# Carbon and its Compounds



- **1. Bond angle:** The angle that is formed between two adjacent bonds on the same atom.
- **2. Bond length:** The equilibrium distance between the nuclei of two groups or atoms that are bonded to each other.
- **3. Hydrocarbons:** An organic compound containing only carbon and hydrogen atoms.
- **4. Saturated hydrocarbons:** A substance in which the atoms are linked by single bonds.
- **5. Unsaturated hydrocarbons:** A substance in which atoms are linked by double or triple bond.
- **6. Allotropy:** The phenomenon of existence of two or more different physical forms of a chemical element.
- **7. Catenation:** The property of self linking of elements to form a long chain.
- 8. Homologous series: A homologous series is a group of organic chemical compounds, usually listed in order of increasing size, that have a similar structure (and hence also have similar properties)

and whose structures differ only by the number of CH<sub>2</sub> units in the main carbon chain.

- **9. Tetravalency:** Tetravalency is the state of an atom in which there are four electrons available with the atom for covalent chemical bonding.
- **10. Isomers:** Compounds having similar molecular formula but different chemical structure.
- **11. Isomerism:** The phenomenon in which the compounds have the same molecular formula and different structural formula.



**12.** Carbon exists in the atmosphere in the form of:

#### [NCERT Exemplar]

- (a) Carbon monoxide only
- (b) Carbon monoxide in traces and carbon dioxide
- (b) Carbon dioxide only
- (d) Coal
- Ans. (c) Carbon dioxide only

### **Explanation** :

Carbon exists in the atmosphere in the form of carbon dioxide gas  $(CO_2)$  in air (Only 0.03%) and in the earth crust it exists in the form of the minerals like carbonates. It also occurs in the form of fossil fuels, organic compounds, wood, cotton and wool, etc.

- **13.** What is true about covalent compounds? They:
  - (a) have high melting and boiling point

- (b) are mostly soluble in water
- (b) are formed between atoms of metals and non-metals
- (d) are formed by the sharing of electrons in the bonding atoms
- **Ans.** (d) Are formed by the sharing of electrons in the bonding atoms.

Covalent compounds are held together by weak intermolecular forces which fail to hold the compound bonded tightly. Thus, a small amount of heat energy is capable of breaking these weak intermolecular forces, therefore, the melting and boiling points of covalent compounds are low. Covalent compounds are non-polar in nature which means they do dissolve in water, instead make a separate layer on the surface of water. Hence, Compounds having covalent bonds are insoluble in water. Covalent compounds are formed by the sharing of electrons in the bonding atoms between two non-metals.

- **14.** Covalent compounds are \_\_\_\_\_\_ conductors of electricity.
  - (a) Good
  - **(b)** Bad
  - (c) Moderate
  - (d) None of them
  - Ans. (b) Bad.

### **Explanation** :

Covalent compounds are bad conductors of electricity because they do not produce ions in solution.

**15.** Buckminster fullerene is an allotropic form of :

### [NCERT Exemplar]

- (a) Phosphorus
- (b) Sulphur
- (c) Carbon
- (d) Tin

Ans. (c) Carbon.

# **Explanation** :

Buckminsterfullerene (C60) is an allotropic form of carbon. It has carbon atoms arranged in the form of football and due to their resemblance with football they are also known as Bucky balls.

- **16.** Which of the following statements are correct for carbon compounds?
  - (i) Most carbon compounds are good conductors of electricity.
  - (ii) Most carbon compounds are poor conductors of electricity.
  - (iii) Force of attraction between molecules of carbon compounds is not very strong.
  - (iv) Force of attraction between molecules of carbon compounds is very strong.
  - (a) (ii) and (iv)
  - (b) (ii) and (iii)
  - (b) (i) and (iv)
  - (d) (i) and (iii)

Ans. (b) (ii) and (iii)

### **Explanation** :

Most carbon compounds are poor conductors of electricity because they are formed by the sharing of electrons and therefore they do not have free electrons. Current results from motion of electrons or ions. On dissolving them in water they do not form ions. So, they are generally poor conductors of electricity. Force of attraction between molecules of carbon compounds is not very strong because they form covalent bond by sharing their valence electron in order to attain stable electronic gas configuration.

**17.** Which of the following statements are usually correct for carbon compounds ? These :

#### [NCERT Exemplar]

- (i) Are good conductors of electricity.
- (ii) Are poor conductors of electricity.
- (iii) Have strong forces of attraction between their molecules.
- (iv) Do not have strong forces of attraction between their molecules.
- (a) (i) and (iii)
- **(b)** (ii) and (iii)
- (c) (i) and (iv)
- (d) (ii) and (iv)
- **Ans.** (d) (ii) and (iv)

### **Explanation :**

Carbon compounds do not have strong forces of attraction between

their molecules because they are bonded to each other through covalent bonds which is weaker than ionic bond. They are poor conductors of electricity because of the absence of free ions.

- **18.** How many number of carbon atoms are joined in a spherical molecule of Buckminsterfullerene?
  - **(a)** 30
  - **(b)** 60
  - **(b)** 90
  - (d) 120
  - **Ans.** (b) 60

# Explanation :

Buckminsterfullerene is the first discovered fullerene. It is a molecule of carbon in the form of a soccer ball consisting of 60 C-atoms and is having the formula C-60. These 60 carbon atoms are joined together by strong covalent bonds and are arranged in interlocking hexagonal and pentagonal rings of carbon atom.

- **19.** The allotrope of carbon which is a good conductor of heat and electricity is
  - (a) Diamond
  - (b) Graphite
  - (b) Charcoal
  - (d) None of these
  - Ans. (b) Graphite

# **Explanation** :

The allotrope of carbon which is a good conductor of heat and electricity is graphite. This is because, in its planar structure it has three electrons which are covalently bonded and fourth electron is free to move along the layers from one carbon atom to the next when connected to an external battery.

- **20.** In diamond, each carbon atom is bonded to four other carbon atoms to form:
  - (a) A hexagonal array
  - (b) A rigid three-dimensional structure
  - (b) A structure in the shape of a football
  - (d) A structure of a ring
  - **Ans.** (b) A rigid three-dimensional structure

### **Explanation** :

In diamond, each carbon atom is bonded to four other carbon atoms tetrahedrally to form a rigid three-dimensional structure. This rigid three dimensional structure of carbon is responsible for the hardness and rigidity of diamond.

- 21. How many electrons are there in the outermost shell of carbon?
  - **(a)** 1
  - **(b)** 2
  - **(b)** 3
  - **(d)** 4
  - **Ans.** (d) 4

### **Explanation** :

Carbon is a member of group 14 elements and has four electrons in its outer shell. Carbon typically shares electrons to achieve a complete valence shell, forming bonds with multiple other atoms.

- **22.** Hydrocarbons are mainly composed of:
  - (a) Hydrogen, carbon and nitrogen
  - (b) Hydrogen and carbon
  - (b) Hydrogen
  - (d) Hydrogen, oxygen and carbon
  - Ans. (b) Hydrogen and carbon

### **Explanation** :

A hydrocarbon is an organic chemical compound composed exclusively of hydrogen and carbon atoms. For example, the simplest hydrocarbon is Methane molecule with the molecular formula of  $CH_4$ .

- **23.** Complete combustion of hydrocarbons gives:
  - (a) Carbon dioxide and water
  - (b) Carbon monoxide and water
  - (b) Carbon monoxide and hydrogen
  - (d) Carbon dioxide and hydrogen
  - Ans. (a) Carbon dioxide and water

### **Explanation** :

The simple word equation for the stoichiometric combustion of a hydrocarbon in air is:

Fuel + Oxygen = Water + Nitrogen + Carbon dioxide

$$CH_4 + 2O_2 = 2H_2O + CO_2$$

24. Carbon forms four covalent bonds by sharing its four valence electrons with four univalent atoms, *e.g.*, hydrogen. After the formation of four bonds, carbon attains the electronic configuration of:

#### [NCERT Exemplar]

- (a) Helium
- (b) Neon
- (b) Argon
- (d) Krypton
- Ans. (b) Neon

#### **Explanation :**

The electronic configuration of carbon (C) is 2, 4. To complete its octet, it will share its 4 valence electrons with hydrogen atom and forms  $CH_4$  molecule. As carbon is sharing its 4 valence electrons, it will form four covalent bonds.

Now, the electronic configuration of C in  $CH_4$  is 2, 8

Electronic configuration of Ne (atomic number = 10) is 2, 8. Hence, after the formation of four covalent bonds, carbon attains the electronic configuration of Neon.

25. Which of the following is not a straight chain hydrocarbon ?

(a) 
$$H_3C$$
— $CH_2$ — $CH_2$ — $CH_2$ — $CH_2$   
( $H_3$ 

(b)  $H_3C$ — $CH_2$ — $CH_2$ — $CH_2$ — $CH_2$ — $CH_3$ 



In straight chain hydrocarbons, carbon atoms are connected through covalent bond in one continuous chain with no branches. In the structure (a), (b) and (c), all the carbon atoms are connected to each other in a continuous straight chain:

(a)  

$$H_{3}\dot{C}$$
  $-\dot{C}H_{2}$   $\dot{C}H_{2}$   $-\dot{C}H_{2}$   $\dot{C}H_{2}$   
(a)  
 $^{6}CH_{3}$   
(b)  $H_{3}\dot{C}$   $-\dot{C}H_{2}$   $-\dot{C}H_{2}$   $-\dot{C}H_{2}$   $-\dot{C}H_{2}$   $-\dot{C}H_{3}$   
 $^{1}CH_{3}$   
 $H_{2}C$   $-H_{2}\dot{C}$   $-H_{2}\dot{C}$   $-\dot{C}H_{2}$   
(c)  $^{6}CH_{3}$ 

In structure (d),  $-CH_3$  group is attached to the second carbon atom of the chain forming a branch. Hence, compound in structure (d) is a branched chain hydrocarbon.

<sup>1</sup>H<sub>3</sub>C  $^{2}$  CH $-^{3}$  CH $_{2}$  $-^{4}$  CH $_{2}$  $-^{5}$  CH $_{3}$ Ha(

- **26.** In double covalent bond there is sharing of:
  - (a) 2 electrons
  - (b) 4 electrons
  - (b) 6 electrons
  - (d) 3 electrons
  - Ans. (b) 4 electrons

A double covalent bond is formed when two pairs of electrons are shared between them. For example, in an oxygen molecule, there is a double bond between two oxygen atoms as they share two pairs of electrons *i.e.* 4 electrons.

- **27.** The bond between two identical non-metallic atoms has a pair of electron :
  - (a) unequally shared between two atoms.
  - (b) transferred completely from one atom to another.
  - (b) with identical spins.
  - (d) equally shared between them.
  - Ans. (d) equally shared between them.

### **Explanation** :

The bond between two identical non-metallic atoms has a pair of electron equally shared between them. This is due to the equal sharing of electrons between the bonded atoms. Hence, the bonded atoms will hold on the shared pair of electrons.

- **28.** Which of the following properties is not true regarding organic compounds ?
  - (a) They are generally covalent compounds.
  - (b) Show isomerism.
  - (b) Compounds have high melting and boiling points.
  - (d) Generally insoluble in water.

### Ans

. (c) Compounds have high melting and boiling points.

### **Explanation** :

Organic compounds have low melting and boiling point because they are made of weak covalent bonds. Thus, the property which is not true regarding organic compounds is that they have high melting and boiling points.

- 29. Which of the following is not an allotropic form of carbon ?
  - (a) Fluorine?
  - (b) Fullerene
  - (b) Diamond
  - (d) Graphite
  - Ans. (a) Fluorine

### **Explanation** :

Carbon is found in many forms in nature which differ from each other in various physical properties but they exist in same state. These forms of carbon are known as allotropes of carbon. From the given options, fullerene, diamond, graphite are all different types of allotropes. Whereas, fluorine is a non-metal which belongs to halogen family. Hence, fluorine is not an allotrope of carbon.

- 30. The term 'Isomerism' applies to organic compounds with same :
  - (a) Molecular formula but different structural formulae.
  - (b) Molecular formula but different empirical formula.
  - (b) Empirical formula but different molecular formula.
  - (d) Structural formula but different molecular formula.
  - **Ans.** (a) Molecular formula but different structural formulae.

# **Explanation** :

The term isomerism refers to the organic compounds with same molecular formula but different structural formulae. An example is the compound with the molecular formula  $C_5H_{12}$ . It has three isomers: n-pentane, Isopentane and neopentane which differ from each other in their structure but they have same molecular formula.





2, 2-Dimethyl propane

- 31. Which of the following is not a characteristic of Diamond ?
  - (a) Hardest substance
  - (b) High thermal conductivity
  - (b) High refractive index
  - (d) Good conductor of electricity
  - Ans. (d) Good conductor of electricity

Diamond is the hardest substance known, this is due to its structure in which carbon atoms are arranged in a lattice giving it a giant covalent structure with great forces of attraction.

Diamond has high thermal conductivity, this is due to the stiff chemical bonds between the carbon atoms. It has high refractive index which gives it the transparency and brilliance and it is a bad conductor of electricity because of the absence of free mobile electrons.

32. A hydrocarbon should have minimum how many carbon atoms to

show isomerism?

- (a) Three
- (b) Four
- (b) Five
- (d) Six
- Ans. (b) Four

### **Explanation** :

Since branching is not possible with carbon 1, 2, 3 so the minimum number of the carbons required by the hydrocarbon to show isomerism is Four.

- **33.** The amount of carbon present in the earth crust as minerals is:
  - (a) 0.03%
  - **(b)** 0.02%
  - **(b)** 0.05%
  - **(d)** 0.08%

**Ans.** (a) 0.02%

### **Explanation** :

The amount of carbon present in the earth crust as minerals is 0.02%. In the earth's crust only 0.02% carbon is found in the form of minerals like carbonates, hydrogen carbonates, coal and petroleum. and the atmosphere has 0.03% of carbon dioxide. In spite of this small amount of carbon available in nature, the importance of carbon is immense.

34. Carbon compounds are ..... conductors of electricity"

- (a) Poor
- (b) Good
- (b) Semi
- (d) None of the above

Ans. (a) Poor

### **Explanation :**

Current results from motion of electrons or ions. Carbon compounds are covalent in nature as they are formed by the sharing of electrons. They do not dissociate into ions in aqueous solution and also it does not have free electrons. Since, there is no flow of charge (i.e., electrons or ions), it is a poor conductor of electricity.

- **35.** Carbon compounds have ..... melting point and ..... boiling point:
  - (a) Low, high
  - (b) Low, Low
  - (c) High, low
  - (d) High, high

Ans. (b) Low, Low

### **Explanation** :

Carbon compounds generally have low melting points and boiling points because the force of attraction between the molecules of carbon compounds is not very strong. These weak intermolecular forces make them very easy to pull apart from each other. Since carbon compounds are easy to separate, they have low melting and boiling point.

- **36.** Which among the following properties does not comply with graphite?
  - (a) Presence of hexagonal rings of carbon
  - (b) Layer tightly held by strong forces of attraction
  - (b) High melting point close to that of diamond
  - (d) Electrical conductivity comparable to metals

**Ans.** (b) Layer tightly held by strong forces of attraction

### **Explanation** :

Graphite has layer lattice structure in which layer of hexagonal rings are held by weak forces of attraction

- 37. Which of the statement is correct
  - (a) Reactivity of element is explained on the tendency to attain completely filled outer shell
  - (b) Ionic compound attain stability via gaining and losing electron from the outermost shell
  - (b) Carbon can gain or lose electron four electron to attain noble gas configuration
  - (d) All of the above
  - **Ans.** (d) All of the above

# **Explanation** :

All the above given statements are correct.

- **38.** Carbon attain stability by ..... its valence electron
  - (a) Donating

- (b) Gaining
- (b) Sharing
- (d) Transferring

Ans. (c) Sharing

### **Explanation :**

Carbon has four electrons in its valence shell. It can either gain electron forming an anion ( $C^{4-}$ ) or it can lose its valence electrons and form cation( $C^{4+}$ ) but in former case it is difficult for nucleus to hold 10 electrons with number of protons to be 6 and in the latter case, it requires large amount of energy for the release of valence electrons.Hence, it can attain stability by sharing of its valence electron

- **39.** Carbon is ..... compound:
  - (a) Tetravalent
  - (b) Pentavalent
  - (b) Hexavalent
  - (d) Octavalent
  - Ans. (a) Tetravalent

### **Explanation :**

The electronic configuration of carbon is 2,4 which means it has four electrons in its outermost shell. Carbon atoms can achieve the inert gas electronic configuration only by sharing of electrons, so carbon always forms covalent bonds. As the valency of carbon is four because one carbon atom requires 4 electrons to achieve the nearest inert gas configuration. Thus, we can say that carbon is a tetravalent compound.

- **40.** Bonds which are formed by sharing of an electron pair between two atom is known as
  - (b) Ionic
  - (b) Covalent
  - (b) Coordinate
  - (d) electrovalent
  - Ans. (b) Covalent

### **Explanation :**

The wide variation of properties in different forms of elementary carbon and existence of innumerable compounds of carbon are due to unique nature of bonding between carbon atoms. Carbon atom generally participates in bond formation by sharing electron. Hence termed as covalent bonding

- **41.** Graphite structure is formed by .....array:
  - (a) Tetragonal
  - (b) Hexagonal
  - (b) Pentagonal
  - (d) None of the above
  - Ans. (b) Hexagonal

### **Explanation** :

In graphite, each atom of carbon is surrounded by three other carbon atoms by single bonds, thereby forming a layer of hexagonal structures. The fourth valence electron of each carbon atom forms a weak bond between the layers of hexagonal structure.

**42.** ..... is the hardest substance:

- (a) Carbon
- (b) Diamond
- (b) Graphite
- (d) C-60

Ans. (b) Diamond

### **Explanation** :

In diamond, carbon atoms are compactly arranged by very strong covalent bonds, diamond is very hard. Due to the compact arrangement of carbon atom, diamond has very high density and tends to be hardest substance.

- **43.** Graphite is ..... and ..... in nature.
  - (a) Smooth, slippery
  - (b) Hard, slippery
  - (b) Smooth, non-slippery
  - (d) None of these

Ans. (a) Smooth, slippery

### **Explanation** :

In graphite, each atom of carbon is surrounded by three other carbon atom by single bonds, thereby forming a layer of hexagonal structures. The fourth valence electron of each carbon atom forms a weak bond between the layers of hexagonal structure Graphite can be used as a dry lubricant in machine where large amount of heat is produced due to friction between different parts of machine. Ordinary lubricating oil gets charred due to generation of heat. The soft slippery nature and high resistance to heat makes graphite useful.

- **44.** ..... is an allotrope of carbon:
  - (a) Fullerenes
  - (b) Diamond
  - (b) Graphite
  - (d) All of them
  - Ans. (d) All of them

### **Explanation :**

All of them are formed through carbon linkages and possess different physical property and same chemical property.

- **45.** Which of the following characteristics does not comply with all non-polar covalent substance?
  - (a) Do not undergo ionization
  - (b) Soluble only in organic solvent
  - (b) Exist only in gaseous state
  - (d) They do not conduct electricity
  - Ans. (c) Exist only in gaseous state

# Explanation :

Non polar covalent compound can exist either in gaseous state or in liquid state. This statement does not hold good as a feature of all

non -polar covalent substance.

- **46.** Compound formed from carbon are:
  - (a) Methane
  - (b) Bio gas
  - (b) CNG
  - (d) All of these

Ans. (d) All of these

### **Explanation** :

Methane is  $CH_4$ , Biogas is mixture of gases primarily consisting of methane and  $CO_2$ .CNG is composed methane ( $CH_4$ ). They all have carbon as the element

- **47.** Chlorine forms...... Molecule:
  - (a) Diatomic
  - (b) Monoatomic
  - (b) Triatomic
  - (d) Tetraatomic
  - Ans. (a) Diatomic

### **Explanation** :

Chlorine atom has 7 electrons and need one electron to attain stability hence sharing of electron between two chlorine atom leads to chlorine molecule

**48.** Identify the correct statement among the following:

- (i) Three bond pair and one lone pair of electron are present in a molecule of ammonia.
- (ii) Two bond pair and two lone pairs of electrons are present in molecule of water
- (iii) Only one bond pair of electron is present in molecule of chlorine
- (iv) One bond pair and three lone pairs of electron are present in molecule of HF
- (a) (i) and (ii)
- **(b)** (i), (ii), (iii)
- (b) (ii) and (iv)
- (d) (i), (ii), (iii), (iv)
- **Ans.** (c) (ii) and (iv)

Chlorine molecule has one bond pair and six lone pair of electron. Each chlorine atom has electron 2,7 and requires one electron for its octet to get complete therefore single bond between the atoms led to formation of chlorine molecules leaving six lone pair of electrons in chlorine

- 49. From which of the following substance pencil lead is formed?
  - (a) Charcoal
  - (b) Wood
  - (b) Lead
  - (d) Graphite

# Ans. (d) Graphite

### Explanation :

**Reason:** Pencil lead is formed of graphite. Graphite is an allotropic form of carbon in which each carbon atom is joined to three others, forming layers:

These layers are put together by weak van der Waals forces which enable the layers to slide over each other, making graphite soft and slippery. So graphite is used as pencil 'lead'. As the pencil moves across the paper, layers of graphite rub off leaving the dark marks on paper.

- **50.** How many number of carbon atoms are joined in a spherical molecule of buckminsterfullerene?
  - **(a)** 30
  - **(b)** 60
  - **(b)** 90
  - **(d)** 120

**Ans.** (b) 60

### **Explanation :**

Buckminsterfullerene is a molecule of carbon in the form of a hollow sphere consisting of 60 C-atoms and is having the formula  $C_{60}$ .

- **51.** Which of the following statements about graphite and diamond is true?
  - (a) They have the same crystal structure
  - (b) They have the same degree of hardness

- (b) They have the same electrical conductivity
- (d) They can undergo the same chemical reactions

Ans. (d) They can undergo the same chemical reactions

### **Explanation :**

Both Graphite and diamond being the allotropes of the same element, carbon, have similar chemical properties. So they undergo the same chemical reactions.

- **52.** Identify the carbon compound in which carbon not exhibit the property of catenation as well multiple bond formation
  - (a) Propene
  - (b) Benzene
  - (b) Acetone
  - (d) Methane

Ans. (d) Methane

### **Explanation** :

In methane there is only one carbon atom and no double or triple bond. So in methane there is no catenation of carbon and multiple bond.

- **53.** Self-linking property of carbon is called.....
  - (a) Catenation
  - (b) Versatile
  - (b) Homologus
  - (d) None of these

# Ans. (a) Catenation

# Explanation :

The ability of an atom to combine with other atom of the same element and form long chain –like structure is called catenation property. The maximum catenation is observed in the compounds of carbon. The chain of carbon compound can be straight, branched or closed like a ring. The formation of different kind of chain of different length by carbon atom is possible because of its four valence electron.

- **54.** The property of self-linkage among identical atoms to form long chain compounds is known as:
  - (a) Catenation
  - (b) Isomerisation
  - (b) Superposition
  - (d) Halogenation
  - Ans. (a) Catenation

# Explanation :

Catenation is the property of self-linking of an element by which an atom combines with the other atoms of the same element to form long chains. This property is exhibited by carbon as it forms covalent bonds with other carbon atoms to form longer chains and structures. This is the reason for the presence of the vast number of organic compounds in nature.

- **55.** Which of the following belongs to homologous series of alkynes?  $C_6H_6, C_2H_6, C_2H_4, C_3H_4.$ 
  - (a) C<sub>6</sub>H<sub>6</sub>

- (b) C<sub>2</sub>H<sub>4</sub>
- **(b)**  $C_2H_6$
- (d) C<sub>3</sub>H<sub>4</sub>
- **Ans.** (d)  $C_3H_4$

Homologous series is the series comprising of compounds that share same chemical properties and functional groups. Alkynes have general formula,  $C_nH_{2n-2}$ , where *n* is number of carbon atoms. Thus, from given options,  $C_3H_4$  belongs to the homologous series of alkynes.

- 56. The number of isomers of pentane is:
  - **(a)** 2
  - **(b)** 3
  - **(b)** 4
  - **(d)** 5

**Ans.** (b) 3

### **Explanation :**

*Isomerism* is a phenomenon in which two or more compounds have the same chemical formula but possesses different structural formulas. Pentane is an organic compound and an alkane with molecular formula  $C_5H_{12}$ . There are five carbons in its structure which can be arranged in three different ways to form 3 different structural isomers of pentane. These are n-pentane, iso-pentane and neo-pentane.



- **57.**  $C_3H_8$  belongs to the homologous series of:
  - (a) Alkynes
  - (b) Alkenes
  - (b) Alkanes
  - (d) Cyclo alkanes
  - Ans. (c) Alkanes

A homologous series is a family of compounds with the same general formula, same functional group and similar chemical properties. Each family of organic compound is called a homologous series for example,

Homologous series of Alkanes has the general formula  $C_n H_{2n+2}$ 

Homologous series of Alkene has the general formula  $C_n H_{2n}$ 

Homologous series of Alkyne has the general formula  $C_nH_{2n-2}$ 

Hence, from the general formula of the homologous series of alkanes, this can be confirmed that  $C_3H_8$  belongs to the homologous series of alkanes.

**58.** Pentane has the molecular formula  $C_5H_{12}$ . It has :

### [NCERT Exemplar]

- (a) 5 covalent bonds
- (b) 12 covalent bonds
- (b) 16 covalent bonds
- (d) 17 covalent bonds
- Ans. (c) 16 covalent bonds

### **Explanation** :

Structural formula of pentane is:



Number of C–C covalent bonds = 4

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Number of C–H covalent bonds = 12
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Hence, the total number of covalent bonds in the structure of pentane is 16.

59. The first member of the alkyne homologous series is:

# [NCERT Exemplar]

- (a) ethyne
- (b) ethene
- (b) propyne
- (d) methane
- Ans. (a) Ethyne

### **Explanation :**

The first member of the alkyne family is Ethyne ( $C_2H_2$ ), with two carbon atoms bonded by a triple bond. It is a hydrocarbon and the simplest alkyne. Its molecular weight is 26.04g/mol.

- **60.** Which of the following does not belong to the same homologous series ?[NCERT Exemplar]
  - (a) CH<sub>4</sub>
  - (**b**) C<sub>2</sub>H<sub>6</sub>
  - (c)  $C_3H_8$
  - (d)  $C_4H_8$
  - Ans. (d)  $C_4H_8$

# **Explanation :**

CH<sub>2</sub>, C<sub>2</sub>H<sub>6</sub>, C<sub>3</sub>H<sub>8</sub> are all saturated carbon compounds with general formula  $C_nH_{2n+2}$  whereas  $C_4H_8$  is an alkene with general formula  $C_nH_{2n}$ . Thus, C<sub>4</sub>H<sub>8</sub> does not belong to the same homologous series as it is an alkene.

- **61.** By how much atomic mass unit successive members of a homologous series vary ?
  - (a) One
  - (b) Sixteen
  - (b) Fourteen
  - (d) Twelve
  - Ans. (c) Fourteen

### **Explanation :**

In homologous series, the two consecutive members will differ by  $CH_2$  unit or 14 amu.

The molecular masses of first three members of alkanes with general formula  $C_nH_{2n+2}$  are shown below:

Methane  $(CH_4) = 16$  amu

Ethane  $(C_2H_6) = 30$  amu

Propane ( $C_3H_8$ ) = 44 amu

From the above examples, it is clear that atomic mass unit of successive members of a homologous series vary by 14 amu.

Assertion and Reasoning Based Questions



applications.

**Reason:** When carbon is heated in presence of excess of air or oxygen, it forms carbon dioxide. During its formation, a large amount of heat and light are released. Further, once ignited, carbon and its compounds keep on burning without needing additional heat energy.

- (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 assertion is false, but reason is true.
- **Ans.** (a) If both assertion and reason are true and reason is the correct explanation of assertion.

### **Explanation** :

Carbon and its compounds have maximum number of carbon and hydrogen, which makes them of high calorific value. Thus, most of the carbon compounds release high amount of energy. This is the cause that carbon and its compounds are used as fuels for most applications.

63. Assertion: Graphite and diamond have same chemical properties

Reason: Graphite and diamond are allotropes of carbon

- (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 assertion is false, but reason is true.
- **Ans.** (a) If both assertion and reason are true and reason is the correct explanation of assertion.

Allotropes of an element exhibit same chemical properties. Graphite and diamond are allotropes of carbon. Thus both assertion and reason are correct and reason is the correct explanation for assertion.

64. Assertion: Coal generally burns red hot without flame

**Reason:** Coal contains sulphur and nitrogen which produce volatile oxides on burning

- (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 assertion is false, but reason is true.
- **Ans.** (a) If both assertion and reason are true, but reason is not the correct explanation of assertion.

### **Explanation** :

Coal and charcoal are solid fuels. So, they generally burn red hot without flame. Coal contains sulphur and oxygen to form volatile oxides. Thus both assertion and reason are correct but reason is not the correct explanation for assertion. **65. Assertion:** Carbon and its compounds are used as fuels.

**Reason:** They give lot of heat and light when burnt in air.

- (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 assertion is false, but reason is true.
- **Ans.** (a) If both assertion and reason are true and reason is the correct explanation of assertion.

#### **Explanation** :

Carbon and its compounds are used as fuels for most applications because most of the carbon compounds give a lot of heat and light when burnt in air. Saturated hydrocarbons burn with a clean flame and no smoke is produced. The carbon compounds, used as a fuel, have high calorific values. Thus, both assertion and reason are true and reason is the correct explanation of the assertion.

66. Assertion: Covalent compounds are poor conductors of electricity.

**Reason:** It is because they do not form the 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 assertion is false, but reason is true.

**Ans.** (a) If both assertion and reason are true and reason is the correct explanation of assertion.

#### **Explanation** :

Covalent compounds are poor conductors of electricity because they do not form the ions . Thus both assertion and reason are true and reason is the correct explanation of the assertion.

67. Assertion: Graphite and diamond are the allotropes of carbon.

**Reason:** It is because they have large network like structure.

- (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 assertion is false, but reason is true.
- Ans. (c) If assertion is true, but reason is false.

#### **Explanation** :

Graphite and diamond are the allotropes of carbon because they have network like structure. Thus, assertion is true but reason is false.

**68. Assertion:** Covalent compounds have high melting and boiling points.

**Reason:** It is because the forces present in covalent bonds are held together by weak Van der Waals forces.

(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 assertion is false, but reason is true.
- **Ans.** (d) If assertion is false, but reason is true.

The forces present in covalent bonds are held together by weak Vander Waals forces and the force of attraction between these molecules are not very strong. A supply of a small amount of energy can weaken this force to a great extent that is why carbon compounds have low melting and boiling point. Thus, assertion is false but reason is true.

**69. Assertion:** Carbon forms ionic compounds.

Reason: It is because of its valency of 4.

- (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 assertion is false, but reason is true.

Ans. (d) If assertion is false, but reason is true.

#### Explanation :

Carbon forms covalent compounds because of its valency of 4 due to which it can share its 4 electrons easily. Thus, assertion is false but reason is true.
**70.** Assertion: Mass number of a carbon is 12.

**Reason:** Carbon possesses equal number of all three fundamental particles.

- (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 assertion is false, but reason is true.
- **Ans.** (a) If both assertion and reason are true and reason is the correct explanation of assertion.

### **Explanation** :

Number of electrons, protons and neutrons in carbon are equal, that is 6. The mass number of carbon is 12. Thus, both assertion and reason are true and reason is the correct explanation of the assertion.

71. Assertion: Carbon forms large number of compounds

Reason: Carbon has small size and is tetravalent

- (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 assertion is false, but reason is true.
- Ans. (b) If both assertion and reason are true, but reason is not the

correct explanation of assertion.

### **Explanation** :

Carbon has the property of self-linkage among identical atoms to form large number of compound. This is because it is smaller in size and is tetravalent which means it has a valency of four and is capable of bonding with four other atoms. These bonds that carbon forms with other elements are very strong making these compounds exceptionally stable. Thus, both assertion and reason are true and reason is the correct explanation of assertion.

72. Assertion: Catenation is shown by carbon.

**Reason:** Catenation is shown by carbon because it has valency of 5.

- (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 assertion is false, but reason is true.

**Ans.** (c) If assertion is true, but reason is false.

### **Explanation** :

Catenation is shown by carbon because it has valency of 4 and it can form large number of compounds with other compounds. Thus, assertion is true but reason is false.

73. Assertion: In a homologous series of alcohols, the formula for the second member is C<sub>2</sub>H<sub>5</sub>OH and the third member is C<sub>3</sub>H<sub>7</sub>OH.
 Reason: The difference between the molecular masses of the two

consecutive members of a homologous series is 144.

- (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 assertion is false, but reason is true.
- **Ans.** (c) If assertion is true, but reason is false.

### **Explanation** :

In homologous series two consecutive members differ by  $- CH_2$  and differ in molecular masses by 14. Thus, assertion is true but reason is false.

**74.** Assertion: General formula of alkanes is  $C_n H_{2n+2}$ .

**Reason:** It is because they are saturated compounds.

- (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 assertion is false, but reason is true.
- **Ans.** (b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

### **Explanation** :

Alkanes are saturated compounds because they are very unstable.

Thus, both assertion and reason are true but reason is not the correct explanation of the assertion.

75. Assertion: Following are the members of a homologous series :

 $CH_3$ 0 Η, С Н 3 С Н 2 0 Η, С Н 3 С Н 2 С Н 2 0 Н

**Reason:** A series of compounds with same functional group but differing by  $-CH_2$ —unit is called a homologous series.

- (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 assertion is false, but reason is true.
- **Ans.** (a) If both assertion and reason are true and reason is the correct explanation of assertion.

### **Explanation** :

The Homologous series of the compounds differ by  $- CH_2$  units and molecular mass of each member differs by 14 amu. Thus, both assertion and reason are true and reason is the correct explanation of the assertion.



**76.** Read the following passage carefully and answer the following questions from 76 (i) to 76 (v):

The phenomenon of the existence of an element in two or more physical forms within the same physical state is known as allotropy. Allotropes have similar chemical properties but they differ in chemical properties. In crystalline form, Carbon occurs as graphite, diamond, and fullerenes. Diamond is the hardest natural substance known and is used in cutting marbles, granite, and glass. Graphite is a greyish black and opaque substance, lighter than a diamond with comparative low density. Graphite has a sheet-like structure having hexagonal layers. One layer slides over the other layer due to weak forces and hence it is soft to touch and breaks easily. Graphite is also used as a lubricant.

(i) Substance A is a moderate conductor of electricity. Observe the structure of substance A given below.



Choose the correct statements regrading substance A.

**Statement I -** It is a covalent compound.

Statement II - It has a giant molecular structure.

**Statement III -** It has the same structure as graphite.

**Statement IV -** It has the same structure as diamond.

- (a) I and III
- (b) II and III
- (c) II and IV
- (d) I, II and IV
- (ii) Which of the following is correct about the structure of diamond?
  - (a) Carbon atoms are held together by single covalent bonds.
  - (b) Electrons move freely through the structure.
  - (b) Layers of atoms slide easily over each other.
  - (d) Carbon atoms conduct electricity in the molten state.
- (iii) Which three allotropes of carbon do the given figures represent?



- |||| ||||
- (a) I-Graphite II-Diamond III-Fullerene
- (b) I-Diamond II-Fullerene III-Graphite
- (b) I-Graphite II-Fullerene III-Diamond
- (d) I-Fullerene II-Graphite III-Diamond
- (iv) Identify the incorrect statement(s):
  - I. Diamond is the hardest substance known while graphite breaks easily.
  - **II.** Each carbon atom in diamond is bonded to 4 other carbon atoms in a tetrahaderal manner to form a giant lattice. All carbon atoms are bonded by strong covalent bonds.
  - **III.** Graphite is poor conductor of electricity unlike other non metals.
  - **IV.** In each layer of graphite, each carbon atom is bonded to three other carbon atoms foming hexagonal rings of carbon atoms.
  - (a) I and III
  - (b) Only III
  - (b) II and IV
  - (d) I, II and IV

- (v) The number of carbon atoms surrounding each carbon atom in a diamond are:
  - **(a)** 3
  - **(b)** 4
  - **(b)** 2
  - **(d)** 5
  - Ans. (i) (c) II and IV
  - (ii) (a) Carbon atoms are held together by single covalent bonds
  - (iii) (a) I-Graphite II-Diamond III-Fullerene
  - (iv) (b) Only III
  - (v) (b) 4
- **77.** Read the following passage carefully and answer the following questions from 77(i) to 77(iv):

As a versatile element, carbon can form large compounds because of its tetravalency and the property of catenation that it exhibits. Here, catenation refers to the combination of carbon atoms with itself to form large molecules. Carbon forms stronger covalent bonds with itself and other elements such as hydrogen, oxygen, sulphur, nitrogen and chlorine. This is because its nucleus has a strong force of attraction and holds these bonds tightly together.



### (i) Match the columns:

Column A	Column B
(1) Methane	(p) C <sub>8</sub> H <sub>18</sub>
(2) Propane	(q) C <sub>4</sub> H <sub>10</sub>
(3) Butane	(r) C <sub>5</sub> H <sub>12</sub>
(4) Pentane	(s) C <sub>3</sub> H <sub>8</sub>
(5) Octane	(t) CH <sub>4</sub>

- (a) (1)-(q), (2)-(s), (3)-(t), (4)-(p), (5)-(r)
- **(b)** (1)-(p), (2)-(r), (3)-(s), (4)-(q), (5)-(t)
- (c) (1)-(t), (2)-(s), (3)-(q), (4)-(r), (5)-(p)
- (d) (1)-(t), (2)-(q), (3)-(s), (4)-(r), (5)-(p)
- (ii) Which of the following statements regarding carbon is incorrect?
  - (a) A single atom of carbon can participate in two double bonds
  - (b) A single atom of carbon can participate in three single bonds and one double bond
  - (c) A single atom of carbon can participate in four single bonds
  - (d) A single atom of carbon can participate in two single bonds and one double bond

- (iii) Put the elements in the right order in terms of their valency, starting with the element of lowest valency?
  - (a) O, C, N, H
  - (b) C, O, N, H
  - (c) H, C, O, N
  - (d) H, O, N, C
- (iv) Which of the following does not represent the molecular formula  $C_{6}H_{14}?$







- **Ans.** (i) (c) (1)-(t), (2)-(s), (3)-(q), (4)-(r), (5)-(p)
  - (ii) (b) A single atom of carbon can participate in three single bonds and one double bond

(iii) (d) H, O, N, C



**78.** Read the following passage carefully and answer the following questions from Q 78 (i) to 78 (v):

The compounds which have the same molecular formula but differ from each other in physical or chemical properties are called isomers and this phenomenon is known as isomerism. Structural isomerism is when isomers have difference in the arrangement of atoms within the molecule, without any reference to space. We can say that compounds which have the same molecular formula but different structural formula show structural isomerism. Compounds of carbon show this phenomenon as the atoms can be linked together in the form of straight chains, banched chains or even rings.

- (i) Among the following sets of compounds, choose the set having the same molecular formulae:
  - (a) Butane and iso-butane
  - (b) Cyclohexane and hexene
  - (b) Propanal and propanone
  - (d) All
- (ii) The minimum number of carbon atoms required in an organic compound, in order to form branching:
  - **(a)** 3
  - **(b)** 4
  - **(b)** 5
  - **(d)** 2
- (iii) Which of the following pairs show isomerism?
  - (a) Ethane and ethene
  - (b) Propane and butane
  - (b) Ethane and propane
  - (d) Butane and 2-methyl propane
- (iv) Which among the following has the longest chain?
  - (a) Iso-pentane
  - (b) 2-methylpentane
  - (c) 2,2-dimethylbutane

- (d) neopentane
- (v) The number of isomers of pentane is:
  - **(a)** 4
  - **(b)** 3
  - **(c)** 2
  - **(d)** 5
  - Ans. (i) (d) All
  - (ii) (b) 4
  - (iii) (d) Butane and 2-methyl propane
  - (iv) (b) 2-methylpentane
  - (v) (b) 3

**Reasoning Based Questions** 

**79.** Why are carbon and its compounds used as fuels for most applications?\*

### [NCERT]

- **Ans.** Carbon and its compounds are used as fuels for most applications because most of the carbon compounds give a lot of heat and light when burnt in air. Saturated hydrocarbons burn with a clean flame and no smoke is produced. The carbon compounds, used as a fuel, have high calorific values.
- 80. Why is fullerene so called?
- **Ans.** Fullerene is so called because it resembles the framework of dome shaped halls designed by American architect Buckminster

fuller.

- 81. Catenation is the ability of an atom to form bonds with other atoms of the same element. It is exhibited by both carbon and silicon. Compare the ability of catenation of the two elements. Give reasons.
- Ans. Carbon has the maximum capacity of catenation. The reason for this is the smaller size of of carbon which makes the C–C bonds strong. The size of sulphur is greater than Carbon. This makes Si —Si bonds comparatively weaker than C- C bond.



- **82.** Answer the following questions:
  - (i) What are the two properties of carbon which lead to the huge number of carbon compounds we see around us?

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- (ii) Which element exhibit the property of catenation to maximum extent and why\*?
- **Ans. (i)** The two features of carbon that give rise to a large number of compounds are as follows:
  - (a) **Catenation:** The ability to form bonds with other atoms of carbon to form a long chain
  - (b) **Tetravalency:** With the valency of four, carbon is capable of bonding with four other atoms.
  - (ii) Carbon exhibits the property of catenation to maximum extent.

It is due to strong tetra valency of carbon.

- 83. Answer the following questions:
  - (i) What is homologous series of carbon compounds?\*
  - (ii) Write the name and formula of the 2nd member of homologous series having general formula  $(C_nH_{2n+2})$ .\*
  - (iii) Write the molecular formula of the 2nd and 3rd member of the homologous series where the first member is ethyne.<u>\*\*</u>
  - (iv) What is the difference in molecular formula of any two consecutive members of a homologous series?
- Ans. (i) The series of organic compounds having same functional group and similar chemical properties is called homologous series. Each member differs from successive member by –CH<sub>2</sub> group. The difference in molecular weight between two successive members is 14*u*.
  - (ii) The name of 2nd member of alkanes: Ethane. The formula of 2nd member of alkanes:  $C_2H_6$  or  $CH_3 CH_3$ .
  - (iii) 2nd member of alkyne series is propyne  $(C_3H_4)$ , 3rd member of alkyne series is butyne  $(C_4H_6)$ .
  - (iv) The molecular formula of two consecutive members of a homologous series differ by –CH<sub>2</sub>.
- 84. State the following:
  - (i) Two properties of carbon which lead to the formation of a large number of carbon compounds.
  - (ii) Write the next homologue of  $C_2H_4$  and  $C_4H_6$ .
  - (iii) Write the name and molecular formula of the first member of

the homologous series of alkyne.

- (iv) Write the next two members of homologous series for  $C_2H_6$ and  $C_3H_8$ ?
- (v) Write the name and formula of second member of homologous series having general formula  $(C_nH_{2n})$ .
- (vi) Write the name and formula of second member of homologous series having general formula  $(C_nH_{2n-2})$ .
- (vii) Write the names of any two isomers represented by the molecular formula  $C_5H_{12}$ .
- Ans. (i) Catenation and tetravalency.
  - (ii)  $C_3H_6$  and  $C_5H_8$
  - (iii) Ethyne  $(C_2H_2)$
  - (iv)  $C_4H_{10}$  and  $C_5H_{12}$
  - (v) Propene  $(C_3H_6)$
  - (vi) Propyne  $(C_3H_4)$
  - (vii) Isopentane and neopentane.



- **85.** What are covalent compounds ? Why are they different from ionic compounds? List their three characteristics properties.\*
- **Ans.** The compounds which are formed by sharing of electrons between two or more same atoms or between two or more non-metals are called covalent compounds. They are different from ionic compounds as:

- (a) Covalent compounds are bad conductors of electricity whereas ionic compounds are good conductors of electricity in molten state.
- (b) Covalent compounds are directional and ionic compounds are non-directional.

### **Characteristics of Covalent compounds:**

- (a) They have low melting and boiling point.
- (b) These compounds are generally insoluble in water.
- (b) These compounds are bad conductors of electricity.
- **86.** Explain the nature of the covalent bond using the bond formation in  $CH_3CI$ .

[NC E R T]

**Ans.** Carbon has 4 valence electrons. It completes its octet by sharing its four electrons with other carbon atoms or with atoms of other elements as it can neither lose four of its electrons nor gain four electrons since both the processes require extra amount of energy and would make the system unstable. Such bonds that are formed by sharing



of electrons and are known as covalent bonds. In covalent bonding, both the atoms share the valence electrons, *i.e.*, the shared electrons belong to the valence shells of both the atoms.

In the formation of  $CH_3CI$ , carbon requires 4 electrons to complete its octet, while each hydrogen atom requires one electron to complete its duplet. Also, chlorine requires an electron to complete the octet. Therefore, all of these share the electrons and as a result, carbon forms 3 bonds with hydrogen atom and one with chlorin atom.

- **87.** Carbon has the unique property to form bonds with other carbon atoms:\*
  - (i) Name the unique property of carbon.
  - (ii) Give reason for unique property of carbon atom.
  - (iii) Draw the structure of cyclohexane.
- Ans. (i) Catenation.
  - (ii) It is due to tetra valency of carbon atom.
  - (iii) Cyclohexane.



**88.** What is a homologous series? Explain with an example.

**Ans.** A homologous series is a series of carbon compounds that have different numbers of carbon atoms but contain the same functional group. There is a difference of  $--CH_2$  unit between each successive member and mass differ by 14*u*. For example, methane, ethane, propane, butane, etc., are all part of the alkane homologous series. The general formula of this series is  $C_nH_{2n+2}$ .



- **89.** Explain why carbon forms compounds mainly by covalent bond. Explain in brief two main reasons for carbon forming a large number of compounds. Why does carbon forms strong bonds with most other elements?
- **Ans.** Carbon is tetravalent. Carbon has 4 electrons in its outer most shell. To complete the octet it needs 4 electrons. Thus, it can either gain or lose 4 electrons. But loosing or gaining 4 electrons is not possible due to energy consideration. Hence, in place of gaining or losing 4 electrons, carbon does sharing of these 4 electrons and covalent bonds.
  - (a) **Catenation:** The tendency of carbon to form chains of identical atoms is known as catenation. Carbon forms long chains by combining with other carbon atoms through covalent bonds.
  - (b) Tetravalency: It has 4 valence electrons, so it can form 4 covalent bonds with four different atoms, or two double bonds or a single and a triple bond with other atoms. This tendency helps carbon to form a large range of compounds. Carbon forms strong bonds with most of other elements like H, O, S, N, Cl. Br, I etc. due to its small size which helps it to attract more number of electrons.

**90.** Answer the following questions:

- (i) State any three physical property of carbon compounds.
- (ii) Carbon is a versatile element. Justify this statement.\*
- Ans. (i) The properties of carbon compounds are:
  - (a) Carbon possesses property of catenation:
  - (b) Poor conductor of electricity.
  - (c) Low melting and boiling point as compared to ionic compounds.
  - (ii) Carbon is a versatile element because of its properties. It shows the property of catenation due to which it forms a large number of compounds. Carbon is tetravalent. Due to this, it forms covalent compounds only.
- **91.** State the reason why carbon can neither form C<sup>4+</sup> cations nor C<sup>4–</sup> anions, but forms covalent compounds. Also state reasons to explain why covalent compounds:\*
  - (i) Are bad conductors of electricity?
  - (ii) Have low melting and boiling point?
- Ans. Carbon needs 4 electrons to complete its octet. It has 4 electrons in its valence shell. Thus, carbon can either gain or lose 4 electrons. But due to energy consideration, it is not possible. Therefore, in place of gaining or losing 4 electrons, carbon does sharing of these 4 electrons to form covalent bonds. Therefore, can neither form C<sup>4+</sup> cations nor C<sup>4 –</sup> anions but forms covalent compounds only by sharing of electrons.
  - (i) Covalent compounds are bad conductors of electricity because they do not contain ions.

- (ii) Covalent compounds have usually low melting and boiling point because the force of attraction between the molecules of covalent bond is very weak.
- **92.** Elements forming ionic compounds attain noble gas configuration by either gaining or losing electrons from their valence shells. Explain giving reason why carbon cannot attain such a configuration in this manner to form its compounds. Name the type of bonds formed in ionic compounds and in the compounds formed by carbon. Also explain with reason why carbon compounds are generally poor conductors of electricity.\*
- **Ans.** Carbon needs 4 electrons to complete its octet. It has 4 electrons in its valence shell. Thus, carbon can either gain or lose 4 electrons. But due to energy consideration, it is not possible. Therefore, in place of gaining or losing 4 electrons, carbon does sharing of these 4 electrons to form 4 covalent bonds. Electrovalent or ionic bond is present in ionic compounds whereas covalent bond is present in Carbon compounds. Carbon compounds are poor conductors of electricity because of absence of ions.
- **93.** Why certain compounds are called hydrocarbons? Write the general formula for homologous series of alkanes, alkenes and alkynes and also draw the structure of the first member of each series. Write the name of the reaction that converts alkenes into alkanes and also write a chemicals equation to show the necessary conditions for the reaction to occur.\*
- **Ans.** Compounds containing only carbon and hydrogen are called hydrocarbons.

General formula for the homologous series of alkanes is  $C_nH_{2n+2}$ First member of the alkane family is methane.



General formula for the homologous series of alkenes is  $C_nH_{2n}$ . First member of the alkene family is ethene.



General formula for the homologous series of alkynes =  $C_n H_{2n-2}$ . First member of the alkyne family is ethyne.

Catalytic hydrogenation is the reaction used to convert alkenes to alkanes.

$$CH_2 = CH_2 + H_2 \xrightarrow{\text{Nickel}} C_2H_6$$
Differentiate Between

**94.** Differentiate between diamond and graphite. <u>\*\*\*\*</u>

### Ans.

	Diamond	Graphite
(a)		

	Dia	Gra
	m	р
	0	hi
	n	te
	d	h
	h	а
	а	S
	S	h
	3-	е
	di	X
	m	а
	e	g
	n	0
	si	n
	0	al
	n	S
	al	h
	n	е
	et	et
	w	la
	or	У
	k	er
	st	st
	ru	ru
	ct	ct
	ur	ur
	e.	е.
(b)	Eac	
	h	
	С	
	ar	
	b	

0	Eac
n	h
in	С
di	ar
a	b
m	ο
0	n
n	h
d	а
is	S
þ	0
0	n
n	e
d	fr
е	е
d	е
to	el
fo	е
ur	ct
ot	ro
h	n
er	w
С	it
ar	h
b	it.
0	
n	
at	
<b>O</b>	
m	
s.	

(C)	Νο	It is
	fr	а
	е	g
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### Analysis and Evaluation Based Questions

**95.** Carbon is so versatile in nature that organic chemistry forms a separate branch of chemistry which deals mainly with carbon and its compounds. Carbon is an element with symbol "C", atomic number 6. Carbon element has a property of catenation. Carbon has a valency of four. So, it is capable of bonding with four other atoms of carbon or atoms of some other monovalent element. Compounds of carbon are formed with oxygen, nitrogen, hydrogen, sulphur, chlorine and many other elements, giving rise to compounds with specific properties which depend on the elements

other than the carbon present in the molecule.



- (i) Name the term used to define property of carbon to form bond with another carbon atom.
- (ii) Name the group and period to which carbon belong.
- (iii) Name the term used for four valency of carbon.
- (iv) Which of these statements is incorrect?
- (a) Valence electrons of carbon are 4.
- (b) Carbon has a valency of four.
- (c) Organic chemistry forms a separate branch of chemistry which deals mainly with carbon and its compounds.
- (d) Electronic configuration of carbon is 2,6.
- **Ans.** (i) Catenation is the term used to define property of carbon to form bond with another carbon atom.
  - (ii) Carbon belongs to second period and fourteenth group of periodic table.
  - (iii) The term used for four valency of carbon is tetravalency.
  - (iv) Total electrons present in carbon are 6. Out of these 6 electrons, 2 are present in first shell and other four in next shell. This gives electronic configuration of carbon to be 2,4. Hence,

the incorrect option is (d).

- **96.** The solid element A exhibits the property of catenation. It is also present in the form of a gas B in the air which is utilised by plants in photosynthesis. An allotrope C of this element is used in glass cutters.
  - (i) What is element A?
  - (ii) What is the gas B?
  - (iii) Name the allotrope C.
  - (iv) State another use of allotrope C (other than in glass cutters).
  - (v) Name another allotrope of element A which exists as spherical molecules.
  - (vi) Name yet another allotrope of element A which conducts electricity.
- Ans. (i) Element A: Carbon
  - (ii) Gas B: Carbon dioxide
  - (iii) Allotrope C: Diamond
  - (iv) Used for making jewellery
  - (v) Buckminsterfullerene
  - (vi) Graphite
- **97.** A colourless organic liquid X of molecular formula  $C_2H_4O_2$  turns blue litmus to red. Another colourless organic liquid Y of molecular formula  $C_2H_6O$  has no action on any litmus but it is used as a nail polish remover. A yet another colourless organic liquid Z of molecular formula  $C_2H_6O$  has also no action on litmus but it is used

in tincture of iodine.



- (i) Name the liquid X. To which homologous series does it belong? Give the name of another member of this homologous series.
- (ii) Name the liquid Y. To which homologous series does it belong? Write the name of another member of this homologous series.
- (iii) Can you name an organic compound having the same molecular formula as liquid Y but which belongs to a different homologous series? What is this homologous series?
- (iv) Name the liquid Z. To which homologous series does it belong? Write the name of another member of this homologous series.
- Ans. (i) Liquid X is ethanoic acid; it belongs to homologous series of carboxylic acids. Methanoic acid is another member of this homologous series.
  - (ii) Liquid Y is Propanone; it belongs to homologous series of ketones. Butanone is another member of this homologous series.
  - (iii) Propanal; it belongs to homologous series of aldehydes.
  - (iv) Liquid Z is ethanol; it belongs to homologous series of alcohols. Methanol is another member of this homologous series.

## Creating Based Questions

- **98.** The solid element A exhibits the property of catenation. It is also present in the form of a gas B in the air which is utilised by plants in photosynthesis. An allotrope C of this element is used in glass cutters.
  - (i) What is element A?
  - (ii) What is the gas B?
  - (iii) Name the allotrope C.
  - (iv) State another use of allotrope C (other than in glass cutters).
  - (v) Name another allotrope of element A which exists as spherical molecules.
  - (vi) Name a yet another allotrope of element A which conducts electricity.
- Ans. (i) Element A : Carbon
  - (ii) Gas B : Carbon dioxide
  - (iii) Allotrope C : Diamond
  - (iv) Used for making jewellery
  - (v) Buckminsterfullerene
  - (vi) Graphite
- **99.** From the given table, answer the following questions :

	Column I	Column II
1.		<ul><li>Used as gems and for making jewellery.</li><li>They can be synthesized by subjecting</li></ul>

	pure carbon to very high pressure and temparature.
2.	<ul> <li>Used in several lubricant products, such as grease and forging lubricants, in blast furnace linings.</li> <li>Its amorphous form is used in the manufacturing of lead used in pencils.</li> </ul>
3.	<ul> <li>Used as an anti-aging and anti-damage agent in the cosmetic sector, used as antiviral agents.</li> <li>Poor conductor of electricity.</li> </ul>

- (i) Identify all three structures mentioned in the table.
- (ii) What type of property bound these following structures?
- (iii) Which one is the good conductor of electricity?
- (iv) What is difference between the first two structures?

### Ans.

(i) (a) Dimond

- (b) Graphite
- (b) Buckminsterfullerene
- (ii) Catenation property
- (iii) Graphite.
- (iv) Diamond is the hardest substance while graphite is smooth and slippery and also graphite is good conductor of electricity.

### 100

# . Based on the information given below answer the following questions:

Carbon has the versatile nature it shows the property of catenation and has the tetravalency. Catenation is the ability of an atom to form bonds with other atoms of the same element. Carbon has the valency of 4 due to which it can form the covalent compounds with the other elements as well and thus it forms hydrocarbons as well which exist in the nature in a form of a series known as the Homologous series.

- (i) List the three characteristics of the Homologous series.
- (ii) Why carbon forms the covalent compounds?
- (iii) Which element other than carbon exhibits the property of catenation?

# Ans. (i) Characteristics of homologous series of carbon compound:

- (a) All the members of a homologous series can be represented by the same general formula and they have same functional group.
- (b) Any two adjacent homologues differ by 1 carbon atom and 2

hydrogen atoms in their molecular formulae.

- (c) The difference in the molecular masses of any two adjacent homologues is 14 *u*.
- (ii) Electricity is conducted by moving electrons. But carbon forms covalent bonds by sharing of electrons. It does not have free electrons.
- (iii) Silicon.

### 101

- . Give two possibilities through which carbon can attain the inert gas configuration.
- Ans. Carbon has two possibilities to attain noble gas configuration.
  - (a) One of the possibilities is to attain four electrons and form C<sup>4–</sup> anion. But it will be difficult for the nucleus to hold four more electrons firmly.
  - (b) Another possibility is to lose four electrons forming C<sup>4+</sup> cation. But this will also be difficult due to the requirement of large energy to lose four electrons from the outermost shell. As a result the atom will contain six protons and two electrons.

### 102

. Study the table related to three hydrocarbons X, Y and Z carefully and answer the following questions from Q 102 (i) to 102 (iii):

Hydrocarbon	Molecular Formula
Х	C <sub>3</sub> H <sub>8</sub>
Y	C <sub>5</sub> H <sub>10</sub>
Z	C <sub>4</sub> H <sub>6</sub>

(i) X, Y and Z are classified as hydrocarbons because these contain:

- (a) Hydrogen
- (b) Oxygen
- (c) Carbon
- (d) Both carbon and hydrogen
- (ii) To which series  $C_5H_{10}$  belongs?
  - (a)  $C_n H_{2n+2}$
  - (b) C*n*H<sub>2*n*</sub>
  - (c)  $C_n H_{2n-2}$
  - (d) C<sub>n</sub>H<sub>n+2</sub>
- (iii) Choose the incorrect statement regarding above three hydrocarbons
  - (a) All have different general formula
  - (b) X and Y differ by  $-CH_2$  unit
  - (c) Z is an alkyne
  - (d) Y is an alkene
- Ans. (i) (d) Both carbon and hydrogen
  - (ii) (b)  $C_n H_{2n}$
  - (iii) (b) X and Y differ by  $-CH_2$  unit

### 103

. Study the table given below carefully and answer any four questions from Q 103 (i) to 103 (iv):

Hydrocarbon	Property

Н	has the molecular formula $C_{10}H_{22}$	
J	has two carbon atoms less than (H) and belongs to the sam homologous series.	
к	has two carbon atoms more than (H) and belongs to the sam homologous series.	

- (i) What is the molecular formula of J?
  - (a) C<sub>12</sub>H<sub>26</sub>
  - **(b)**  $C_8H_{16}$
  - (c) C<sub>8</sub>H<sub>18</sub>
  - (d) C<sub>8</sub>H<sub>14</sub>
- (ii) Compounds H, J, K belong to which homologous series?
  - (a) C<sub>n</sub>H<sub>2n</sub>
  - **(b)**  $C_n H_{2n-2}$
  - **(b)** C<sub>n</sub>H<sub>2n+2</sub>
  - (d) C<sub>n</sub>H<sub>2n+1</sub>
- (iii) What is the molecular formula of K?
  - (a) C<sub>12</sub>H<sub>26</sub>
  - **(b)**  $C_{12}H_{24}$
  - (c)  $C_{12}H_{22}$
  - (d) C<sub>12</sub>H<sub>28</sub>
- (iv) Choose the correct statements regarding compounds H, J and K
  - (a) All have the same chemical properties
- (b) All have different general formula
- (c) All differ by  $-CH_2$  unit
- (d) All have same melting and boiling points

**Ans.** (i) (c) C<sub>8</sub>H<sub>18</sub>

- (ii) (c)  $C_n H_{2n+2}$
- (iii) (a) C<sub>12</sub>H<sub>26</sub>
- (iv) (a) All have the same chemical properties

#### 104

. Question number 104(i)-104(iv) are based on the table given below. Study the table and answer the following questions.

Homologous Series	General Formula	Functional Group	Example
Alkanes	C <sub>n</sub> H <sub>2n + 2</sub>	C – C	Met h a n e, C H 4
			Eth
			а
			n
			е,
			С
			2
			H
			6

			Pro p a n e, C 3 H 8 But a n e, C 4 H 10
Alkenes	C <sub>n</sub> H <sub>2n</sub>	C = C	Eth e n e, C 2 H 4

		Pro
		р
		е
		n
		е,
		С
		3
		Н
		6
		But
		е
		n
		е,
		С
		4
		Н
		8
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- (i) Give the name of the fifth member of the homologous series of Alkanes.
- (ii) What type of bond is present in Alkanes?
- (iii) Which hydrocarbon is also known as marsh gas?
- (iv) Give one use of the ethene.

### Ans

- . (i) Pentane ( $C_5H_{12}$ ).
- (ii) Single bond is present in alkanes.
- (iii) Methane.
- (iv) In the manufacture of many important polymers like polyethene and polyvinyl chloride (PVC).

105

. Based on the structures given below answer the following questions:



- (i) Give the name of the third member of the homologous series of alkene.
- (ii) Write the number of covalent bonds in the molecule of butane.
- (iii) Write the number of covalent bonds in the molecule of propane.
- (iv) Draw the structure of butane.
- **Ans.** (i) Butene  $(C_4H_8)$ .
  - (ii) Thirteen
  - (iii) 10 bonds



### 106

. Define bond length.

# 107

Define allotropy.

# 108

- . Which of the following is used in pencil lead?
  - (a) Diamond
  - (b) Graphite
  - (c) Coke
  - (d) All the above

#### 109

- . Which of the following is not a characteristic of graphite?
  - (a) Soft and slippery
  - (b) Good conductor of electricity
  - (c) Heavier than diamond
  - (d) Contains free electrons
- 110. Which one is called buckminsterfullerene?

- (a) C<sub>60</sub>
- **(b)** C<sub>70</sub>
- (**c**) C<sub>80</sub>
- (d) C<sub>90</sub>

**111. Assertion:** Carbon and its compounds are used as fuels.

Reason: They give lot of heat and light when burnt in air.

- 112. What its catenation?
- 113. What do you mean by isomers?
- **114.** What is general formula of alkanes?
- **115.** Which of the following is an example of triple bond?

 $C_2H_6, C_2H_2, C_2H_4, C_3H_4$ 

- 116. What are non-crystalline allotropes of carbon?
- **117.** Classify the following compounds as alkanes, alkenes and alkynes: C<sub>2</sub>H<sub>4</sub>, C<sub>3</sub>H<sub>4</sub>, C<sub>4</sub>H<sub>8</sub>, C<sub>5</sub>H<sub>12</sub>, C<sub>5</sub>H<sub>8</sub>, C<sub>3</sub>H<sub>8</sub>, C<sub>6</sub>H<sub>6</sub>.