17. VERSATILE NATURE OF CARBON

SOLUTIONS

TEACHING TASK

JEE MAINS LEVEL QUESTIONS

1. The unique property of carbon atoms responsible for the formation of very large number of organic compounds is : **(FA & SA- 2 Marks)**

   1) Hybridisation 2) Allotropy 3) Catenation 4) None of these

Answer:3

Solution:Catenation is the ability of carbon atoms to form long chains and rings with other carbon atoms, leading to a vast number of organic compounds.

2. The crystalline allotropic forms of carbon are:

   1) Graphite 2) Diamond 3) '1' and '2' 4) None of these

Answer:3

Solution:The crystalline allotropes of carbon are graphite and diamond.

3. Organic compounds are very large in number because of

   1) Tetravalency of carbon
   2) Catenation
   3) Ability of carbon to form multiple bonds with elements itself and with other
   4) All are correct

Answer:4

Solution:The large number of organic compounds is due to tetravalency, catenation, and the ability to form multiple bonds.

4. Number of isomers are possible for the compound with molecular formula $C_{15}H_{12}$ (Pentane) **(FA & SA- 5Marks / 8 Marks)**

   1) 1 2) 2 3) 3 4) 4

Answer:3

Solution:Pentane (C_5H_{12}) has three structural isomers: n-pentane, isopentane (2-methylbutane), and neopentane (2,2-dimethylpropane).

5. Carbon exists as gaseous state in

   1) Oxides 2) Hydrocarbons 3) Both '1' and '2' 4) None of these

Answer:3

Solution:Carbon exists in gaseous form in its oxides (CO, CO_2) and hydrocarbons (e.g., methane, ethane in gaseous state)

6. The main reason behind allotropy is

   1) physical forms

2) chemical properties
3) different arrangement of atoms in the molecule
4) All the above

Answer:3

Solution:Allotropy arises due to different bonding arrangements of atoms in the solid state.

7. Crystalline allotropic forms of carbon is
1) diamond 2) graphite 3) C_{60} 4) All the above

Answer:4

Solution:Diamond, graphite, and C_{60} (fullerene) are all crystalline allotropes of carbon.

8. Purest form of carbon is
1) diamond 2) graphite 3) C_{60} 4) All the above

Answer:1

Solution:Diamond is considered the purest form of carbon because it consists solely of carbon atoms in a tetrahedral network.

9. The bond angle and bond length in diamond is

(FA & SA- 3 Marks / 4 Marks)

1) $109^0 28'$, 1.42 A^0 2) $105^0 28'$, 1.54 A^0
3) $109^0 28'$, 1.54 A^0 4) $105^0 28'$, 1.42 A^0

Answer:3

Solution:In diamond, each carbon is sp^3 hybridized with bond angles ~109.5° and C–C bond length ~1.54 Å.

10. The adjacent layers in graphite are held by
1) Weak van der Waal's forces 2) Covalent forces
3) Both 1 & 2 4) None

Answer:1

Solution:Graphite layers are held together by weak van der Waals forces, allowing them to slide.

JEE ADVANCED LEVEL QUESTIONS

Multi correct answer type:

11. Which of the following statements is correct about carbon
1) Possesses maximum tendency for catenation
2) Shows isomerism
3) Tetravalency
4) exhibits allotropy

Answer:1,2,3,4

Solution:1) Possesses maximum tendency for catenation $\rightarrow$True (strongest among elements due to C–C bond strength)
2) Shows isomerism $\rightarrow$ True (organic compounds have isomers due to carbon's

bonding)

3) Tetravalency → True
4) Exhibits allotropy → True (diamond, graphite, etc.)

12. Which of the following is correct about structure of Diamond
1) Carbons are arranged in regular tetrahedron
2) Bond angle is $109^0 28'$ and bond length is 1.54 A^0.
4) Density is 3.51 g/cc
D) Refractive index is 2.41

Answer:1,2,3,4

Solution:

1) Carbons are arranged in regular tetrahedron → True (each C sp^3, tetrahedral)
2) Bond angle is 109°28' and bond length is 1.54 Å → True
3) Density is 3.51 g/cc → True
4) Refractive index is 2.41 → True (approx 2.417 for diamond)

Assertion and Reason Type:

1) Both Assertion and Reason are true, and Reason is the correct explanation for Assertion.
2) Both Assertion and Reason are true, but Reason is NOT the correct explanation for Assertion.
3) Assertion is true, but Reason is false.
4) Assertion is false, but Reason is true.

13. **Assertion :**Diamond is used for cutting glass
Reason : Atoms are held firmly by strong covalent bonds

Answer:1

Solution:Assertion: True – Diamond is extremely hard due to its structure.
Reason: True – The hardness comes from strong covalent bonds in a tetrahedral network.
But the reason directly explains why diamond is hard, and hardness allows it to cut glass.

14. **Assertion :** Graphite acts as good conductor of electricity and heat.
Reason : Loosely held electron is present in Graphite

Answer:1

Solution:Assertion: True – Graphite conducts electricity due to delocalized p-electrons in layers.
Reason: True – Each carbon has one delocalized electron in p-orbital forming p-bonds.
Reason correctly explains Assertion.

Comprehension Type:

Graphite is soft, greasy, dark grayish coloured crystalline solid. In graphite, each carbon atom is linked to three other carbon atoms in a hexagonal planar structure. The C-C bond length is 1.42 A^0 and bond angle is 120^0. The

adjacent layers are held by weak van der Waal's forces and the distance between two layers is 3.4 A^0. Thus, two adjacent layers can easily slide over each other and hence graphite is soft and possesses low density.

15. Graphite is used as lubricant due to
    1) Carbons are arranged in regular tetrahedron
    2) two adjacent layers can easily slide over each other
    3) low Density
    4) High Refractive index

Answer:2

Solution:In graphite, carbon atoms form hexagonal sheets arranged in layers. These layers are held together by weak van der Waals forces, allowing them to slide over each other easily, producing a soft and slippery feel—perfect for lubrication.

16. Which of the following statement is correct about graphite
    1) It is insoluble in ordinary solvents
    2) Acts as good conductor of electricity and heat.
    3) Both 1 & 2
    4) None

Answer:3

Solution:A) It is insoluble in ordinary solvents $\rightarrow$True
B) Acts as good conductor of electricity and heat $\rightarrow$ True

Integer type:

17. Bond angle in graphite is _____

Answer:120^0

Solution:In graphite, each carbon is sp^2 hybridized, forming trigonal planar geometry.The bond angle is 120°.

Matrix Matching Type:

18.

Column I	Column II
1) grayish coloured crystalline solid	(P) plumbago
2) black lead	(Q) slow down the high energy neutrons
3) moderator	(R) graphite
4) Buckminsterfullerene	(S) buckyballs

Answer:1-R,2-P,3-Q,4-S

Solution:

1) grayish coloured crystalline solid	(R) graphite
2) black lead	(P) plumbago
3) moderator	(Q) slow down the high energy neutrons
4) Buckminsterfullerene	(S) buckyballs

LEARNER'S TASK

CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ's)

1. Graphite is not :
   1) A good conductor of heat 2) An amorphous allotrope of carbon
   3) Softer than diamond 4) Used for making lubricants

Answer:2

Solution:Graphite is a crystalline allotrope of carbon, not amorphous.

2. Carbon atoms in diamond are bonded with each other in a configuration :
   1) Linear 2) Planar 3) Tetrahedral 4) Octahedral

Answer:3

Solution:In diamond, each carbon atom is sp^3 hybridized and bonded tetrahedrally to four other carbon atoms.

3. Buckminster fullerene is :
   1) Graphite 2) Diamond 3) C-60 4) Bone charcoal

Answer:3

Solution:Buckminster fullerene is the C_{60} molecule, a spherical allotrope of carbon.

4. The refractive index of diamond is:
   1) 4.3 2) 2.45 3) 4.5 4) 5.42

Answer:2

Solution:The refractive index of diamond is approximately 2.42

5. Main source of most of the organic compounds is
   1) Coal tar 2) Petroleum 3) Both 1 & 2 4) Ammonia

Answer:3

Solution:Coal tar and petroleum are both considered significant sources of organic compounds. Coal tar is a by-product of the destructive distillation of coal. Petroleum, also known as crude oil, is a fossil fuel composed of a mixture of hydrocarbons. Both contain a variety of organic molecules that can be refined and utilized in various industries.

6. Generally organic compounds are
   1) Amorphous 2) Complexes 3) Covalent 4) Electrovalent

Answer:3

Solution: Organic compounds generally have covalent bonding.

7. The first organic compound synthesised in the laboratory from an inorganic compound is
   1) NH_4NCO 2) $NH_2-CO-NH_2$ 3) CH_3COOH 4) CH_4

Answer:2

Solution:The first organic compound synthesized in the laboratory from an inorganic compound was urea, which has the formula $NH_2–CO–NH_2$.

8. Which of the following properties is not true regarding organic compounds?
   1) They are generally covalent compounds
   2) They have high melting and boiling points
   3) They are generally insoluble in water
   4) They usually show isomerism.

Answer:2

Solution:Most organic compounds have low melting and boiling points due to weak intermolecular forces.

9. The most stable isotope of carbon is
   1) C-12 2) C-13 3) C-14 4) All the above

Answer:1

Solution:C-12 is the most abundant and stable isotope of carbon.

10. The property of carbon atoms to form long chains is called:
    1) Catenation 2) Hybridisation 3) Allotropy 4) All the above

Answer:1

Solution:Catenation is the property of carbon atoms to form long chains with other carbon atoms.

JEE MAINS LEVEL QUESTIONS

11. Organic compounds are numerous since
    1) Carbon has high catenation ability
    2) Tetravalency of carbon
    3) Isomerism of organic compounds
    4) All of these

Answer:4

Solution:Organic compounds are numerous due to catenation, tetravalency, and isomerism.

12. The distance between two layers in graphite is

(FA & SA- 5 Marks / 8 Marks)

    1) 3.4 A^0 2) 2.4 A^0 3) 3.5 A^0 4) 6.4 A^0

Answer:1

Solution:The interlayer distance in graphite is about 3.35–3.4 Å.

13. A pure diamond is transparent to
    1) X-rays 2) Ultraviolet rays 3) visible rays 4) All the above

Answer:4

Solution:A pure diamond is colorless, brittle solid and transparent to X-rays, ultraviolet rays and visible rays.The polished gem has smooth surfaces.

14. Which of the following statement is correct

1) Graphite is chemically more active than diamond
2) Diamond is chemically more active than Graphite
3) Both Diamond and Graphite are equally chemically active
4) None of the above

Answer:1

Solution:Graphite reacts more easily than diamond due to its layered structure and presence of free electrons.

15. Graphite acts as good conductor of electricity and heat due to **(FA & SA- 3 Marks / 4 Marks)**

1) Loosely held electron 2) Strongly held electron
3) Moderately held electron 4) All the above

Answer:1

Solution:Graphite conducts electricity due to delocalized p-electrons in its layers.

16. Which is insoluble in ordinary solvents but not with strong solvents

1) Graphite 2) Diamond 3) C-60 4) Bone charcoal

Answer:1

Solution:Graphite is insoluble in ordinary solvents like water and most organic solvents. However, its layered structure allows it to be dispersed or reacted with certain strong chemicals and molten metals.

17. Catenation takes place between

1) Same elements 2) Different Elements
3) Both 1 & 2 4) None

Answer:1

Solution:Catenation refers to the bonding of atoms of the same element into chains (especially carbon).

18. Molecular formula of Pentane

1) C_5H_{12} 2) C_6H_{12} 3) C_4H_{10} 4) C_5H_{14}

Answer:1

Solution:Pentane is an alkane with molecular formula C_5H_{12}.

19. Radioactive isotopes of carbon is **(FA & SA- 2 Marks)**

1) C-12 2) C-13 3) C-14 4) All the above

Answer:3

Solution:C-14 is the radioactive isotope of carbon, used in radiocarbon dating.

20. Allotropes have

1) Different chemical properties and same physical properties
2) Different physical properties and same chemical properties
3) Different physical properties and different chemical properties
4) None

Answer:2

Solution:Allotropes differ in physical properties but generally have similar chemical properties.

JEE ADVANCED LEVEL QUESTIONS

Multi correct answer type:

21. Which of the following is correct about Allotropic forms
    1) Sulphur : rhombic, monoclinic and plastic.
    2) Phosphorus : red and yellow
    3) Carbon : C-12, C-13 and C-14
    4) Carbon : diamond and graphite

Answer:1,2,4

Solution:1) Sulphur : rhombic, monoclinic and plastic.
True — these are allotropes of sulfur.
2) Phosphorus : red and yellow
True — common allotropes of phosphorus (also white, black, etc., but red and yellow are well-known).
3) Carbon : C-12, C-13 and C-14
False — these are isotopes, not allotropes.
4) Carbon : diamond and graphite
True — these are crystalline allotropes of carbon.

Assertion and Reason Type:

1) Both Assertion and Reason are true, and Reason is the correct explanation for Assertion.
2) Both Assertion and Reason are true, but Reason is NOT the correct explanation for Assertion.
3) Assertion is true, but Reason is false.
4) Assertion is false, but Reason is true

22. **Assertion :** Graphite is soft and possesses low density
    Reason : Two adjacent layers can easily slide over each other

Answer:1

Solution:Assertion is true — Graphite is soft and has low density.
Reason is true — Graphite has layered structure, and weak van der Waals forces between layers allow them to slide.
The Reason correctly explains the Assertion

23. **Assertion :** Graphite is is used in making electrodes
    Reason : Graphite contains loosely held electron

Answer:1

Solution:Assertion is true — Graphite is used for making electrodes.
Reason is true — Graphite has delocalized (free) electrons that conduct electricity.
The Reason correctly explains the Assertion

Comprehension Type:

Buckminsterfullerene is made from interlocking hexagonal and pentagonal

rings of carbon atoms. Its structure is similar to soccer ball and commonly called buckyballs. It has been found that some fullerene based compounds of helium, neon, argon are superconductors, i.e., they conduct electricity without any resistance.

24. Which of the following conduct electricity without any resistance
    1) fullerene based compounds of helium
    2) fullerene based compounds of neon
    3) fullerene based compounds of argon
    4) All the above

Answer:4

Solution:Fullerenes (like C_{60}) when doped with noble gases such as helium, neon, or argon, can form compounds that exhibit superconductivity — meaning they conduct electricity without any resistance at very low temperatures. These are known as fullerene-based superconductors, and all the noble gases mentioned can form such compounds.

Integer type:

25. Ignition temperature of Graphite is _____

Answer:700

Solution:Ignition temperature of Graphite is 700 °C

Matrix Matching Type:

26.

Column I	**Column II**
1) amorphous forms	(P) isomers
2) crystalline forms	(Q) Charcoal
3) same molecular formula	(R) diamond
4) Catenation	(S) open chain or closed chain of compounds

Answer:1-Q,2-R,3-P,4-S

Solution:

A) amorphous forms	(Q) Charcoal
B) crystalline forms	(R) diamond
C) same molecular formula	(P) isomers
4) Catenation	(S) open chain or closed chain of

compounds

KEY

				TEACHING TASK					
			JEE MAINS LEVEL QUESTIONS						
1	2	3	4	5	6	7	8	9	10
3	3	4	3	3	3	4	1	3	1
			JEE ADVANCED LEVEL QUESTIONS						
11	12	13	14	15	16	17	18		
1,2,3,4	1,2,3,4	1	1	2	3	120	1-R,2-P,3-Q,4-S		
				LEARNER'S TASK					
			CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ's)						
1	2	3	4	5	6	7	8	9	10
2	3	3	2	3	3	2	2	1	1
			JEE MAINS LEVEL QUESTIONS						
11	12	13	14	15	16	17	18	19	20
4	1	4	1	1	1	1	1	3	2
			JEE ADVANCED LEVEL QUESTIONS						
21	22	23	24	25	26				
1,2,4	1	1	4	700	1-Q,2-R,3-P,4-S				