CBSE Class 11 Chemistry

Sample Paper 03 (2020-21)

Maximum Marks: 70

Time Allowed: 3 hours

General Instructions:

i. There are 33 questions in this question paper. All questions are compulsory.
ii. Section A: Q. No. 1 to 16 are objective type questions. Q. No. 1 and 2 are passage based questions carrying 4 marks each while Q. No. 3 to 16 carry 1 mark each.
iii. Section B: Q. No. 17 to 25 are short answer questions and carry 2 marks each.
iv. Section C: Q. No. 26 to 30 are short answer questions and carry 3 marks each.
v. Section D: Q. No. 31 to 33 are long answer questions carrying 5 marks each.
vi. There is no overall choice. However, internal choices have been provided.
vii. Use of calculators and log tables is not permitted.

Section A

1. **Read the following passage and answer the following questions:**

Sodium carbonate is generally prepared by Solvay Process. In this process, advantage is taken of the low solubility of sodium hydrogencarbonate whereby it gets precipitated in the reaction of sodium chloride with ammonium hydrogen carbonate. The latter is prepared by passing CO_2 to a concentrated solution of sodium chloride saturated with ammonia, where ammonium carbonate followed by ammonium hydrogen carbonate are formed.

$$NH_3 + H_2O + CO_2 \rightarrow \underset{Ammonium\ bicarbonate}{NH_4HCO_3}$$

$$NaCl + NH_4HCO_3 \rightarrow \underset{Sodium\ bicarbonate}{NaHCO_3\downarrow} + NH_4Cl$$

$$2NaHCO_3 \xrightarrow{\Delta} \underset{Sodium\ carbonate}{Na_2CO_3} + H_2O + CO_2$$

The most abundant source of sodium chloride is seawater which contains 2.7 to 2.9% by mass of the salt. In tropical countries like India, common salt is generally obtained by evaporation of seawater. Sodium hydroxide is generally prepared commercially by the

electrolysis of sodium chloride in the Castner-Kellner cell.

i. In solvay process, NH_3 is recovered when the solution containing NH_4Cl is treated with $Ca(OH)_2$. the by-product is
   a. calcium hydroxide
   b. calcium chloride
   c. sodium hydroxide
   d. none of these

ii. What are Oxo-Acids?
   a. Acid containing Oxygen
   b. Acid containing Sulphur
   c. Acid containing Carbon
   d. None of the Above

OR

Which one is the most stable carbonate?
   a. $BaCO_3$
   b. $MgCO_3$
   c. $CaCO_3$
   d. $BeCO_3$

iii. Which of the following are the uses of sodium hydroxide?
   a. the manufacture of soap, paper
   b. in petroleum refining
   c. in the purification of bauxite
   d. all of these

iv. Crude sodium chloride, generally obtained by the crystallisation of brine solution, which of the following impurities it contains?
   a. sodium sulphate
   b. calcium sulphate
   c. both (a) and (b)
   d. none of these

2. **Read the passage and answer the following question:**

In 1830, Michael Faraday showed that if electricity is passed through a solution of an

electrolyte, chemical reactions occurred at the electrodes, which resulted in the liberation and deposition of matter at the electrodes. In mid-1850s Faraday began to study electrical discharge in partially evacuated tubes, known as cathode ray discharge tubes. When sufficiently high voltage is applied across the electrodes, current starts flowing through a stream of particles moving in the tube from the negative electrode to the positive electrode. These were called cathode rays or cathode ray particles. J.J. Thomson measured the ratio of electrical charge (e) to the mass of the electron (m_e) by using a cathode ray tube and applying electrical and magnetic fields perpendicular to each other as well as to the path of electrons. Positively charged particle was characterised in 1919. Later, a need was felt for the presence of an electrically neutral particles as one of the constituents of the atom.

In these question, a statement of assertion followed by the statement of reason is given. Choose the correct answer out of the following choices

a. Assertion and reason both are correct statements and reason is the correct explanation for assertion.
b. Assertion and reason both are correct statements and reason is not the correct explanation for assertion.
c. Assertion is the correct statement but reason is wrong statement.
d. Assertion is the wrong statement but reason is correct statement.

i. **Assertion:** The cathode rays start from cathode and move towards the anode.
Reason: In the absence of electrical or magnetic field, cathode rays travel in straight lines.

ii. **Assertion:** Thomas argued that the lighter the particle, greater the deflection.
Reason: Deflection depends upon the mass of the particle.

iii. **Assertion:** Television picture tubes are anode ray tubes.
Reason: Electrons are the basic constituent of all the atoms.

iv. **Assertion:** The charge to mass ratio of the particles depends on the gas from which these originate.
Reason: The smallest and lightest positive ion was obtained from hydrogen and was called proton.

OR

Assertion: A cathode ray tube is made of glass containing two thin pieces of metal

electrodes.

Reason: The value of e/m_e is $2.758820 \times 10^{11} C\ kg^{-11}$.

3. The empirical formula of sucrose is
   a. CHO
   b. $C_{12}H_{22}O_{11}$
   c. $C(H_2O)_2$
   d. CH_2O
4. The Mass Number of an atom is
   a. the total number of nucleons and neutrons
   b. the total number of protons and electrons
   c. the total number of protons and neutrons
   d. the total number of electrons and positrons

OR

If proton (p^+) number of an element changes,

   a. it will become another element
   b. it will become an electrolyte
   c. it will sublimate immediately
   d. it will become an isotope
5. Which of the following is less reactive than benzene towards electrophilic substitution reactions?
   a. Bromobenzene
   b. Nitrobenzene
   c. Aniline
   d. Chlorobenzene
6. For an isolated system, $\Delta U = 0$, what will be ΔS?
   a. $\Delta S > 0$
   b. ΔS will increase for some time and then reduce
   c. $\Delta S < 0$
   d. $\Delta S = 0$

OR

On the basis of thermochemical equations (A), (B) and (C), find out which of the algebraic relationships given in options (i) to (iv) is correct:

A. C(graphite) + $O_2(g) \rightarrow CO_2(g)$; $\triangle_r H$ = x KJ mol^{-1}

B. C(graphite) + $\frac{1}{2}O_2(g) \rightarrow CO(g)$; $\Delta_r H$ = y KJ mol^{-1}

C. $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$; $\Delta_r H = zkJmol^{-1}$

a. x = y + z

b. y = 2z – x

c. z = x + y

d. x = y – z

7. Group IlA of the periodic table consists of the six elements are collectively known as _____.

a. alkaline earth metals.

b. alkali metals.

c. noble gases

d. transition elements

OR

Choose the appropriate one that shows the hydration enthalpies of alkali metal ions in the decreasing order is.

a. $K^+ > Rb^+ > Cs^+ < Li^+ < Na^+$

b. $Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$

c. $Rb^+ > Cs^+ < Li^+ < Na^+ < K^+$

d. $Na^+ > K^+ > Rb^+ > Cs^+ < Li^+$

8. The synthesis of 3-octyne is achieved by subsequent stepwise reactions of sodium amide with an alkyne, and a bromoalkane. The bromoalkane and the other alkyne respectively are:

a. $BrCH_2CH_2CH_3$ and $CH_3CH_2CH_2C \equiv CH$

b. $BrCH_2CH_2CH_2CH_2CH_3$ and $CH_3C \equiv CH$

c. $BrCH_2CH_2CH_2CH_3$ and $CH_3CH_2C \equiv CH$

d. $BrCH_2CH_2CH_2CH_2CH_3$ and $CH_3CH_2C \equiv CH$

9. The electronic configuration $1s^2 2s^2 2p^1$ belongs to
   a. Boron
   b. Carbon
   c. Beryllium
   d. Lithium
10. The catalyst required for the given reaction is

$$HC = CH + \text{dil. } H_2SO_4 \xrightarrow{\text{Catalyst}} CH_3CHO$$

   a. Pd
   b. $AlCl_3$
   c. Pt
   d. $HgSO_4$
11. Species having same bond order are:
   a. F_2^+ and N_2^+
   b. F_2^+ and O_2^-
   c. N_2 and N_2^-
   d. O_2^- and N_2^-
12. **Assertion:** 1 g O_2 and 1 g O_3 have an equal number of atoms.

    Reason: Mass of 1-mole atom is equal to its gram atomic mass.
   a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
   b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
   c. Assertion is CORRECT but, reason is INCORRECT.
   d. Assertion is INCORRECT but, reason is CORRECT.
13. **Assertion:** Boron does not form BF_6^{3-} ion while AI_6^{3-} is known.

    Reason: B does not have d-orbitals in valence shell while AI has d-orbitals in valence shell.
   a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
   b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation

of the assertion.

c. Assertion is CORRECT but, reason is INCORRECT.
d. Assertion is INCORRECT but, reason is CORRECT.

14. **Assertion:** Compressibility factor ideal gases is one.
Reason: For ideal gasses, pV = nRT equation is obeyed.
    a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
    b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
    c. Assertion is CORRECT but, reason is INCORRECT.
    d. Assertion is INCORRECT but, reason is CORRECT.

OR

Assertion: The pressure of ideal gases is always less than the pressure of real gases.
Reason: The intermolecular forces of attraction in ideal gases are less than those of real gases.

    a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
    b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
    c. Assertion is CORRECT but, reason is INCORRECT.
    d. Assertion is INCORRECT but, reason is CORRECT.

15. **Assertion:** Fluorine acts as a stronger reducing agent than oxygen.
Reason: Fluorine is more electronegative.
    a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
    b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
    c. Assertion is CORRECT but, reason is INCORRECT.
    d. Assertion is INCORRECT but, reason is CORRECT.
16. **Assertion:** Alkylbenzene is not prepared by Friedel Crafts alkylation of benzene.
Reason: Alkyl halides are less reactive than acyl halides.
    a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of

the assertion.

b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
c. Assertion is CORRECT but, reason is INCORRECT.
d. Assertion is INCORRECT but, reason is CORRECT.

Section B

17. All transition elements are d-block elements, but all d-block elements are not transition elements. Explain.

OR

What is the basic difference in approach between Mendeleev's periodic law and the Modern Periodic Law?

18. Identify the pairs of compounds that represent position isomerism.

CH_3-C(CH_3) (OH)-CH_3

CH_3-CH(CH_3)-CH_2-OH

CH_3-O-CH_2-CH_2-CH_3

CH_3-O-CH(CH_3)-CH_3

CH_3- CH_2- CH_2-CH_2-OH

CH_3-CH_2-CH(OH)-CH_3

19. A sample of HI (g) is placed in a flask at a pressure of 0.2 atm. At equilibrium partial pressure of HI (g) is 0.04 atm. What is K_p for the given equilibrium?

$$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$$

OR

Give two characteristics of a buffer solution.

20. Write the IUPAC name of the compound from its given structure.

$$\underset{6}{CH_3} - \underset{5}{CH_2} - \underset{4}{\overset{\overset{O}{\|}}{C}} - \underset{3}{CH_2} - \underset{2}{\overset{\overset{O}{\|}}{C}} - \underset{1}{CH_3}$$

OR

Write the state of hybridisation of carbon in the following compounds and shapes of each

of the molecules.

i. $H_2C{=}O$,

ii. CH_3F

iii. $HC{\equiv}N$

21. Complete the following reactions:

i. $H_2\,(g) + M_mO_o\,(s) \xrightarrow{\Delta}$

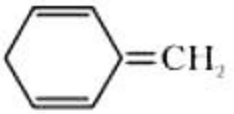
ii. $CO\,(g) + H_2\,(g) \xrightarrow[catalyst]{\Delta}$

iii. $C_3H_8\,(g) + 3H_2O\,(g) \xrightarrow[catalyst]{\Delta}$

iv. $Zn\,(s) + NaOH\,(aq) \xrightarrow{Heat}$

22. Why is water an excellent solvent for ionic or polar substances?

23. Explain why the system are aromatic?



24. Among the elements B, Al, C and Si,(i) which element has the highest first ionisation enthalpy? (ii) which element has the most metallic character? Justify your answer in each case.

25. Permanganate ion reacts with bromide ion in basic medium to give manganese dioxide and bromate ion. Write the balanced ionic equation for the reaction.

Section C

26. Density of a gas is found to be 5.46 g/ dm^3 at 27°C and at 2 bar pressure. What will be its density at STP?

OR

Pay load is defined as the difference between the mass of the displaced air and the mass of the balloon.

Calculate the pay load when a balloon of radius 10 m, mass 100 kg is filled with helium at 1.66 bar at 27°C (Density of air = 1.2 kg m^{-3} and R = 0.0833 bar dm^3 K^{-1} mol^{-1})

27. Vitamin C is essential for the prevention of scurvy. Combustion of 0.2000g of vitamin C gives 0.2998g of CO_2 and 0.819g of H_2O. What is the empirical formula of vitamin C?

OR

10 mL of a solution of NaCl containing KCl, gave an evaporation 0.93 g of the mixed salt. This salt - mixture gave 1.865 g of AgCl by reacting with Ag NO_3 solution.

Calculate the quantity of NaCl in 10 mL of the solution.

Given: Atomic masses; Ag = 108, Cl = 35.5, K = 39.0, N = 14.0, O = 16.0

28. An alkene 'A' on ozonolysis gives a mixture of ethanal and pentan-3-one. Write the structure and IUPAC name of 'A'.
29. When BCl_3 is treated with water, it hydrolyses and forms $[B(OH)_4]^-$ only whereas $AlCl_3$ in acidified aqueous solution forms $[Al(H_2O)_6]^{3+}$ ion. Explain what is the hybridisation of boron and aluminium in these species?
30. When 1 g of liquid naphthalene ($C_{10}H_8$) solidifies, 149 J of heat is evolved. Calculate the heat of fusion of naphthalene.

Section D

31. How is molecular orbital different from atomic orbital? Give electronic configuration of
    i. H_2^+
    ii. Li_2
    iii. B_2
    iv. C_2.

    Calculate their bond order and predict their magnetic behaviour.

OR

Which hybrid orbitals are used by carbon atoms in the following molecules?

a. $CH_3–CH_3$;
b. $CH_3–CH = CH_2$;
c. CH_3-CH_2-OH;
d. CH_3-CHO
e. CH_3COOH

32. Calculate the pH of a 0.10M ammonia solution. Calculate the pH after 50.0 mL of this

solution is treated with 25.0 mL of 0.10M HCl. The dissociation constant of ammonia, K_b = 1.77×10^{-5}

OR

Calculate the pH of the following solutions:

a. 2g of TlOH dissolved in water to give 2 litre of the solution
b. 0.3 g of $Ca(OH)_2$ dissolved in water to give 500 mL of the solution
c. 0.3 g of NaOH dissolved in water to give 200 mL of the solution
d. 1 mL of 13.6 M HCl is diluted with water to give 1 litre of the solution.

33. What is meant by hybridization? Compound $CH_2 = C = CH_2$ contains sp or sp^2 hybridized carbon atoms. Will it be a planar molecule?

OR

Draw the resonance structures for the following compounds. Show the electron shift using curved-arrow notation.

a. C_6H_5OH
b. $C_6H_5NO_2$
c. $CH_3CH{=}CHCHO$
d. $C_6H_5{-}CHO$
e. $C_6H_5 - \overset{+}{C}H_2$
f. $CH_3CH = CH\overset{+}{C}H_2$

CBSE Class 11 Chemistry

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Solution

Section A

1. i. (b) calcium chloride

   ii. (a) Acid containing Oxygen

OR

(a) $BaCO_3$

   iii. (d) all of these

   iv. (c) both (a) and (b)

2. i. (b) Assertion and reason both are correct statements and reason is not the correct explanation for assertion.

   ii. (a) Assertion and reason both are correct statements and reason is the correct explanation for assertion.

   iii. (d) Assertion is the wrong statement but reason is correct statement.

   iv. (b) Assertion and reason both are correct statements and reason is not the correct explanation for assertion.

OR

(c) Assertion is the correct statement but reason is wrong statement.

3. (b) $C_{12}H_{22}O_{11}$

Explanation: $C_{12}H_{22}O_{11}$

Consider the relation of molecular formula and empirical formula of a compound given by the expression,

Molecular formula = (Empirical formula)$_n$

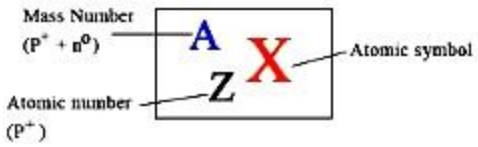
Where n Is a common positive integer.

Since, there is no common integer to differentiate between empirical formula of Sucrose C_6 H_{22} O_{11} hence,

Sucrose has the same empirical and molecular formula.

4. (c) the total number of protons and neutrons

   Explanation: The mass number (symbol A), also called atomic mass number or nucleon number, is the total number of protons and neutrons (together known as nucleons) in an atomic nucleus



OR

   (a) it will become another element

   Explanation: it will become another element

5. (b) Nitrobenzene

   Explanation: A nitro group is an electron-withdrawing group. It withdraws electron density from the benzene ring thereby deactivating the ring towards attack by the electrophile.

6. (a) $\Delta S > 0$

$$\triangle U = 0$$

   Explanation: For an isolated system, and for a spontaneous process, Total

   entropy change must be positive.

   Moreover, $\triangle S = \frac{q_{rev}}{T} = \frac{\triangle H}{T} = \frac{\triangle U + p\triangle V}{T} = \frac{0 + p\triangle V}{T}$

   $i.e.\ T\triangle S > 0 Or \triangle S > 0$

OR

   (a) x = y + z

   Explanation: We have, C(graphite) + $O_2(g) \rightarrow CO_2(g)$; $\triangle_r H$ = x KJ mol^{-1} ..... (1)

   C(graphite) $+\frac{1}{2}O_2(g) \rightarrow CO(g); \Delta_r H = ykJmol^{-1}$ .... (2)

   Subtacting (1) and (2), we get;

   $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$; $\triangle_r H$ = (x-y) $kJmol^{-1}$

   $\therefore$ z = x - y $\Rightarrow$ x = y + z

7. (a) alkaline earth metals.

Explanation: Group IIA of the periodic table consists of the six elements are collectively known as alkaline earth metals because their oxide and hydroxide are alkaline in nature and these metal oxide are found in earth's crust.

OR

(b) $Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$

Explanation: As the size increases positive charge density decreases so hydration energy also decreases. Hydration varies inversely with the size.

8. (c) $BrCH_2CH_2CH_2CH_3$ and $CH_3CH_2C \equiv CH$

Explanation: 3 - Octyne can be synthesized as per the following stepwise conversion reactions:

Step 1. Formation of a Sodium alkynide, by the reaction of 1 -butyne with sodium amide

$$CH_3CH_2C \equiv CH + NaNH_2 \rightarrow CH_3CH_2C \equiv CNa^+ + NH_3$$

1-butyne sodium amide sodium butynide

Step 2. Reaction of the alkynide (sodium butynide) with 1 - bromobutane

$$CH_3CH_2C \equiv CNa^+ + CH_3CH_2CH_2CH_2Br \rightarrow$$
$$CH_3CH_2C \equiv CCH_2CH_2CH_2CH_3 + NaBr$$

Sodium Butynide 1-bromobutane 3 - Octyne

9. (a) Boron

Explanation: Boron is a chemical element with symbol B and atomic number 5. So electronic configuration of boron is $1s^2 2s^2 2p^1$

10. (d) $HgSO_4$

Explanation: Alkynes are not readily hydrated due to their low reactivity towards electrophilic addition reactions.Further dilute H_2SO_4 has no effect on carbon carbon triple bond.In the presence of HgSO4 as catalyst,hydration occurs readily.

11. (b) F_2^+ and O_2^-

Explanation: bond order of F_2^+ and O_2^- is same i.e 1.5

12. (b) Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

Explanation: Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

13. (a) Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

    Explanation: Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

14. (a) Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

    Explanation: Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

OR

(d) Assertion is INCORRECT but, reason is CORRECT.

Explanation: Assertion is INCORRECT but, reason is CORRECT.

15. (b) Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

    Explanation: Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

16. (b) Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

    Explanation: Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

Section B

17. Elements in which the last electron enters the d-orbitals, are called d-block elements. These elements have general outer electronic configuration $(n-1)d^{1-10}\ ns^{0-2}$. Zn, Cd and Hg which have general electronic configuration, $(n-1)\ d^{10}ns^2$ do not show most of the properties of transition elements. d-orbitals in these elements are completely filled in the ground state as well as in their common oxidation states. Thus, on the basis of properties, all transition elements are d-block elements but on the basis of electronic configuration, all d- block elements are not transition elements.

OR

In Mendeleev's periodic law, physical and chemical properties of elements are periodic

functions of their atomic weights whereas the Modern Periodic Law uses atomic numbers as the measure of the periodicity.

18. In position isomerism, two or more compounds differ in the position of substituent, functional group or multiple bonds but molecular formula is same. In the given structures, I and II, III and IV, and VI and VII are position isomers.
    I. CH_3-C(CH_3) (OH)-CH_3 and CH_3-CH(CH_3)-CH_2-OH are position isomers.
    II. CH_3-O-CH_2-CH_2-CH_3 and CH_3-O-CH(CH_3)-CH_3 are position isomers.
    III. CH_3- CH_2- CH_2-CH_2-OH and CH_3-CH_2-CH(OH)-CH_3 are position isomers.
19. Here, p(HI)= 0.04 atm, P(H_2) = 0.08 atm p(I_2) = 0.08 atm.

    Therefore, $K_p = \frac{P_{H_2} \times P_{I_2}}{(P_{HI})^2} = \frac{(0.08\ atm) \times (0.08\ atm)}{(0.04\ atm)^2} = 4.0$

    OR

    The characteristics of buffer solution are given below:
    (i) Its pH value does not change on the addition of small amount of acid or base.
    (ii) Its pH does not change on dilution or standing.
20. The functional group present is ketone (>C=O), hence suffix '-one'. The presence of two keto groups is indicated by 'di', hence suffix becomes 'dione'. The two keto groups are at carbons 2 and 4. The longest chain contains 6 carbon atoms, hence, parent hydrocarbon is hexane.
    Thus, the IUPAC name / systematic name is Hexane-2, 4-dione.

    OR

    i. sp^2 hybridised carbon, trigonal planar shape.
    ii. sp^3 hybridised carbon, tetrahedral shape.
    iii. sp hybridised carbon, linear shape.
21. i. H_2 (g) + M_mO_o (s) $\xrightarrow{\Delta}$ mM (s) + oH_2O(l)
    ii. CO (g) + H_2 (g) $\xrightarrow[catalyst]{\Delta}$ $\underset{\text{Methanol}}{CH_3OH(l)}$
    iii. C_3H_8 (g) + 3H_2O (g) $\xrightarrow{\Delta}$ 3CO (g) + 7H_2 (g)
    iv. Zn (s) + NaOH (aq) $\xrightarrow[Heat]{catalyst}$ $\underset{\text{Sodium zincate}}{Na_2ZnO_2(aq)} + H_2(g)$

22. Water is a good solvent due to its polarity and high dielectric constant. When an ionic compound or polar compound is immersed in water, it is surrounded by water molecules. Due to the high dielectric constant of water, the force of attraction between cation and anion gets weakened. Hence, water acts as a good solvent.
23. For the given compound, the number of π-electrons is 6.

    By Huckel's rule,

    $4n + 2 = 6$

    $\Rightarrow 4n = 4$

    $\Rightarrow n = 1$

    For a compound to be aromatic, the value of n must be an integer (n = 0, 1, 2...).

    In this case, the value of n is 1 which is an integer, hence the given compound is aromatic in nature.
24. i. As we know Along a period, ionisation enthalpy increases and decreases down a group. Hence, C has the highest first ionisation enthalpy.
    ii. The metallic character increases down the group and decreases along a period due to increase in nuclear charge, So, Al has the most metallic character.
25. To balance any chemical reaction follow the following step:

    Step 1: Find out the oxidation state of each and every element participate in a redox reaction.

    Step 2: Identify the oxidized and reduced species and balance them.

    Step 3: Balance the O-atom by the help of a water molecule in case of acidic medium or by the help of OH^- ion in case of the basic medium.

    Step 4: Balance the unequal H-atom by using H^+ ion.

    Step 5: Balance the unequal charge by using an electron.

    The skeletal ionic equation is,

    $\mathbf{MnO_4^-}$ (aq) + Br^- (aq) $\longrightarrow$ MnO_2(s) + $\mathbf{BrO_3^-}$ (aq)

    The balanced chemical reaction is,

    $$\mathbf{2MnO_4^-\,(aq) + Br^-\,(aq) + H_2O(I) \rightarrow 2MnO_2(s) + BrO_3^-\,(aq) + 2OH^-\,(aq)}$$

Section C

26. $d = \frac{MP}{RT}$ where d=density, M=Molar mass, P=Pressure, R=Gas constant, T=Temperature in K

    For the same gas at different temperatures and pressures, $\frac{d_1}{d_2} = \frac{P_1}{T_1} \times \frac{T_2}{P_2}$...equation (1)

Here, d_1 = 5.46g dm^{-3}, T_1 = 27°C = 300 K, P_1 = 2 bar

At STP, d_2 = ? T_2 = 0°C = 273 K, P_2 = 1bar

Substituting the values in equation (1)

$\therefore \frac{5.46g\ dm^{-3}}{d_2} = \frac{2bar}{300K} \times \frac{273K}{1\ bar}$ or d_2 = 3g dm^{-3}

OR

Radius of the balloon = 10 m

$\therefore$ Volume of the balloon $= \frac{4}{3}\pi r^3 = \frac{4}{3} \times \frac{22}{7} \times (10\ m)^3$ = 4190.5 m^3

So volume of 'He' filled at 1.66 bar and 27°C = 4190.5 m^3

Calculation of mass of He

$PV = nRT = \frac{w}{M}RT$, where Pressure P = 1.66 bar, Volume V = 4190.5x10^3 dm^3, Mass of He=w, Molar mass of He = 4g/mol = 4x10^{-3} kg/mol, Gas constant R = 0083 bar $dm^3K^{-1}mol^{-1}$, Temperature T = 27°C = 27 + 273 = 300 K

or $w = \frac{MPV}{RT} = \frac{(4\times10^{-3}kg\ mol^{-1})(1.66\ bar)(4190.5\times10^3\ dm^3)}{(0.083bar\ dm^3K^{-1}\ mol^{-1})(300\ K)}$

= 1117.5 kg

Total mass of the balloon along with He = 100 + 1117.5 = 1217.5 kg

Maximum mass of the air that can be displaced by balloon to go up = Volume $\times$ Density

$= 4190.5m^3 \times 1.2kg\ m^{-3}$ = 5028.6 kg

Pay load = Mass of the displaced air-mass of balloon along with He = 5028.6 kg - 1217.5 kg = 3811.1 kg

27. Since, Combustion of 0.2000g of vitamin C gives 0.2998g of CO_2 and 0.819g of H_2O.

Therefore, Percentage of carbon = $\frac{12}{44} \times 0.02998 \times \frac{100}{0.2}$ = 47.69

Percentage of Hydrogen = $\frac{2}{18} \times 0.0819 \times \frac{100}{0.2}$ = 4.55

Percentage of oxygen = 100 - (47.69) + 4.55 = 47.76

Element	**%**	**Atomic Mass**	**Relative no. of atoms**	**Simplest molar Ratio**	**Simple whole number molar ratio**
C	47.69	12	$\frac{47.69}{12}$ = 3.97	$\frac{3.97}{2.98}$ = 1.33	4/3 = 8/6
H	4.55	1	$\frac{4.55}{1}$ = 4.55	$\frac{4.55}{2.98}$ = 1.5	3/2 = 9/6

O	47.76	16	$\frac{47.76}{15}$ = 2.98	$\frac{2.98}{298}$ = 1	1

Therefore, Empirical formula = $C_{1.33}H_{1.5}O = C_{\frac{8}{6}} H_{\frac{9}{6}} O_1 = C_8H_9O_6$

OR

Step 1

The chemical equation for the reaction of $AgNO_3$ with NaCl is represented stoichiometrically as :

$$\underset{23 + 35.5 = 58.5\,g}{AgNO_3} + NaCl \rightarrow \underset{108 + 35.5 = 143.5\,g}{AgCl} + NaNO_3$$

Let the masses of NaCl and KCl in the mixture be "a" g and "b" g, respectively.

$\therefore$ a + b = 0.93 g, (given)

(i) For NaCl - Since, 58.5 g of NaCl give AgCl = 143.5 g

$\therefore$ "a" g of NaCl will give AgCl = [{(143.5 g) / (58.5 g)} $\times$ a] g

(ii) For KCl, Similarly, 74.5 g of KCl gives AgCl = 143.5 g

(as ,Gram molar mass of KCl = (39 + 35.5) = 74.5 g)

"b" g of KCl will give AgCl = [{ (143.5 g) / (74.5 g) } $\times$ b] g

Step 2

But mass of AgCl actually formed = 1.865 g (given)

$\therefore \frac{143.5 \times a}{58.5} + \frac{143.5 \times b}{74.5}$ = 1.865 g [since, b = (0.93 - a) g]

$\Rightarrow$ 2.453 a + 1.93 (0.93 - a) = 1.865 $\Rightarrow$ 2.453 a + 1.795 - 1.93 a = 1.865

$\Rightarrow$ 0.523 a = 0.07 g

$\therefore$ a = [0.07 / 0.523] g

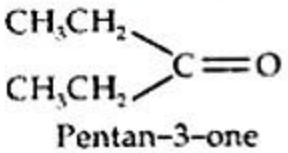
= 0.14 g

Mass of NaCl in the mixture = 0.14 g

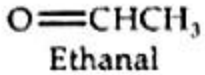
Mass of KCl in the mixture = (0.93 - 0.14) = 0.79 g

Hence, "The mass of NaCl in 10 ml of this solution is 0.14 g"

28. Step 1. Write the structure of the products side by side with their oxygen atoms pointing towards each other.



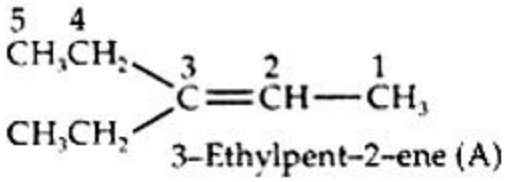
Pentan–3–one



Ethanal

Step 2. Remove the oxygen atoms and join the two ends by a double bond, the structure of

the alkene 'A' is



3-Ethylpent-2-ene (A)

29. BCl_3 on hydrolysis in water forms tetrahedral $[B(OH)_4]^-$ compound.

Hybridisation state of B is Sp^3 .

Reactions:

$$BCl_3 + 3H_2O \longrightarrow B(OH)_3 + 3HCl$$

$$B(OH)_3 + H_2O \longrightarrow [B(OH)_4]^- + H^+$$

$AlCl_3$ in acidified aqueous solution forms octahedral $[Al(H_2O)_6]^{3+}$ ion.

In this complex, the 3d-orbitals of Al are involved.

Hybridisation state of Al is $sp^3 d^2$.

Reaction:$AlCl_3 + \text{Water} \longrightarrow [Al(H_2O)_6]^{3+} + 3Cl^-(aq)$

30. Molecular mass of naphthalene $= 128\text{g mol}^{-1}$

Solidification reaction:

$$C_{10}H_8(l) \longrightarrow C_{10}H_8(s)$$

According to the question, heat evolved when 1 g of naphthalene solidifies $= 149\ J$

Heat evolved when 128 g of naphthalene solidifies $= 149 \times 128 = 19072\ J$

$\Delta_{fus}H^{\ominus} = -19072\ \text{J}$

Fusion reaction:

$$C_{10}H_8(s) \longrightarrow C_{10}H_8(l)$$

This reaction is the reverse of the solidification..$\because \Delta_{fus}H^{\circ} = +19072\ \text{J}$

Section D

31.

Bonding Molecular Orbitals	Antibonding Molecular Orbitals
The bonding molecular orbitals (BMOs) are obtained by the addition of atomic orbitals and are represented by σ and π.	The antibonding molecular orbitals (AMOs) are obtained by the subtraction of atomic orbitals and are represented by σ^* and π^*.
The electron density is located between the nuclei of the bonded atoms.	Most of the electron density is located away from the space in between the nuclei.

A bonding molecular orbital has always lower energy than either of the atomic orbitals that have combined to form it.	An antibonding molecular orbital has higher energy than either of the atomic orbitals that have combined to form it.

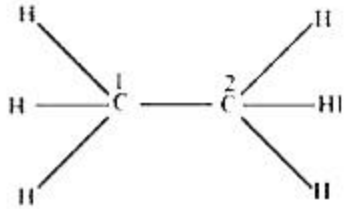
i. $H_2^+(1) = (\sigma 1s)^1 \Rightarrow$ Bond order = $\frac{1}{2}$ (1 - 0) = 0.5, It is paramagnetic due to presence of 1 lone electron

ii. Li_2 (6) $= (\sigma ls)^2(\overset{*}{\sigma} 1s)^2(\sigma 2s)^2 \Rightarrow$ Bond order = $\frac{1}{2}$ (4 - 2) = $\frac{2}{2}$ = 1, It is diamagnetic as all electrons are paired.

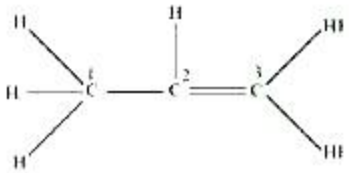
iii. B_2 (10) = $(\sigma 1s)^2(\dot{\sigma} 1s)^2(\sigma 2s)^2(\dot{\sigma} 2s)^2 \left(\pi 2p_x^1 = \pi 2p_y^1\right) \Rightarrow$ Bond order = $\frac{1}{2}$ (6 - 4) = 1, It is paramagnetic due to presence of unpaired electrons.

iv. C_2 (12) = $(\sigma 1s)^2(\dot{\sigma} 1s)^2(\sigma 2s)^2(\dot{\sigma} 2s)^2 \left(\pi 2p_x^2 \approx \pi 2p_y^2\right) \Rightarrow$ Bond order = $\frac{1}{2}$ (8 - 4) = 2, It is diamagnetic due to absence of unpaired electrons.

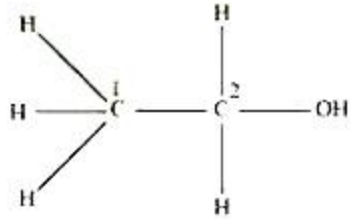
OR

a. 

According to structure, C_1 & C_2 are making 4 sigma bonds(single bond) each with the help of ones hybrid orbital & 3 p hybrid orbital, hence C_1 & C_2 are sp^3 hybridized

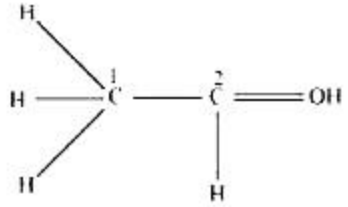
b. 

Here C1 is making 4 sigma bond, therefore, its sp^3 hybridized, while C_2 and C_3 are making a double bond (1 sigma + 1 pie bond) therefore they both are sp^2 hybridized.

c. 

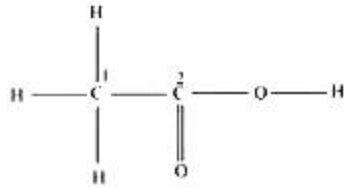
Both the carbons C_1 & C_2 are making single bond(sigma bond), therefore they are

sp^3hybridized.

d. 

From the structure it is clear that C1 is making sigma bonds only, therefore it is sp^3 hybridized. C_2 is making a double bond therefore it is sp^2 hybridized.

C_1 issp^3hybridized and C_2 issp^2hybridized.

e. 

Here C1 is making a sigma bond, therefore, it is in sp^3 hybridization state, while C_2 is making a double bond, it is in the sp^2 hybridized state.

32. $NH_3 + H_2O \longrightarrow NH_4^+ + OH^-$

Kb = $\left[NH_4^+\right]\left[OH^-\right] / \left[NH_3\right] = 1.77 \times 10^{-5}$

Before neutralization,

$[NH_3] = 0.10 - x = 0.10$

$x^2 / 0.10 = 1.77 \times 10^{-5}$

Thus, $x = 1.33 \times 10^{-3} = [OH^-]$

Therefore,

$\left[H^+\right] = K_x/IOH - 1 = 10^{-14}/(1.33 \times 10^{-3}) = 7.51 \times 10^{-12}$

$pH = -\log(7.5 \times 10^{-12}) = 11.12$

On addition of 25 mL of 0.1M HCl solution (i.e., 2.5 mmol of HCl) to 50 mL of 0.1M ammonia solution (i.e., 5 mmol of NH_3), 2.5 mmol of ammonia molecules are neutralized.

The resulting 75 mL solution contains the remaining unneutralized 2.5 mmol of NH_3 molecules and 2.5 mmol of NH_4^+

NH_3	+	HCl	→	NH_4^+	+	Cl^-
2.5		2.5		0		0
At equilibrium						
0		0		2.5		2.5

The resulting 75 mL of solution contains 2.5 mmol of NH_4^+ ions (i.e., 0.033 M) and 2.5 mmol (i.e., 0.033 M) of neutralised NH_3 molecules. This NH_3 exists in the following equilibrium:

NH_4OH	⇌	NH_4^+	+	OH^-
0.033M – y		y		y

where, y = $[OH^-]$ = $[NH_4^+]$

The final 75 mL solution after neutralization already contains 2.5 m mol NH_4^+ ions (i.e. 0.033M), thus total concentration of NH_4^+ ions is given as:

$[NH_4^+]$ = 0.033 + y

As y is small, $[NH_4OH] \simeq 0.033$ M and $[NH_4^+] \simeq 0.033$M.

We know,

$$K_b = [NH_4^+][OH]/[NH_4OH]$$

= y(0.033)/(0.033) = 1.77×10^{-5} M

Thus, y = 1.77×10^{-5} = $[OH^-]$

$$[H^+] = 10^{-14}/1.77 \times 10^{-5} = 0.56 \times 10^{-9}$$

Hence, pH = 9.24

OR

a. Molar conc. of TlOH $= \frac{2g}{(204+16+1)g\ mol^{-1}} \times \frac{1}{2L} = 4.52 \times 10^{-3}M$

$[OH^-] = [TlOH] = 4.52 \times 10^{-3}\ M$

$[H^+] = 10^{-14}/(4.52 \times 10^{-3}) = 2.21 \times 10^{-12}M$

$\therefore pH = -\log(2.21 \times 10^{-12})$ = 12 - (0.3424) = 11.66

b. Molar conc. of $Ca(OH)_2 = \frac{0.3g}{(40+34)g\ mol^{-1}} \times \frac{1}{0.5L} = 8.11 \times 10^{-3}M$

$Ca(OH)_2 \rightarrow Ca^2 + 2OH^-$

$[OH^-] = 2[Ca(OH)_2] = 2 \times (8.11 \times 10^{-3})M = 16.22 \times 10^{-3}M$

$pOH = -\log(16.22 \times 10^{-3}) = 3 - 1.2101 = 1.79$

pH = 14 - 1.79 = 12.21

c. Molar conc. of NaOH $= \frac{0.3g}{40g\ mol^{-1}} \times \frac{1}{0.2L} = 0.75 \times 10^{-2}M$

$[OH^-] = 3.75 \times 10^{-2}M$

$pOH = -\log(3.75 \times 10^{-2})$ = 2 - 0.0574 = 1.43

pH = 14 - 1.43 = 12.57

d. $M_1V_1 = M_2V_2 \therefore 13.6M \times 1mL = M_2 \times 1000mL \therefore M_2 = 1.36 \times 10^{-2}M$

$[H^+] = [HCl] = 1.36 \times 10^{-2}M, pH = -\log(1.36 \times 10^{-2})$ = 2 - 0.1335 = 1.87

33. **Hybridisation:** The process of intermixing of the orbitals of slightly different energies so as to redistribute their energies, resulting in the formation of new set of orbitals of equivalent energies and shape. For example, when one 2s and three 2p-orbitals of carbon hybridise, there is the formation of four new sp^3 hybrid orbitals.

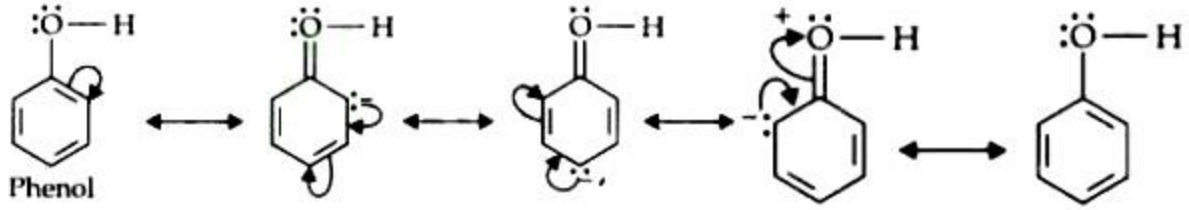
In CH_2=C=CH_2(allene), 1 and 3 carbon atoms are sp^2 hybridized because it has 3σ bonds. While carbon atom 2 has 2σ bonds, so it is sp hybridized.

So, Allene molecule is non-planar because hybridisation of carbons are different.

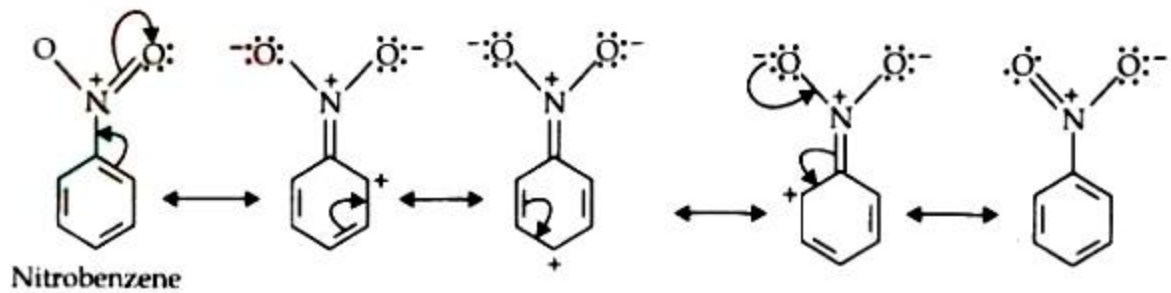
OR

Resonance structure of compound using curved arrow notation;

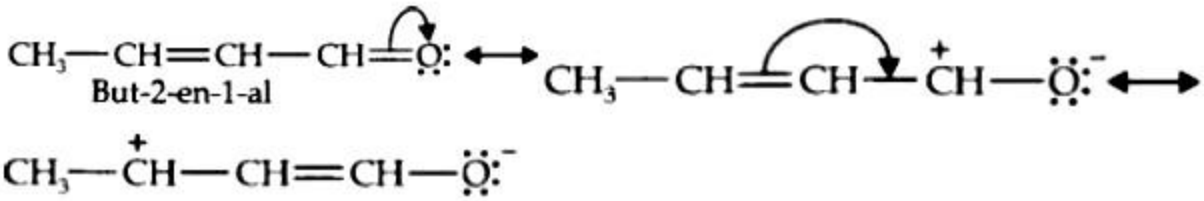
a. The structure of C_6H_5OH is:



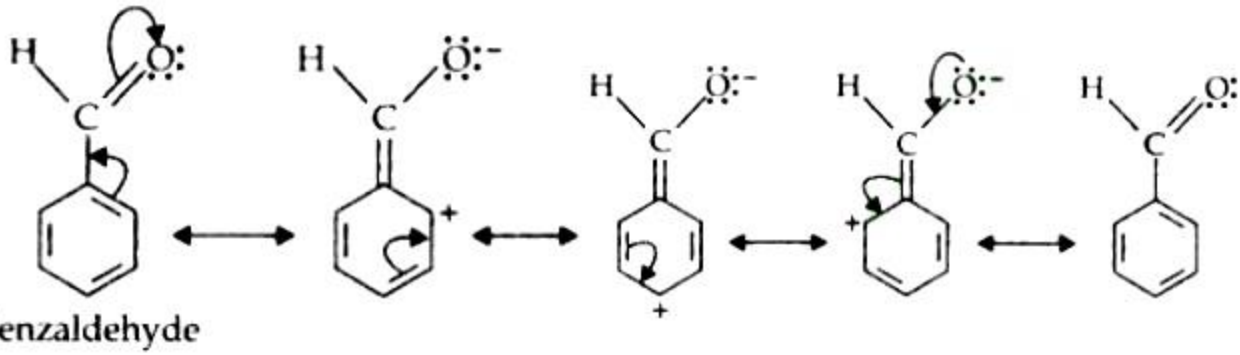
b. The structure of $C_6H_5NO_2$ is:



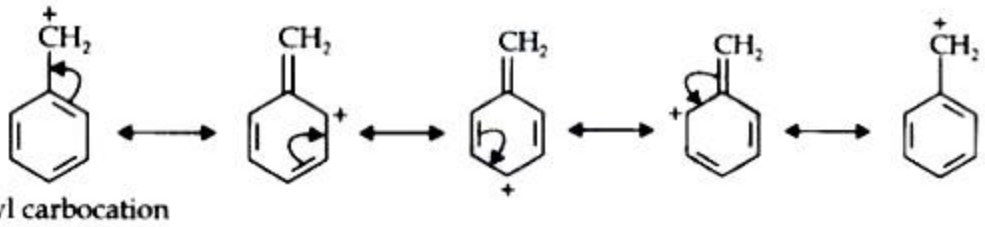
c. The structure of CH_3CH=CHCHO is:



d. The structure of C_6H_5-CHO is:



e. The structure of $C_6H_5 - \overset{+}{C}H_2$ is:



f. The structure of $CH_3CH = CH\overset{+}{C}H_2$ is: