Class XI
CHEMISTRY FULL SYLLABUS – 1

Time : 3 Hrs **M.M – 70 Marks**

General Instructions:

(i) There are 33 questions in this question paper with internal choice.
(ii) Section – A consists of 16 multiple-choice questions carrying 1 mark each.
(iii) Section – B consists of 5 short answer questions carrying 2 marks each.
(iv) Section – C consists of 7 short answer questions carrying 3 marks each.
(v) Section – D consists of 2 case-based questions carrying 4 marks each.
(vi) Section – E consists of 3 long answer questions carrying 5 marks each.
(vii) All questions are compulsory.
(viii) Use of log tables and calculators is not allowed.

SECTION - A

Q1. What will be the molarity of a solution, which contains 5.85 g of NaCl(s) per 500 mL?

(A) 4 mol L^{-1} (B) 20 mol L^{-1} (C) 0.2 mol L^{-1} (D) 2 mol L^{-1}

Q2. The empirical formula and molecular mass of a compound are CH_2O and 180 g respectively. What will be the molecular formula of the compound?

(A) $C_9H_{18}O_9$ (B) CH_2O (C) $C_6H_{12}O_6$ (D) $C_2H_4O_2$

Q3. Which of the following conclusions could not be derived from Rutherford's α-particle scattering experiment?

(A) Most of the space in the atom is empty.
(B) The radius of the atom is about 10^{-10} m while that of nucleus is 10^{-15} m.
(C) Electrons move in a circular path of fixed energy called orbits.
(D) Electrons and the nucleus are held together by electrostatic forces of attraction

Q4. The number of radial nodes for 3p orbital is _____.

(A) 3 (B) 4 (C) 2 (D) 1

Q5. Consider the isoelectronic species, Na^+, Mg^{2+}, F^- and O^{2-}. The correct order of increasing length of their radii is _____.

(A) $F^- < O^{2-} < Mg^{2+} < Na^+$
(B) $Mg^{2+} < Na^+ < F^- < O^{2-}$
(C) $O^{2-} < F^- < Na^+ < Mg^{2+}$
(D) $O^{2-} < F^- < Mg^{2+} < Na^+$

Q6. Isostructural species are those which have the same shape and hybridization. Among the given species identify the isostructural pairs.

(A) [NF_3 and BF_3]
(B) [BF_4^- and NH_4^+]
(C) [BCl_3 and $BrCl_3$]
(D) [NH_2^- and NO_3^-]

Q7. The types of hybrid orbitals of nitrogen in NO_2^+, NO_3^- and NH_4^+ respectively are expected to be:

(A) sp, sp^3 and sp^2
(B) sp, sp^2 and sp^3
(C) sp^2, sp and sp^3
(D) sp^2, sp^3 and sp

Q8. Choose the correct answer.
A thermodynamic state function is a quantity:

(A) used to determine heat changes.
(B) whose value is independent of path.
(C) used to determine pressure–volume work.
(D) whose value depends on temperature only.

Q9. ΔU° of combustion of methane is $-X$ kJ mol^{-1}.

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

The value of ΔH° is:

(A) $= \Delta U^\circ$ (B) $> \Delta U^\circ$ (C) $< \Delta U^\circ$ (D) $= 0$

Q10. Among halogens, the correct order of amount of energy released in electron gain (electron gain enthalpy) is:

(A) F > Cl > Br > I (B) F < Cl < Br < I (C) F < Cl > Br > I (D) F < Cl < Br < I

Q11. We know that the relationship between Kc and Kp is:
$Kp = Kc\,(RT)^{\Delta n}$
What would be the value of Δn for the reaction:

$NH_4Cl(s) \rightleftharpoons NH_3(g) + HCl(g)$

(A) 1 (B) 0.5 (C) 1.5 (D) 2

Q12. For the reaction
$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$,
the standard free energy change is $\Delta G^\circ > 0$. The equilibrium constant (K) would be:

(A) K = 0 (B) K > 1 (C) K = 1 (D) K < 1

Q13. **Assertion (A):** Simple distillation can help in separating a mixture of propan-1-ol (boiling point 97°C) and propanone (boiling point 56°C).

Reason (R): Liquids with a difference of more than 20°C in their boiling points can be separated by simple distillation.

Select the most appropriate answer from the options given below:

(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

Q14. **Assertion (A):** Generally, ionization enthalpy increases from left to right in a period.

Reason (R): When successive electrons are added to the orbitals in the same principal quantum level, the shielding effect of inner core electrons does not increase very much to compensate for the increased attraction of the electron to the nucleus.

Select the most appropriate answer from the options given below:
(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

Q15. **Assertion (A):** The compound cyclooctatetraene has the following structural formula:
It is cyclic and has conjugated 8π-electron system but it is not an aromatic compound.

Reason (R): (4n + 2)π electrons rule does not hold good and ring is not planar.

Select the most appropriate answer from the options given below:

(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

Q16. **Assertion (A):** Toluene on Friedel–Crafts methylation gives *o*- and p-xylene.

Reason (R): CH_3 group bonded to benzene ring increases electron density at *o*- and *p*- positions.

Select the most appropriate answer from the options given below:
(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

SECTION - B

Q17. (a) Give the balanced chemical equation for combustion of Methane gas.
(b) Calculate the amount of water (g) produced by the combustion of 16 g of methane.

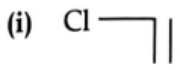
Q18. Mention the physical significance of ψ and ψ^2.

Q19. (a) Which has maximum bond angle? CH_4, $BeCl_2$, NH_3.
(b) Arrange the above compounds in decreasing order of bond angle.

Q20. Give the IUPAC name/structure of:
(i) $(CH_3)_2(C_2H_5)C–(CH_2)_3–C(CH_3)_3$ (ii) Ortho-chloro anisole

OR

Write IUPAC names of the following:

(i) 

(ii) 

Q21. (a) Define buffer solution.
(b) Give one example each of acidic and basic buffer.

SECTION - C

Q22. Calculate:
(i) Mass in gram of 5.8 mol N_2O
(ii) Number of moles in 8.0 g of O_2
(iii) Molar mass if 11.2 L at STP weigh 8.5 g

Q23. Ethyl acetate is formed by the reaction between ethanol and acetic acid and the equilibrium is represented as:
$CH_3COOH(l) + C_2H_5OH(l) \rightleftharpoons CH_3COOC_2H_5(l) + H_2O(l)$

(i) Write the concentration ratio (reaction quotient) Q^c for this reaction
(Note: water is not in excess and is not a solvent in this reaction.)
(ii) At 293 K, if one starts with 1.00 mol of acetic acid and 0.18 mol of ethanol, there is 0.171 mol of ethyl acetate in the final equilibrium mixture. Calculate the equilibrium constant.
(iii) Starting with 0.5 mol of ethanol and 1.0 mol of acetic acid and maintaining it at 293 K, 0.214 mol of ethyl acetate is found after some time. Has equilibrium been reached?

Q24. What is the (a) formula of compound (b) nature of bond formed between element X (atomic number 31) and element Y (atomic number 8)? Draw the Lewis dot structure. What is the formula of the compound?

Q25. The enthalpy of combustion of methane, graphite and dihydrogen at 298 K are −890.3 kJ mol^{-1}, −393.5 kJ mol^{-1} and −285.8 kJ mol^{-1} respectively. Calculate the enthalpy of formation of methane gas.

Q26. Differentiate between the following (with examples):
(i) Open and closed system
(ii) Adiabatic and isothermal process
(iii) State function and path function

Q27. In sulphur estimation, 0.157 g of an organic compound gave 0.4813 g of $BaSO_4$. What is the % of sulphur in the given organic compound?

Q28. Explain briefly carcinogenicity and toxicity of aromatic hydrocarbons.

Q29. Read the following passage and answer the questions that follow:
The energy needed to remove the neutral atom's most loosely bonded electron is known as the first ionisation enthalpy (IE_1). The second ionisation enthalpy (IE_2) is the energy needed to remove the second electron from the resultant cation, and so on. The energy needed to remove an s-electron from the same shell would require more ionisation enthalpy than it would to remove a p-electron, which in turn would take more energy than it would to remove a d-electron, and so on. Due to a rise in the number of inner electrons that balance off the increase in nuclear charge, there is an increase in the shielding effect on the outermost electron, and the removal of the outermost electron takes less energy down a group.
(a) Which element in the periodic table has the highest ionization energy (IE)?
(b) Although B is larger than Be, it has a lower first ionization energy than Be. Why?

OR

How does size of an atom affect its ionization enthalpy?
(c) How does screening effect work? In what ways does it affect the ionization enthalpy?

Q30. Read the passage and answer the following questions:
Put a strip of metallic zinc in a copper nitrate aqueous solution for roughly an hour. The strip may start to acquire a reddish metallic copper coating, and the solution's original blue colour may start to fade. When the blue colour of the solution caused by Cu^{2+} has vanished, it is simple to determine that Zn^{2+} ions are among the products. Making the solution alkaline with ammonia will cause the appearance of white zinc sulphide, or ZnS, if hydrogen sulphide gas is passed through the colourless solution containing Zn^{2+} ions.
(a) Write the chemical reaction taking place between metallic zinc and copper nitrate aqueous solution.
(b) Define standard electrode potential.

OR

Out of Zn and Cu vessel, one will be more suitable to store 1M HCl?
Given,
$E^{\circ}_{Zn^{2+}/Zn} = -0.76\,V$
$E^{\circ}_{Cu^{2+}/Cu} = +0.34\,V$

(c) What is metal activity series? Does the series have another name? What is the basis of the series and which type of cell is used to prepare this?

Q31. Attempt any five of the following:

(a) Write the electronic configuration of the following ions:

(i) He^+ (ii) Mg^{2+}

(b) What are the atomic numbers of elements whose outermost electrons are represented by:

(i) $3s^2$ (ii) $2p^5$

(c) Which atoms are indicated by the following configurations?

(i) $[He]\ 2s^2$ (ii) $[Ne]\ 3s^2\ 3p^5$

(d) Write a short note on Aufbau principle.

(e) What are the values of all the four quantum numbers for the nineteenth electron of copper?

(f) Which quantum number is not obtained from the solution of Schrödinger wave equation?

(g) How many radial and angular nodes are present in 2p orbital?

Q32. (i) Define Isomerism. Explain position isomerism with examples.

(ii) Write structural formulae for compounds named as:

(a) 1-Bromoheptane

(b) 5-Bromoheptanoic acid

OR

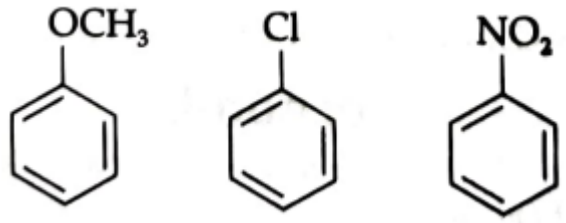
(a) Define homologous series. Write the general formula of alkanes, alkenes and alkynes.

(b) Define functional groups. Write the general formula of carboxylic acids and acid chlorides.

Q33. Give mechanism of addition of HBr to Propene.

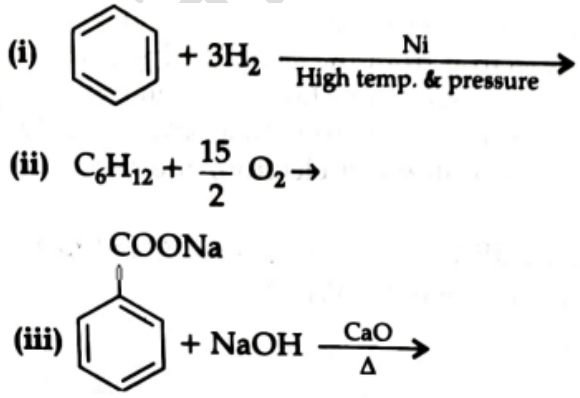
OR

(a) (i) Arrange the following set of compounds in the order of their decreasing relative reactivity with an electrophile.



(ii) Give one important structural difference between cyclohexanol and phenol.

(b) Complete the following reactions:



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SOLUTION

Q1. **(C)**

Explanation: Weight of NaCl (w) = 5.85 g

Volume of solution (V) = 500 mL

Molecular weight of NaCl = 58.5

$$\text{Molarity} = \frac{w \times 1000}{\text{Molecular weight} \times \text{Volume in mL}}$$

$$= \frac{5.85 \times 1000}{58.5 \times 500} = 0.2 \text{ mol L}^{-1}$$

Q2. **(C)**

Explanation:

Empirical formula mass (CH_2O)

= 12 + 2(1) + 16 = 30

Molecular mass = 180

$$n = \frac{\text{Molecular mass}}{\text{Empirical formula mass}} = \frac{180}{30} = 6$$

$$\text{Molecular formula} = n \times \text{empirical formula}$$

$$= 6 \times CH_2O = C_6H_{12}O_6$$

Q3. **(C)**

Explanation: The concept of movement of electrons in circular paths of fixed energy called **orbits** was given by **Bohr**, not Rutherford.

Q4. **(D)**

Explanation: For 3p subshell,

n = 3, l = 1

Number of radial nodes = n − l − 1

= 3 − 1 − 1 = 1

Q5. **(B)**

Explanation: The radii of cations and anions forming an isoelectronic series decrease with an increase in nuclear charge.

Q6. **(B)**

Explanation:

(i) NF_3 is pyramidal whereas BF_3 is trigonal planar.

(ii) BF_4^- and NH_4^+ are tetrahedral.

(iii) BCl_3 is triangular planar whereas $BrCl_3$ is pyramidal.

(iv) NH_3 is pyramidal whereas NO_3^- is triangular planar.

Q7. **(B)**

Number of orbitals involved in hybridization (H):

$$H = \frac{1}{2}[V + M - C + A]$$

Where:
V = valence electrons of central atom
M = number of monovalent atoms linked with central atom
C = charge of cation
A = charge of anion

NO_2^+: $= \frac{1}{2}[5 + 0 - 1 + 0] = 2 \Rightarrow sp$

NO_3^-: $= \frac{1}{2}[5 + 0 - 0 + 1] = 3 \Rightarrow sp^2$

NH_4^+: $= \frac{1}{2}[5 + 4 - 1 + 0] = 4 \Rightarrow sp^3$

Q8. **(B)**

Explanation:
A **state function** does not depend upon the path followed; it is independent of the path.

Q9. **(C)**

Explanation: $\Delta H^\circ = \Delta U^\circ + \Delta nRT$
For the reaction:
$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$
$\Delta n = n_p - n_r = 1 - 3 = -2$
$\Delta H^\circ = \Delta U^\circ - 2RT$
$\therefore\ \Delta H^\circ < \Delta U^\circ$

Q10. **(C)**

Explanation: In a group, electron gain enthalpy decreases on moving down the group, but the electron gain enthalpy of Cl is more negative than F.
This happens due to the addition of an electron to the compact 2p orbital of fluorine, which results in greater electron–electron repulsion compared to the addition of an electron to the 3p orbital of chlorine.

Q11. **(B)**

Explanation: $\Delta n =$ (Number of moles of gaseous products) − (Number of moles of gaseous reactants)
$= 2 - 0 = 2$

Q12. **(D)**

Explanation: $\Delta G^\circ = -RT\ln\ K$
Given $\Delta G^\circ > 0$, this is possible only if $\ln K$ is negative, i.e., $K < 1$

Q13. **(A)**

Q14. **(A)**

Explanation:
Assertion and Reason both are **correct statements**, and **Reason is the correct explanation** of Assertion.

Q15. **(A)**

Q16. **(A)**

Q17. (a) The balanced equation for combustion of methane is:

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$$

1 mol 2 moles 1 moles 2 moles

16 g

(b)

1 mole of CH_4(g) gives **2 moles of H_2O(g)**

2 moles of water (H_2O)

= 2 × (2 + 16) = 2 × 18 = **36 g**

1 mole of H_2O = 18 g H_2O

Amount of water produced by the combustion of 16 g of methane

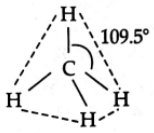
$$= 2 \text{ mol } H_2O \times \frac{18 \text{ g } H_2O}{1 \text{ mol } H_2O}$$

$$= 2 \times 18g \ \mathbf{H_2O} \ = \mathbf{36} \text{ g } \mathbf{H_2O}$$

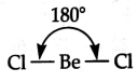
Q18. Physical significance of ψ : All the information about the electron in an atom is stored in its orbital wave function ψ and quantum mechanics makes it possible to extract this information out of ψ.
Physical significance of ψ^2 : From the value of $|\psi|^2$ at different points within an atom, it is possible to predict the region around the nucleus where electron will most probably be found

Q19.

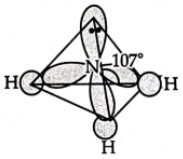
(a) Structure of CH_4:



Structure of $BeCl_2$:



Structure of NH_3:

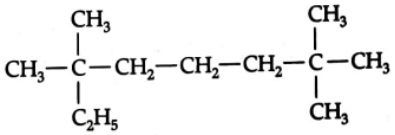


(Bond angle decreases due to *lp* – *bp* repulsion)

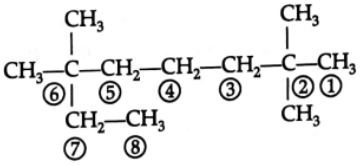
(b) **Decreasing order of bond angle –**

$BeCl_2 > CH_4 > NH_3$

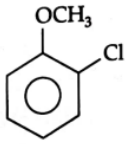
Q20. (i) 2, 2, 6, 6 – tetramethyl octane



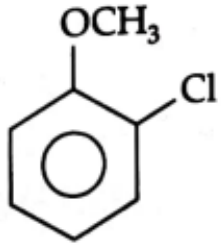
Or



(ii) 2-Chloromethoxy benzene



(ii) 2-Chloromethoxy benzene



OR

(i) 1-chloroethene

(ii) 1-methylcyclobutane

Q21. **(a)** The solution which resists change in pH on dilution or with the addition of small amounts of acid or alkali is called buffer solution.

(b) Example of acidic buffer – $CH_3COOH + CH_3COONa$ (pH = 4.75)

Example of basic buffer – $NH_4OH + NH_4Cl$ (pH = 9.25)

Q22. **(i)** Molecular mass of $N_2O = 2(14) + 16 = 44$

Mass = Molecular mass × No. of moles

= 44 × 5.8 = 255.2 g

(ii) Number of moles of O_2 = Mass of O_2 / Molecular mass of O_2 = 8.0 / 32 = 0.25 mol

(iii) ∴ 11.2 L at STP weigh = 8.5 g

∴ 22.4 L at STP will weigh = $\frac{8.5}{11.2} \times 22.4 = 17 \text{ g mol}^{-1}$

Q23. The given reaction is

$CH_3COOH(l) + C_2H_5OH(l) \rightleftharpoons CH_3COOC_2H_5(l) + H_2O(l)$

H_2O is not in excess and is not a solvent.

(i) $Q_c = \frac{[CH_3COOC_2H_5(l)] \times [H_2O(l)]}{[CH_3COOH(l)] \times [C_2H_5OH(l)]}$

(ii) $[CH_3COOH(l)] = 1.00 \text{ mol}$

$[C_2H_5OH(l)] = 0.18 \text{ mol}$

$[CH_3COOC_2H_5(l)] = 0.171 \text{ mol}$

$CH_3COOH(l) + C_2H_5OH(l) \rightleftharpoons CH_3COOC_2H_5(l) + H_2O(l)$

Initial conc.	1.0 mol	0.18 mol		
Equilibrium	(1 – 0.171) mol	(0.18 – 0.171) mol	0.171 mol	0.171 mol
Molar conc.	$\frac{0.829}{V}$	$\frac{0.009}{V}$	$\frac{0.171}{V}$	$\frac{0.171}{V}$

$$K_c = \frac{\frac{0.171}{V} \times \frac{0.171}{V}}{\frac{0.829}{V} \times \frac{0.009}{V}} = 3.92$$

(where V = volume of container in L)

∴ Equilibrium constant = 3.92

(iii)

$CH_3COOH + C_2H_5OH \rightleftharpoons CH_3COOC_2H_5 + H_2O$

Initial conc.	1.00 mol	0.50 mol		
Equilibrium	(1 – 0.214) mol	(0.500 – 0.214) mol	0.214 mol	0.214 mol
	= 0.786 mol	0.286 mol	0.214 mol	0.214 mol

$$Q_c = \frac{\frac{0.214}{V} \times \frac{0.214}{V}}{\frac{0.786}{V} \times \frac{0.286}{V}} = 0.2037$$

As $Q_c \neq K_c$

∴ Equilibrium is not been attained.

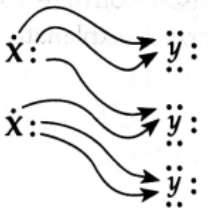
Q24.

$_{31}X = 2, 8, 18, 3$ (Ga)

$_8y = 2, 6$ (O)

∴ There is a very high electronegative difference in both these elements. So, these elements form an ionic bond.

Lewis dot structure –



Or $2[X]^{3+}\, 3\left[:\ddot{y}:\right]^{2-}$

Formula of compound:

X_2y_3, i.e., Ga_2O_3

Q25.

Given that,

(i) $CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(g)$; $\Delta_cH^\circ = -890.3\ kJ\ mol^{-1}$

(ii) $C(s) + O_2(g) \longrightarrow CO_2(g)$; $\Delta_cH^\circ = -393.5\ kJ\ mol^{-1}$

(iii) $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(g)$; $\Delta_cH^\circ = -285.8\ kJ\ mol^{-1}$

We have to calculate Δ_fH° of the equation:

$C(s) + 2H_2(g) \longrightarrow CH_4(g)$; $\Delta_fH^\circ = ?$

Applying inspection method,

– eq. (i) + eq. (ii) + 2 × eq. (iii)

$-CH_4(g) - 2O_2(g) + C(s) + O_2(g) + 2H_2(g) + O_2(g) \longrightarrow -CO_2(g) - 2H_2O(g) + CO_2(g)$

or $C(s) + 2H_2(g) \longrightarrow CH_4(g)$

$\therefore \Delta_fH^\ominus = -(-890.3) + (-393.5) + 2 \times (-285.8)$

$= 890.3 - 393.5 - 571.6 = 890.3 - 965.1$

$= -74.8\ kJ\ mol^{-1}$

Q26. **(i)**

Open System	Closed System
It can exchange matter as well as energy with its surroundings.	It does not exchange matter with its surroundings but can exchange energy in the form of heat.
e.g., Reaction mixture in open beaker.	e.g., Hot water in a closed container.

(ii)

Adiabatic Process	Isothermal Process
In this process, no heat can flow in or out of the system.	In this process, temperature remains constant.
i.e., dq = 0	i.e., dT = 0

(iii)

State Function	Path Function
The variables which depend upon the initial and final states of a system are called state functions.	The variables which depend upon the path followed are called path functions.
e.g., Internal energy, pressure, volume, enthalpy, etc.	e.g., Heat, work, etc.

Q27. Mass of organic compound = 0.157 g

Mass of $BaSO_4$ = 0.4813 g

Percentage of Sulphur

$$= \frac{32}{233} \times \frac{\text{Mass of } BaSO_4}{\text{Mass of organic compound}} \times 100$$

$$= \frac{32}{233} \times \frac{0.4813}{0.197} \times 100 = 42.10\%$$

Q28. Benzene and polynuclear hydrocarbons containing more than two benzene rings fused together are toxic and said to possess cancer producing property. Such polynuclear hydrocarbons are formed due to incomplete combustion of organic material like tobacco, coal and petroleum. They damage DNA and cause cancer. Some of the carcinogenic polynuclear hydrocarbons are 1, 2-Benzanthracene, 3-methyl-cholanthrene, 1, 2-Benzpyrene, 1, 21, 25-, 6, 5, 6-Dichloro anthracene and 9, 10-Dimethyl 1, 2,- Benzanthracene.

Q29. **(a)** Helium has the highest ionization enthalpy.

(b) Electronic configuration of Be(4) = 2, 2 = $1s^2$, and $2s^2$ is the answer.

Electronic setup of B(5) = 2, 3 = $1s^2$, $2s^2$, and $2p^1$

Compared to B, Be's 2s orbital is fully filled, hence more energy is needed to remove an electron from there. Therefore, boron's initial I.E. is lower than Be.

OR

The ionisation enthalpy depends upon the distance between the electron and the nucleus, i.e., size of the atom. It decreases with increase in atomic size.

(c) Screening Effect: The outermost electrons are protected from the nucleus's attractive pull by the

core electrons in the inner shells. Screening effect is the name given to this kind of impact.
(1) The effective nuclear charge decreases with an increase in the screening effect. As a result, the valence shell electrons' force of attraction towards the nucleus reduces, which lowers the ionisation enthalpy.

Q30.

(a) $Zn(s) + Cu^{2+}(aq)NO_3^{-1}(aq) \rightarrow Zn^{2+}(aq)NO_3^{-1}$
(blue) (reddish brown)(aq) + Cu(s)

(b) The standard electrode potential is the potential of an electrode where the concentration of each species participating in the electrode reaction is unity (if any gas is involved, its pressure is considered as 1 atmosphere), and where the temperature is kept at 298 K

OR

As we know that the metals having negative value of standard reduction potential (E°) are highly reactive and displace hydrogen from acids. So, out of Zn and Cu vessel. Zn has negative value of E° i.e., −0.76 V, hence it displaces hydrogen from 1 M HCl and Cu has positive value of E° i.e., +0.34 V, hence it cannot displace hydrogen from 1 M HCl. Thus, it is concluded that Cu vessel will be more suitable to store 1 M HCl.

(c) The list of elements in the activity series is arranged in decreasing order of reactivity. This list of metal elements is known as metal activity series. The electrodes (metals and nonmetals) in contact with the ions of the elements are organised according to the values of their standard reduction potentials or standard oxidation potentials, and thus, also known as electrochemical, electromotive, or activity series of the elements. The Galvanic cell is used for this purpose.

Q31. **(a)**
(i) He^+: Number of electrons = 2 − 1 = 1
Electronic configuration = $1s^1$
(ii) Mg^{2+}: Number of electrons = 12 − 2 = 10
Electronic configuration = 2, 8 = $1s^2$, $2s^2$, $2p^6$

(b)
(i) $3s^2$, Atomic number of element = 12
(ii) For $2p^5$, Atomic number of element = 9

(c)

Electronic Configuration	Atomic No.	Atom
(i) $[He]2s^2$	4	Be
(ii) $[Ne]\ 3s^2 3p^5$	17	Cl

(d) Aufbau principle: According to this principle, "In the ground state of the atoms, the sub-shells are filled in order of their increasing energies." In case, two or more sub-shell have same energy then electron can be filled in those sub-shell, which has least 'n' value.

(e) ^{29}Cu = 2, 8, 18, 1 = $1s^2$, $2s^2 2p^6$, $3s^2 3p^6\ 3d^{10}$, $4s^1$
19th electron of copper lies in 4s orbital.
Therefore, n = 4, l = 0, m = 0, s = +½

(f) Spin quantum number is not obtained from solution of Schrondinger wave equation

(g) Radial nodes = n − l − 1
Angular nodes = n − 1
Here in case of 2p, the value of n = 2
Therefore, 2p orbital contains–

Radial nodes = 0
Angular nodes = 1

Q32. **(i)** Two or more compounds having the same molecular formula but different physical and chemical properties are called isomers and this phenomenon is called isomerism

Position Isomerism : Compounds which have the same structure of carbon chain but differ in the position of double or triple bonds or functional group are called position isomers and this phenomenon is called position isomerism.

e.g., $CH_3–CH_2–CH=CH_2$ and $CH_3–CH=CH–CH_3$

(ii)

(a) $\overset{7}{CH_3}—\overset{6}{CH_2}—\overset{5}{CH_2}—\overset{4}{CH_2}—\overset{3}{CH_2}—\overset{2}{CH_2}—\overset{1}{CH_2}—Br$

1-Bromoheptane

(b) $\overset{7}{CH_3}—\overset{6}{CH_2}—\overset{5}{CH}(Br)—\overset{4}{CH_2}—\overset{3}{CH_2}—\overset{2}{CH_2}—\overset{1}{C}(=O)—O—H$

5-Bromoheptanoic acid

OR

(a) Homologous Series: It is defined as group of similar organic compounds which contains the similar functional groups and the two adjacent members of the series differ by a $–CH_2$ group. For example, alkanes, alkenes, alkynes, etc.

Alkanes C_nH_{2n+2}

Alkenes C_nH_{2n}

Alkynes C_nH_{2n-2}

(b) Functional Groups: It is an atom or group of atoms bonded together in a unique manner which is usually the site of chemical reactivity in an organic molecule. e.g. CH_3OH

General formula of carboxylic acids:

$C_nH_{2n+1}COOH$

General formula of acid chlorides:

RCOCl

Q33. Addition of HBr to propene (unsymmetrical alkene) follows Markovnikov's rule according to which the negative part of the addendum gets attached to that C atom which possesses lesser number of hydrogen atoms.

$CH_3—CH=CH_2 + H—Br \xrightarrow[\text{rule}]{\text{Markovniknov's}} CH_3—\underset{\displaystyle Br}{\underset{|}{CH}}—CH_3$

Propene

2-Bromopropane

Mechanism: Hydrogen bromide provides an electrophile, H^+, which attacks the double bond to form carbocation as:

$\overset{3}{H_3C}—\overset{2}{CH}=\overset{1}{CH_2} + H-Br$

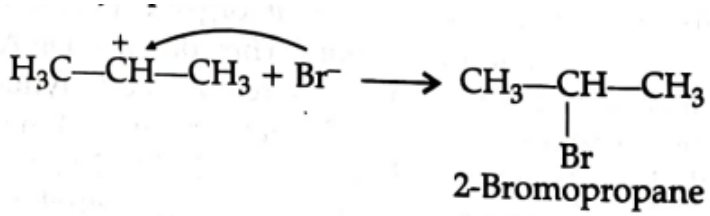
$\downarrow H^+$

$H_3C—CH_2—\overset{+}{C}H_2 + Br^-$ (less stable primary carbocation)

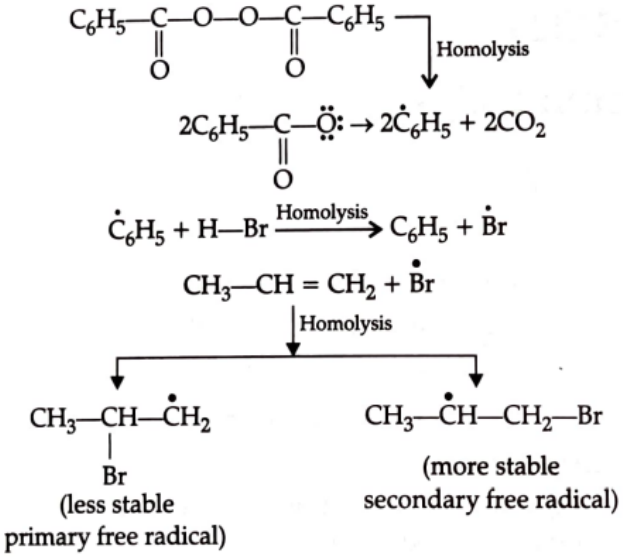
$H_3C—\overset{+}{C}H—CH_3 + Br^-$ (more stable secondary carbocation)

Secondary carbocations are more stable than primary carbocations. Therefore, the former

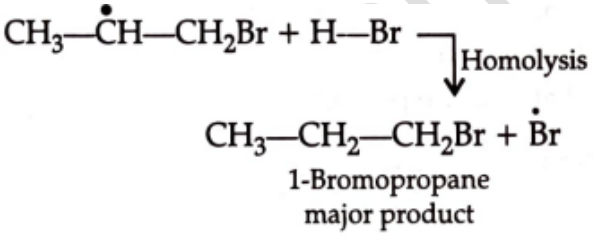
predominates as it will form at a faster rate. Thus, in the next step, Br^- attacks the carbocation to form 2-bromopropane as the major product.



Addition of HBr to unsymmetrical alkenes like propene in the presence of light or peroxide takes place contrary to the Markovnikov's rule. This so happens only with HBr but not with HCl and HI. This addition of HBr to propene in the presence of benzoyl peroxide follows anti-Markovnikov's rule or peroxide effect or Kharash effect.

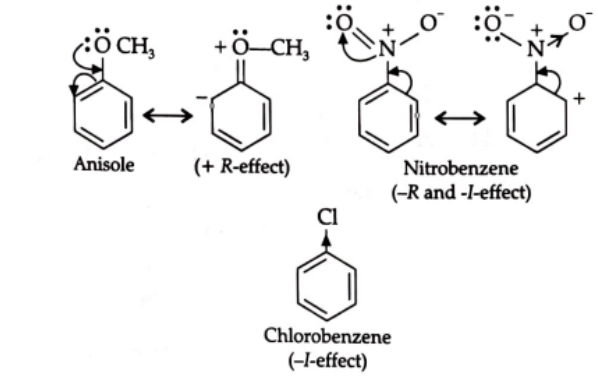


Secondary free radicals are more stable than primary radicals. Therefore, the former predominates since it forms at a faster rate. Thus, 1-bromopropane is obtained as the major product.



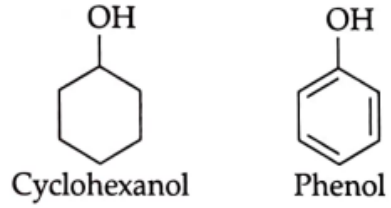
OR

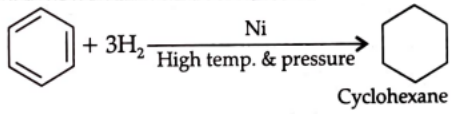
(a) (i)



The overall overall reactivity of these three reacu compounds towards electrophiles decreases in the following order: Anisole > Chlorobenzene >Nitrobenzene

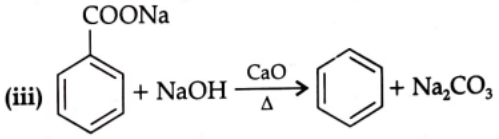
(ii) In phenol, benzene ring has alternate single and double bonds while cyclohexanol is alicyclic compound.



(b) (i) 

Cyclohexane

(ii) $C_6H_{12} + \frac{15}{2} O_2 \rightarrow 6CO_2 + 3H_2O$

(iii) 

Benzene