NCERT CLASS 10 SCIENCE - CHAPTER 4: CARBON AND ITS COMPOUNDS COMPLETE EXERCISE SOLUTIONS

Q1. Ethane, with the molecular formula C2H6 has
(a) 6 covalent bonds.
(b) 7 covalent bonds.
(c) 8 covalent bonds.
(d) 9 covalent bonds.

Answer: (b) 7 covalent bonds.
Explanation: Ethane contains one single C-C bond and six single C-H bonds, making a total of 7 covalent bonds (H3C—CH3).

Q2. Butanone is a four-carbon compound with the functional group
(a) carboxylic acid.
(b) aldehyde.
(c) ketone.
(d) alcohol.

Answer: (c) ketone.
Explanation: The suffix '-one' specifies a ketone functional group (—CO—) located within a carbon chain.

Q3. While cooking, if the bottom of the vessel is getting blackened on the outside, it means that
(a) the food is not cooked completely.
(b) the fuel is not burning completely.
(c) the fuel is wet.
(d) the fuel is burning completely.

Answer: (b) the fuel is not burning completely.
Explanation: Incomplete combustion creates unburnt carbon particles (soot), which stick to the underside of the cooking vessel and turn it black.

Q4. Explain the nature of the covalent bond using the bond formation in CH3Cl.

Answer: A covalent bond is generated by the mutual sharing of valence electrons
between atoms to complete their octet or duplet configuration.
In Chloromethane (CH3Cl):
- Carbon has 4 valence electrons and requires 4 more to fill its shell.
- Three Hydrogen atoms share 1 electron each with Carbon, building 3 single C-H covalent bonds.
- One Chlorine atom shares 1 electron with Carbon, creating 1 single C-Cl covalent bond.

This electron sharing helps all atoms attain stable configurations. Because electrons are shared and no ions are generated, it acts as a non-conducting molecular compound.

Q5. Draw the electron dot structures for
(a) ethanoic acid.
(b) H2S.
(c) propanone.
(d) F2.

Answer:
(a) Ethanoic acid (CH3COOH):

```
   H   O:
   |  //
```

H-C-C
| \
H O-H

[In dot terms: Carbon-1 shares single pairs with 3 Hydrogens and Carbon-2. Carbon-2 shares a double pair with top Oxygen and a single pair with the OH group's Oxygen. Oxygen shares a single pair with Hydrogen].

(b) Hydrogen sulphide (H2S):

H : S : H
..

[The central Sulphur atom shares a single pair of electrons with each of the two Hydrogen atoms and retains two unshared lone pairs].

(c) Propanone (CH3COCH3):

H O: H

| // |
H-C--C---C-H

| |
H H

[The central Carbon-2 shares a double pair of electrons with the Oxygen atom, and single pairs with Carbon-1 and Carbon-3 on either side].

(d) Fluorine molecule (F2):

:F: :F:
.. ..

[Two Fluorine atoms share a single pair of electrons between them, allowing both atoms to complete their stable valence octet configuration].

Q6. What is an homologous series? Explain with an example.

Answer: A homologous series is a family of structural organic compounds that

possess the same functional group and similar chemical characteristics, where consecutive members differ by a specific —CH2— unit and 14 mass units.
Example: The Alkane series:
- Methane (CH4)
- Ethane (C2H6) [Difference = CH2]
- Propane (C3H8) [Difference = CH2]

Q7. How can ethanol and ethanoic acid be differentiated on the basis of their physical and chemical properties?

Answer:
Physical Differences:
- Odour: Ethanol has a pleasant, distinct alcoholic smell. Ethanoic acid has a pungent, sharp vinegar smell.
- Boiling Point: Ethanol boils at 78°C, while Ethanoic acid boils at 118°C.

Chemical Differences:
- Litmus Test: Ethanol is neutral and does not affect litmus. Ethanoic acid is acidic and turns blue litmus paper red.
- Sodium Bicarbonate Test: Ethanol does not react with NaHCO3. Ethanoic acid reacts briskly, producing carbon dioxide gas that turns lime water milky.
CH3COOH + NaHCO3 -> CH3COONa + H2O + CO2(g)

Q8. Why does micelle formation take place when soap is added to water? Will a micelle be formed in other solvents such as ethanol also?

Answer: Soap molecules possess two unique regions: a hydrophilic (water-loving)
polar ionic head and a hydrophobic (water-fearing) non-polar hydrocarbon tail. When mixed with water, the hydrophobic tails group together inwards to avoid contact with water, while the ionic heads point outwards into the water. This

spherical cluster configuration is called a micelle.
Micelles do not form in ethanol. Soap dissolves completely in ethanol because the hydrocarbon tails find ethanol to be compatible, preventing them from clustering together.

Q9. Why are carbon and its compounds used as fuels for most applications?

Answer: Carbon and its compounds are used as fuels because they burn readily in
oxygen, releasing an immense quantity of heat energy per unit mass (high calorific value). These clean reactions produce manageable products like carbon dioxide and water vapor, leaving behind no solid ash residues when combustion is complete.

Q10. Explain the formation of scum when hard water is treated with soap.

Answer: Hard water carries high concentrations of dissolved calcium (Ca^{2+}) and
magnesium (Mg^{2+}) metal ions. When soap is added, these metal ions react with the soluble soap molecules, replacing sodium ions to form an insoluble, sticky white precipitate. This insoluble residue is called scum, which wastes soap and reduces its cleaning power.

Q11. What change will you observe if you test soap with litmus paper (red and blue)?

Answer: Red litmus paper turns blue, while blue litmus paper shows no change.
Soap is formed by combining a weak fatty acid with a strong base (NaOH),

giving it an alkaline nature in water.

Q12. What is hydrogenation? What is its industrial application?

Answer: Hydrogenation is an addition reaction where unsaturated hydrocarbons
(alkenes/alkynes) react with hydrogen gas in the presence of a catalyst like Nickel or Palladium to yield saturated hydrocarbons.
Industrial Application: This chemical pathway is widely used to convert liquid vegetable oils (unsaturated fats) into solid vegetable ghee/margarine (saturated fats).

Q13. Which of the following hydrocarbons undergo addition reactions?
C2H6, C3H8, C3H6, C2H2 and CH4.

Answer: C3H6 (Propene) and C2H2 (Ethyne) will undergo addition reactions.
Reason: Only unsaturated hydrocarbons containing double or triple carbon bonds
can participate in addition reactions. C2H6, C3H8, and CH4 are saturated alkanes and cannot undergo addition.

Q14. Give a chemical test to distinguish between saturated and unsaturated hydrocarbons.

Answer: The Bromine Water Test.
Add bromine water (which has a distinct reddish-brown color) to both samples:
- Unsaturated Hydrocarbons: Rapidly decolourise the bromine water, turning the liquid completely clear due to an addition reaction.

- Saturated Hydrocarbons: Do not react with the bromine water, leaving the reddish-brown color unchanged.

Q15. Explain the mechanism of the cleaning action of soaps.

Answer: Soap molecules consist of a hydrophilic ionic head and a hydrophobic hydrocarbon tail.

1. When soap is applied to dirty clothes, the hydrophobic tails attach themselves directly to the greasy, oily dirt particles, while the polar hydrophilic heads face outwards toward the water.
2. This creates a spherical micelle structure that traps the oily dirt securely inside the center of the cluster.
3. Agitating or scrubbing the fabric loosens these micelles from the surface. The trapped grease particles suspend into the water and rinse away, leaving the clothes clean.

==========