
C) 

D) 

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

Answer:2

Solution:F_2 has a single bond between two F atoms, each with three lone pairs.



9. Which of the following statement is correct

1. Double and triple bonds are called multiple bonds

2. lone pairs of electrons present in the atom involve in co-ordinate covalent bonds.

3. The unpaired electrons present in the valency shell of an atom involve in covalent bonds

4. All are correct

Answer:4

Solution:Double and triple bonds are called multiple bonds.

Lone pairs of electrons present in the atom involve in coordinate covalent bonds.

The unpaired electrons present in the valency shell of an atom involve in covalent bonds.

10. Which of the following statement is incorrect

1. Polar covalent bond is formed by the mutual sharing of electron pairs between two similar atoms

2. Pure covalent bond is formed by the mutual sharing of electron pairs between two dissimilar atoms

3. Covalent compounds doesnot exhibit space isomerism

4. All are incorrect

Answer:4

Solution:Polar covalent bond is formed between two similar atoms $\rightarrow$ (It is between dissimilar atoms).

Pure covalent bond is formed between two dissimilar atoms $\rightarrow$ (It is between similar atoms).

Covalent compounds do not exhibit space isomerism $\rightarrow$ (They do, e.g., geometric

isomers).

11. The melting and boiling points of covalent compounds are proportional to their

1. Structure 2. Molecular weight 3. Formula 4. All the above

Answer:4

Solution:They depend on molecular weight and intermolecular forces, which are related to structure.

12. Covalent subtances do not contain free electrons or free ions. So they are not electrical conductors but the exception is

1. Diamond 2. Graphite 3. Boron 4. Silicon

Answer:2

Solution:Graphite has delocalized electrons and conducts electricity.

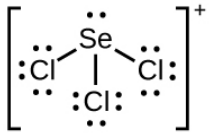
13. Covalent substances involve in chemical reactions slowly because

1. molecules take part in the reactions. 2. Ions take part in the reactions.

3. Both A & B 4. None

Answer:1

Solution:Covalent reactions involve breaking strong covalent bonds, and molecules react slowly.

14. 

What is the formal charge for Selenium

1. +1 2. -1 3. 0 4. -2

Answer:1

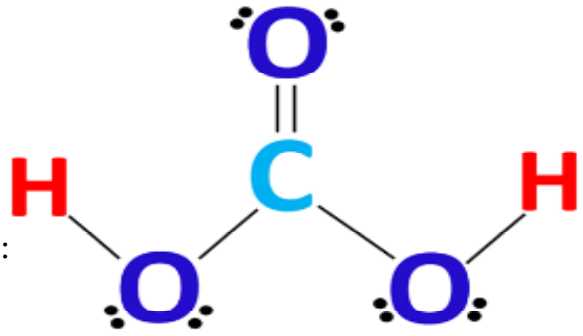
Solution:FC of Se=6-2-3=1

15. In the molecule H_2CO_3, what is the formal charge on the carbon atom?

a) +1 b) -1 c) 0 d) +2

Answer:C

Solution:



H_2CO_3 Lewis structure

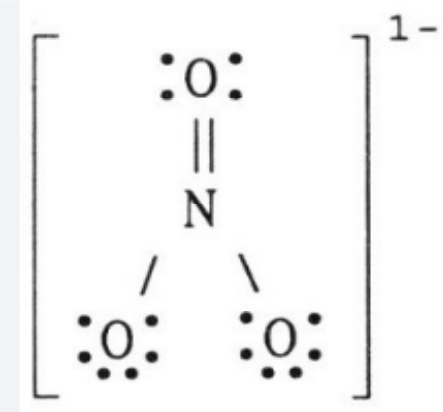
FC of Carbon=4-0-4=0

16. In the molecule NO_3^-, what is the formal charge on the nitrogen atom?

a) +1 b) -1 c) 0 d) +2

Answer:A

Solution:



FC of N=5-0-4=+1

17. Consider the molecule CO_2. What are the formal charges on the carbon and oxygen atoms, respectively?

A) Carbon: +1, Oxygen: -1 B) Carbon: 0, Oxygen: 0

C) Carbon: +2, Oxygen: -2 D) Carbon: -1, Oxygen: +1

Answer:B

Solution:O=C=O

FC of C=4-0-4=0

FC of O=6-4-2=0

JEE ADVANCED LEVEL QUESTIONS

MULTI CORRECT ANSWERS

1. In which of the following molecule(s), multiple bond is present:

1. CO_2 2. O_2 3. N_2 4. HCN

Answer:1,2,3,4

Solution:1. CO_2: Has two C=O double bonds.

2. O_2: Has an O=O double bond.

3. N_2: Has a N≡N triple bond.

4. HCN: Has a C≡N triple bond.

2. Examples for covalent polymers

1. Diamond 2. Graphite 3. Boron 4. Silicon

Answer:1,2

Solution:1. Diamond: Giant covalent network (carbon atoms bonded in a tetrahedral structure).

2. Graphite: Giant covalent layer structure.

3. Which of the following statements regarding formal charge is/are correct?

A) Formal charge helps in determining the most stable Lewis structure of a molecule.

B) Formal charge represents the charge an atom would have if all the bonding electrons were shared equally.

C) Formal charge considers the actual distribution of electrons in a molecule.

D) Formal charge provides information about the relative stability of resonance structures.

Answer:A,B,D

Solution:A) Helps determine most stable Lewis structure

B) Represents charge if bonding electrons shared equally

C) Considers actual distribution of electrons $\rightarrow$(that's partial charge, not formal charge)

D) Provides info about relative stability of resonance structures

REASON AND ASSERTION TYPE

A) Both (A) and (R) are true and (R) is the correct explanation of(A)

B) Both (A) and (R) are ture and (R) is not the correct explanation of (A)

C) (A) is true but (R) is false D) (A) is false but (R) is true

4. Assertion: The formation of a covalent bond always leads to the formation of a stable molecule.

Reason: Covalent bonds result from the sharing of electrons, stabilizing the at oms involved.

Answer:D

Solution:(A) is false because the formation of a covalent bond does not always lead to a stable molecule. For example, some molecules like radicals (e.g., $CH_3\bullet$) have cova lent bonds but are unstable and highly reactive.

(R) is true: covalent bonds do stabilize atoms by sharing electrons.

5. Assertion: The bond length in a covalent bond decreases with an increase in the number of shared electrons.

Reason: Increased electron density between atoms leads to stronger attraction and shorter bond length.

Answer:A

Solution:(A) is true: for example, a triple bond (with 6 shared electrons) is shorter than a double bond (4 shared electrons), which is shorter than a single bond (2 shared electrons).

(R) is true and correctly explains (A): more shared electrons mean higher electron

density, stronger attraction, and shorter bond length.

6. Assertion: The formation of a covalent bond releases energy.
Reason: Energy is released when atoms come closer together and form a more stable arrangement in a covalent bond.

Answer:A

Solution:

(A) is true: bond formation is exothermic; energy is released when a covalent bond forms.

(R) is true and correctly explains (A): the atoms achieve a lower energy state when bonded, releasing energy.

7. Assertion: In the molecule NH_3, the nitrogen atom has a formal charge of -1.
Reason: Nitrogen in NH_3 has three valence electrons and forms three covalent bonds.

Answer:D(both incoorect)

Solution:

Nitrogen has 5 valence electrons, not 3.

In NH_3:Formal charge = 5 – (2 (lone pair) + 3 bonds) = 5 – (2 + 3) = 0.

Assertion is false.

Reason is false (Nitrogen has 5 valence electrons, not 3).

8. Assertion: In the molecule H_2SO_4, the sulfur atom has a formal charge of +6.
Reason: Sulfur in H_2SO_4 has six valence electrons and is bonded to four oxygen atoms.

Answer:D

Solution:

Oxidation state of S in H_2SO_4 is +6.

Formal charge on S is 0 (check with Lewis structure).

Assertion is false.

Reason is true(S has six valence electrons and is bonded to four oxygen atoms).

9. Assertion: Formal charge is a measure of the charge assigned to an atom in a molecule.
Reason: It is calculated by the difference between the number of valence elec trons of an atom and the number of electrons assigned to it in the Lewis struc ture.

Answer:A

Solution:

(A) is true: formal charge is a concept to assign charge to atoms in a Lewis structure.

(R) is true and correctly explains how formal charge is calculated: formal charge =

valence electrons - (non-bonding electrons + bonding electrons/2).

STATEMENT TYPE

1) Statement-I, Statement-II both are true
2) Statement-I, Statement-II both are false
3) Statement-I is true, Statement-II is false.
4) Statement-I is false, Statement-II is true.

10. Statement I: Single bond is formed by the mutual sharing of one pair of electrons between two atoms
Statement II : Single bond is always a sigma bond

Answer:1

Solution:

Statement I is true: A single bond is indeed formed by the sharing of one pair of electrons (2 electrons) between two atoms.
Statement II is true: A single bond is always a sigma bond. In covalent bonding, the first bond between two atoms is always a sigma bond. Multiple bonds (double or triple) consist of one sigma bond and the rest are pi bonds, but a single bond is exclusively a sigma bond.

11. Statement I: SiF_4 has octet configuration, but acts as an electron pair acceptor
Statement II: Central atom of Si has vacant d-orbitals is its valence shell

Answer:1

Solution:

Statement I is true: SiF_4 has an octet configuration (silicon has 8 electrons in its valence shell: 4 from bonds with F and 4 from its own valence electrons). However, it acts as an electron pair acceptor because it can expand its octet due to vacant d-orbitals. For example, it forms $[SiF_6]^{2-}$ by accepting two electrons from a donor.
Statement II is true: Silicon has vacant 3d orbitals in its valence shell (since it is in the third period), which allows it to accept electron pairs and form expanded octet species.

COMPREHENSION TYPE

The attractive forces holding various constituents together in different chemical species is called chemical bond. The bond between two atoms is formed in general to complete the octet of their valence shell. However, in certain cases stable bonds are even formed in that state in which the octet of valence shell of bonding atoms is not complete.

12. In which compounds octet of all the atoms in their valence shell is not complete
1. CH_4 2. CO_2 3. BF_3 4. OF_2

Answer:3

Solution:

Boron in BF_3 has only 6 electrons (incomplete octet). CH_4 and CO_2 have octets for all atoms; OF2 also has octets

13. In which compounds expansion of octet of valence shell has occurred of the central atom

1. PCl_3 2. PCl_5 3. SO_3 4. H_2S

Answer:2,3

Solution:

P in PCl_5 and S in SO_3 exceed 8 electrons (expanded octet). PCl_3 and H_2S do not (they obey the octet).

MATRIX MATCH TYPE

14.

List-I	**List-II**
A) Ionic bond	1) Eight electrons in the outermost orbit
B) Covalent bond	2) NaCl
C) Valency	3) Number of electronsin the outermost orbit
D) Octet rule	4) H_2O
	5) Lone pair of electrons

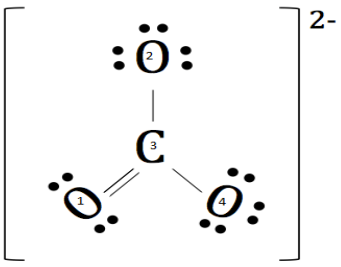
Answer:A-2,B-4,C-3,D-1

Solution:

A) Ionic bond	2) NaCl
B) Covalent bond	4) H_2O
C) Valency	3) Number of electronsin the outermost orbit
D) Octet rule	1) Eight electrons in the outermost orbit

INTEGER TYPE

28.



What is the formal charge for the oxygen labeled 2 and 4

Answer:-1

Solution:

Formal Charge (FC) = Valence electrons - (Non-bonding electrons + Bonding electrons/2)

FC for Oxygen 2= 6-6-1=-1

FC for Oxygen 4= 6-6-1=-1

KEY

				TEACHING TASK					
			JEE MAIN LEVEL QUESTION						
1	2	3	4	5	6	7	8	9	10
B	B	2	C	3	1	A	C	3	4
11	12	13	14	15					
1	2	2	1	D					
			JEE ADVANCED LEVEL QUESTIONS						
1	2	3	4	5	6	7	8	9	10
1,4	1,2,3	A	A	A	D	A	D	A	1
11	12	13	14	15		16	17	18	
3	1	4	1,2	A-2,B-3,C-4,D-1,5		0,-1	0	0,1	
				LEARNER'S TASK					
			Conceptual Understanding Questions (CUQ'S)						
1	2	3	4	5	6	7	8	9	10
4	4	1	4	3	3	3	2	2	2
			JEE MAINS LEVEL QUESTIONS						
1	2	3	4	5	6	7	8	9	10
B	B	B	B,C	3	1,2,3	2,3,4	2	4	4
11	12	13	14	15	16	17			
4	2	1	1	C	A	B			
			JEE ADVANCED LEVEL QUESTIONS						
1	2	3	4	5	6	7	8	9	10
1,2,3,4	1,2	A,B,D	D	A	A	D	D	A	1
11	12	13	14			28			
1	3	2,3	A-2,B-4,C-3,D-1			-1			