

DEHRADUN PUBLIC SCHOOL
ASSIGNMENT (2022-23)
SUBJECT - CHEMISTRY (043)
CLASS – XI

UNIT-I (SOME BASIC CONCEPTS OF CHEMISTRY)

Q1. Read the questions and tick the correct option.

- i. A compound has 20% of Mg, 26.66% S and 53.33% O, the empirical formula of compound is (Mg = 24u, S = 32u, O = 16u)
- a. $MgSO_3$ b. $MgSO_4$ c. $MgSO_2$ d. $MgSO_5$
- ii. The formula of ammonium nitrite is
- a. NH_4NO_3 b. NH_4NO_2 c. NH_4NO_4 d. $(NH_4)_2NO_3$
- iii. The volume of N_2 gas liberated at STP by heating 6.4 g of NH_4NO_2 is equal to [N=14 u H=1u, O=16u]
- a. 1.12 L b. 2.24 L c. 22.4 L d. 11.2 L
- iv. 25cm³ of oxalic acid completely neutralized by 0.064 g of NaOH. Molarity of oxalic acid solution is
- a. 0.064 b. 0.045 c. 0.015 d. 0.032
- v. Which of the following pairs have the same number of atoms?
- i. 16g of $O_2(g)$ and 4g of $H_2(g)$ ii. 16g of O_2 and 44g of CO_2
- iii. 28g of N_2 and 32g of O_2 iv. 12g of C(s) and 23g of Na(s)
- a. i and ii b. ii and iii c. iii and iv d. i and iv

Q2. In the following questions, a statement of assertion followed by a 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 correct explanation for assertion.
- b. Assertion and reason both are correct statements but reason is not correct explanation for assertion.
- c. Assertion is correct statement but reason is wrong statement.
- d. Assertion is wrong statement but reason is correct statement.
- i. **Assertion:** One atomic mass unit is defined as one twelfth of the mass of one carbon-12 atom.
Reason: Carbon-12 isotope is the most abundant isotope of carbon and has been chosen as standard.
- ii. **Assertion:** Combustion of 16 g of methane gives 18 g of water.
Reason: In the combustion of methane, water is one of the products.

Q3. i. Complete the following analogy.

88g CO_2 : 2 mol :: 96g O_2 : _____

- a. 0.25 mol b. 1.0 mol c. 2.0 mol d. 3.0 mol
- ii. **Which of the following analogies is correct ?**
- a. Molarity : mol/L :: Density : mol/kg
- b. Molality : mol/L :: Temperature : °C
- c. Mole : mol :: Density: kg/L
- d. Mass : gram :: Volume : Litre

Q4. Answer the following questions.

- i. 1.5 g of ethane on complete combustion gave 4.4 g of CO_2 and 2.7 g of H_2O . Show that the results are in accordance to the law of conservation of mass.
- ii. What weight of NaCl would be decomposed by 4.900g of H_2SO_4 , if 6g of $NaHSO_4$ and 1.825g of HCl are produced in the reaction?

- iii. An atom of an element is 55.847 times as heavier as $1/12$ mass of an atom of C-12. What is the atomic mass of the element in amu?
- iv. Calculate the number of gram atoms present in the following masses:
 - a. 12.69 g of hydrogen.
 - b. 40.089 g of calcium
 (Given, atomic mass of H = 1.008 amu and atomic mass of Ca = 40.08 amu)
- v. If the value of Avogadro's number is changed to 1.0×10^{20} , what would be the molecular mass of nitrogen gas?
- vi. Chlorophyll, the green colouring matter of plants contains 2.68 % of magnesium by mass. Calculate the number of magnesium atoms present in 2.5 g of chlorophyll.
- vii. One lakh atoms of gold weigh 3.271×10^{-17} g. What is the atomic mass of gold?
- viii. Calculate the molarity of pure water at room temperature if the density is 0.998 g/ml.

Q5. Read the passage given below and answer the questions that follow.

Concentrations of solution can be expressed in terms of mass percentage, volume percentage, mass/volume percentage. Molarity, molality and mole fractions are also used to express concentration of solution. Molality can be converted into molarity and vice-versa if density of solution is given. Mole fraction of solute can be converted into molality and vice-versa if we know molar mass of solvent.

The following questions are multiple choice questions. Choose the most appropriate answer:

- i. The number of H₂O molecules in 18 mL of H₂O [Molar mass= 18 g mol⁻¹, density of H₂O= 1g/mL]
 - a. 6.022×10^{22}
 - b. 6.022×10^{23}
 - c. 6.022×10^{24}
 - d. 6.022×10^{25} molecules
- ii. Molality is defined as number of moles of solute per
 - a. kg of solution
 - b. kg of solvent
 - c. Litre of solution
 - d. Litre of solvent
- iii. Whenever gases combine, they do so in volume and bear a simple ratio among themselves and to the products if these are gaseous at same temperature and pressure is known as
 - a. Boyle's law
 - b. Charle's law
 - c. Avogadro's law
 - d. Gay lussac's law of combining volume
- iv. The unit of molarity is
 - a. molL⁻¹
 - b. mol/kg
 - c. no unit
 - d. g/litre
- v. The molarity of NaOH in the solution prepared by dissolving 4g in enough water to form 250 mL of solution is [Molar mass of NaOH = 40g/mol]
 - a. 0.2
 - b. 0.4
 - c. 0.8
 - d. 0.1

UNIT-II (STRUCTURE OF ATOM)

Q1. Read the questions and tick the correct option.

- i. The number of radial nodes for 3p orbital is _____.
 - a. 3
 - b. 4
 - c. 2
 - d. 1
- ii. For the electrons of oxygen atom, which of the following statements is correct?
 - a. Z_{eff} for an electron in a 2s orbital is the same as Z_{eff} for an electron in a 2p orbital.
 - b. An electron in the 2s orbital has the same energy as an electron in the 2p orbital.
 - c. Z_{eff} for an electron in 1s orbital is the same as Z_{eff} for an electron in a 2s orbital.
 - d. The two electrons present in the 2s orbital have spin quantum numbers m_s but of opposite sign.
- iii. Which of the following statements concerning the quantum numbers are correct?
 - a. Angular quantum number determines the three dimensional shape of the orbital.
 - b. The principal quantum number determines the orientation and energy of the orbital.
 - c. Magnetic quantum number determines the size of the orbital.
 - d. Spin quantum number of an electron determines the orientation of the spin of electron relative to the chosen axis.

- iv. What is ratio of velocity of electron and proton if both are associated with same de Broglie wavelength? $m_e = 9.1 \times 10^{-31}$ kg, $m_p = 1.67 \times 10^{-27}$ kg
 a. 1800 times b. 1836 times c. 1/1836 d. 1900 times
- v. The value of 'h' = 6.63×10^{-34} Js. The speed of light is 3×10^{17} nm s⁻¹. Which value is closer to the wavelength in nanometer of a quantum of light with frequency 6×10^{15} s⁻¹.
 a. 50 b. 75 c. 10 d. 25

Q2. In the following questions, a statement of assertion(A) followed by a statement of reason (R) is given. Choose the correct answer out of the following choices.

- a. Assertion and reason both are correct statements and reason is correct explanation for assertion.
 b. Assertion and reason both are correct statements but reason is not correct explanation for assertion.
 c. Assertion is correct statement but reason is wrong statement.
 d. Assertion is wrong statement but reason is correct statement.
- i. **Assertion:** In Lyman series, electron jumps from various energy level to 1st energy level.
Reason: Lyman series belongs to U.V. region.
- ii. **Assertion:** When electron jumps from 5th energy level to 1st energy level, number of spectral lines are equal to 10.
Reason: Balmer series belong to infra-red region.
- iii. **Assertion:** The mass of 1.09×10^{27} electrons is equal to 1 g.
Reason: The mass of 1 electron is 9.1×10^{-31} kg.

Q3. i. Complete the following analogy.

Principal Quantum Number : energy and size of orbital :: Azimuthal Quantum Number: ?

- a. Orientation of Orbital. b. Energy of orbital.
 c. Spin of electron. d. Shape of the orbital.
- ii. **Which of the following analogies is incorrect ?**
- a. X-ray : 10^{17} - 10^{20} Hz :: Ultraviolet : 10^{20} - 10^{24} Hz
 b. Microwave : 3×10^{11} - 10^{13} Hz :: X-ray : 10^{17} - 10^{20} Hz
 c. Infrared : 10^{20} - 10^{24} Hz :: radiowaves : $< 3 \times 10^{11}$ Hz
 d. X-ray : 10^{20} - 10^{24} Hz :: radiowave : $< 3 \times 10^{11}$ Hz

Q4. Answer the following questions.

- i. Calculate charge and mass of nucleus of N-7.
 ii. What are the values of four quantum numbers for the $3d^2$ and $4d^7$ electrons.
 iii. What is the experimental evidence in support of the idea that electronic energies in an atom are quantized?
 iv. Chlorophyll present in green leaves of plants absorbs light at 4.620×10^{14} Hz. Calculate the wavelength of radiation in nanometer. Which part of the electromagnetic spectrum does it belong to?
 v. Table-tennis ball has a mass 10 g and a speed of 90 m/s. If speed can be measured within an accuracy of 4% what will be the uncertainty in speed and position?
 vi. Threshold frequency is the minimum frequency which a photon must possess to eject an electron from a metal. It is different for different metals. When a photon of frequency 1.0×10^{15} s⁻¹ was allowed to hit a metal surface, an electron having 1.988×10^{-19} J of kinetic energy was emitted. Calculate the threshold frequency of this metal. Show that an electron will not be emitted if a photon with a wavelength equal to 600 nm hits the metal surface.
 vii. Calculate the energy and frequency of the radiation emitted when an electron jumps from $n = 3$ to $n = 2$ in a hydrogen atom.
 viii. A photon of 300 nm is absorbed by a gas. It then emits two photons. The wavelength of one re-emitted photon is 496 nm. Calculate the energy of other photon emitted.

Q5. Read the passage given below and answer the questions that follow.

Orbitals are region or space where there is maximum probability of finding electrons.

Qualitatively, these orbitals can be distinguished by their size, shape and orientation. An orbital of small size means there is more chance of finding the electron near the nucleus. Shape and orientation means the direction in which probability of finding electron is maximum. Atomic orbitals can be distinguished by quantum numbers. Each orbital is designated by three quantum numbers n , l and ml (magnetic quantum number) which defines energy, shape and orientation but these are not sufficient to explain spectra of multi-electrons atoms. Spin quantum number (m_s) determines the spin of electron. Spin angular momentum of electron has two orientations relative to chosen axis which are distinguished by spin quantum numbers m_s which can take values $+1/2$ and $-1/2$.

Value of ' l '	0	1	2	3	4
Notation for subshell	s	p	d	f	g

- $n=2, l=1, n=4, l=0$ respectively represent:
 - 2d, 4s
 - 2p, 4s
 - 2s, 4p
 - 2s, 4d
- The d-orbitals on the axis are-
 - dx_y
 - dy_z
 - dz_x
 - dx²-y² and dz²
- Magnetic moment 2.83 BM is given by which of the following ions?
[Atomic number Ti= 22, Cr = 24, Mn = 25, Ni = 28]
 - Ti³⁺
 - Ni²⁺
 - Cr²⁺
 - Mn²⁺
- The pair of ions having same electronic configuration is _____.
 - Cr³⁺, Fe³⁺
 - Fe³⁺, Mn²⁺
 - Fe³⁺, Co³⁺
 - Sc³⁺, Cr³⁺
- The number of orbitals in 3rd shell are equal to-
 - 3
 - 6
 - 9
 - 12

UNIT-III (CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES)**Q1. Read the questions and tick the correct option.**

- Which type of compound is formed by Group 14 elements in 3rd period and what is the formula of its chloride and its oxide?
 - Ionic, SiCl₄, SiO₂
 - Covalent, SiCl₄, SiO₂
 - Covalent, SiCl₂, SiO₂
 - Ionic, SiCl₃, SiO₂
- Which of the following has highest ionisation enthalpy?
 - O
 - N
 - P
 - S
- Which of the following is most electropositive element?
 - Li
 - Na
 - K
 - Cs
- Considering the elements F, Cl, O and N, the correct order of their chemical reactivity in terms of oxidizing property is:
 - F > Cl > O > N
 - F > O > Cl > N
 - Cl > F > O > N
 - O > F > N > Cl
- Z=114 has been discovered recently. It will belong to which of the following family group and electronic configuration?
 - Carbon family [Rn] 5f 14 6d¹⁰ 7s² 7p²
 - Oxygen family [Rn] 5f 4 6d¹⁰ 7s² 7p⁴
 - Nitrogen family [Rn] 5f 14 6d¹⁰ 7s² 7p⁵
 - Halogen family [Rn] 5f 14 6d¹⁰ 7s² 7p⁵

Q2. In the following questions, a statement of assertion (A) followed by a statement of reason (R) is given. Choose the correct answer out of the following choices.

- Assertion and reason both are correct statements and reason is correct explanation for assertion.

- b. Assertion and reason both are correct statements but reason is not correct explanation for assertion.
- c. Assertion is correct statement but reason is wrong statement.
- d. Assertion is wrong statement but reason is correct statement.
 - i. **Assertion:** Among 2nd period, $\text{Li} < \text{B} < \text{Be} < \text{C} < \text{O} < \text{N} < \text{F} < \text{Ne}$ is order of ionization enthalpy.
Reason: Atomic size goes on increasing along a period from left to right.
 - ii. **Assertion:** $\text{B} < \text{Ga} < \text{Al} < \text{In} < \text{Tl}$ is the increasing order in terms of atomic size of group 13.
Reason: Tl^+ is more stable than Tl^{3+} due to inert pair effect.
 - iii. **Assertion:** Group 2 elements have very high 2nd ionisation enthalpy.
Reason: Group 2 elements acquire noble gas configuration after losing 2 electrons.

Q3. i. Complete the following analogy.

Maximum ionization enthalpy :A::Maximum electronegativity:B

- a. $\text{A:F}::\text{B:Cl}$ b. $\text{A:He}::\text{B:F}$ c. $\text{ALCs}::\text{B:F}$ d. $\text{AL:He}::\text{B:Cl}$

ii. Which of the following analogies is incorrect?

- a. Idea of triad: Doebereiner :: Law of octave: Newlands
- b. Atomic mass: Modern Periodic table:: Atomic number: Mendeleev Periodic table
- c. Antimony: Sb :: Silver: Ag
- d. $\text{Na:11}::\text{Ca:20}$

Q4. Answer the following questions.

- i. Predict the position of the element in the periodic table satisfying the electronic configuration $(n-1) d^1 ns^2$ for $n=4$.
- ii. Na^+ has a higher value of ionization enthalpy than Ne, though both have the same electronic configuration.
- iii. Explain why the electron gain enthalpy of fluorine is less negative than that of chlorine.
- iv. Nitrogen has positive electron gain enthalpy whereas oxygen has negative. However, oxygen has lower ionisation enthalpy than nitrogen. Explain.
- v. p-Block elements form acidic, basic and amphoteric oxides. Explain each property by giving two examples and also write the reactions of these oxides with water
- vi. Arrange the elements H, Cl, N and O in decreasing order of their Vander Waal's radii.
- vii. How many maximum elements can be accommodated in the present long form of periodic table?
- viii. The formation of $\text{F}^- (\text{g})$ from $\text{F} (\text{g})$ is exothermic whereas formation of $\text{O}^{2-} (\text{g})$ from $\text{O} (\text{g})$ is endothermic. Explain.
- ix. An anion (X^-) contains 36 electrons and 45 neutrons. What is the atomic mass of element X and its position in periodic table?
- x. Name the element which has highest
 - a. -ve electron gain enthalpy.
 - b. electro negativity
 - c. melting point

Q5. Read the passage given below and answer the questions that follow.

Modern periodic table arranges the elements in the increasing order of atomic number. It has 18 groups and 7 periods. Atomic numbers are consecutive in a period and increases in the group in a pattern. Elements are divided into four blocks, s-block, p-block, d-block, and f-block based on their electronic configuration. 78% of elements are metals, about 20 elements are non-metals, and few elements like B, Si, Ge, As are metalloids. Metallic character increases down the group but decreases along the period from left to right. The physical and chemical properties vary periodically with their atomic numbers. Periodic trends are observed in atomic size, ionization enthalpies, electron gain enthalpies, electronegativity, and valence. Oxides of metals are basic, some are amphoteric. Non-metals form acidic oxides, some form neutral oxides. s-block elements are soft, highly reactive, do not show variable oxidation states. p-block elements are metals, non-metals as well as metalloids, show variable oxidation states, exist as solids, liquids, and gases. d-

block elements are metals, form coloured ions, show variable oxidation states, have high melting and boiling points. Lanthanoids and actinoids are f-block elements, form coloured ions. All actinoids are radioactive.

- Name the elements which belong to the d-block but are not transition metals.
- What is the difference between oxidation states of p-block and d-block elements?
- Which group elements are most electropositive and why?
- What happens to reactivity down the group 17?
- What type of compound is formed by elements belonging to group 14 and third period?

UNIT-IV (CHEMICAL BONDING AND MOLECULAR STRUCTURE)

Q1. Read the questions and tick the correct option.

- The correct order of the lattice energies of the following ionic compounds is
 - NaCl > MgBr > CaO > Al₂O₃
 - NaCl > CaO > MgBr₂ > Al₂O₃
 - Al₂O₃ > MgBr₂ > CaO > NaCl
 - MgBr₂ > Al₂O₃ > CaO > NaCl
- The correct order of increasing bond length of C-H, C-O, C-C and C=C is
 - C-H < C-O < C-C < C=C
 - C-H < C=C < C-O < C-C
 - C-C < C=C < C-O < C-H
 - C-O < C-H < C-C < C=C
- The bond angle in NF (102.3°) is smaller than NH (107.2°). This is because of
 - large size of F compared to H
 - large size of N compared to F
 - opposite polarity of N in the two molecules
 - small size of H compared to N
- Which of the following molecules have same bond order?

H ₂	Cl ₂	CO	Br ₂	N ₂
I	II	III	IV	V

Choose the correct option.

- I, II and IV have same bond order.
 - III and V have same bond order.
 - Both (a) and (b)
 - I and IV have same bond order.
- v. The types of hybrid orbitals of nitrogen in ethyne, methane and ethane respectively are expected to be
- sp, sp³ and sp²
 - sp, sp² and sp³
 - sp, sp² and sp³
 - sp, sp² and sp

Q2. In the following questions, a statement of assertion(A) followed by a statement of reason(R) is given. Choose the correct answer out of the following choices.

- Assertion and reason both are correct statements and reason is correct explanation for assertion.
- Assertion and reason both are correct statements but reason is not correct explanation for assertion.
- Assertion is correct statement but reason is wrong statement.
- Assertion is wrong statement but reason is correct statement.
 - Assertion:** Though the central atom of both NH₃ and H₂O molecules are sp³ hybridised, yet H-N-H bond angle is greater than that of H-O-H.
Reason: This is because nitrogen atom has one lone pair and oxygen atom has two lone pairs.
 - Assertion:** The dipole moment helps to predict whether a molecule is polar or non-polar.
Reason: The dipole moment helps to predict the geometry.
 - Assertion:** ClF₃ is almost T-shaped.
Reason: Cl atom is surrounded by 2 lone pairs and 3 bond pairs.

Q3.i. Complete the following analogy.

Oxygen molecule: Double bond :: Nitrogen molecule: ?

- a. Single bond b. Double bond c. Triple bond d. Octet bond

ii. Which of the following analogies is correct?

- a. KCl : Polar and Linear :: NH₃ : Polar and trigonal Pyramidal
b. KCl : Non-polar and linear :: NH₃ : Non-polar and trigonal Pyramidal
c. KCl : polar and pyramidal :: NH₃ : polar and linear
d. KCl : Non-polar and pyramidal :: NH₃ : Non-polar and linear

Q4. Answer the following questions.

- i. What type of hybridization takes place in P in PCl₅ and S in SF₆?
ii. How would the bond lengths vary in the C₂, C₂⁻, C₂²⁻ species?
iii. In the SF₄ molecule, the lp electrons occupy an equatorial position in the trigonal bipyramidal arrangement to an axial position. Give a reason.
iv. Write the Lewis dot structure of HNO₃.
v. Using molecular orbital theory, compare the bond energy and magnetic character of O₂⁺ and O₂⁻ species.
vi. Explain why PCl₅ is trigonal bipyramidal whereas IF₅ is square pyramidal.
vii. Elements X, Y and Z have 4, 5 and 7 valence electrons respectively.
 a. Write the molecular formula of the compounds formed by these elements individually with hydrogen.
 b. Which of these compounds will have the highest dipole moment?
viii. CO₂ is linear whereas SO₂ is bent – shaped. Give reason.

Q5. Read the passage given below and answer the questions that follow.

In order to explain the shapes of molecules adequately, Sidgwick and Powell in 1940 proposed a theory based on the repulsive interaction of the electron pairs in the valence shell of the atoms. Nyholm and Gillespie (1950) further developed and redefined the concept. The main postulates of this theory are as follows :

The number of valence shell electron pairs (bonded or non-bonded) present around the central atom decides the shape of the molecules. The shared electron pairs are called bond pairs and unshared or non-bonding electrons are called lone pairs. Electron pairs of valence shell repel one another because their electron clouds are negatively charged. These electron pairs arrange themselves in such a way so that there is minimum repulsion and maximum distance in between them. The valence shell is considered as a sphere in which the electron pairs are localised on the spherical surface at maximum distance from one another. A lone pair occupies more space than a bonding pair, since it lies closer to the central atom. This means that the repulsion between the different electron pairs follow the order :

Lone pair-lone pair > lone pair-bond pair > bond pair-bond pair

(lp - lp) > (lp - bp) > (bp - bp)

The following questions (i-iv) are multiple choice questions. Choose the most appropriate answer :

- i. Which of the following molecule has net dipole moment zero?
a. HF b. H₂O c. BF₃ d. CHCl₃
- ii. Which one of the following species contains three bond pairs and one lone pair around the central atom?
a. H₂O b. BF₃ c. NH₂⁻ d. PCl₃
- iii. Why do the deviations occur from idealized shape of H₂O and NH₃ molecules?
a. Same hybridization b. Different hybridisation
c. Repulsive effect d. None of the above
- iv. The species, having bond angles of 120° is
a. PH₃ b. ClF₃ c. NCl₃ d. BCl₃
- v. Which of the following molecule does not show hydrogen bonding?
a. HF b. H₂O c. NH₃ d. H₂S

UNIT-VI (THERMODYNAMICS)

Q1. Read the questions and tick the correct option.

- i. Which of the following is not correct?
- ΔG is zero for a reversible reaction
 - ΔG is positive for a spontaneous reaction
 - ΔG is negative for a spontaneous reaction
 - ΔG is positive for a non-spontaneous reaction
- ii. The pressure-volume work for an ideal gas can be calculated by using the expression $w = - \int_{V_i}^{V_f} p_{\text{ex}} dV$. The work can also be calculated from the pV- plot by using the area under the curve within the specified limits. When an ideal gas is compressed
- reversibly or b. irreversibly from volume V_i to V_f . Choose the correct option.
- a. w (reversible) = w (irreversible) b. w (reversible) < w (irreversible)
- c. w (reversible) > w (irreversible) d. w (reversible) = w (irreversible) + $p_{\text{ex}} \Delta V$
- iii. In an adiabatic process, no transfer of heat takes place between system and surroundings. Choose the correct option for free expansion of an ideal gas under adiabatic condition from the following.
- $q = 0, \Delta T \neq 0, w = 0$
 - $q \neq 0, \Delta T = 0, w = 0$
 - $q = 0, \Delta T = 0, w = 0$
 - $q = 0, \Delta T < 0, w \neq 0$
- iv. In an exothermic reaction, heat is evolved, and system loses heat to the surrounding. For such system
- q_p will be negative
 - $\Delta_r H$ will be negative
 - q_p will be positive
 - $\Delta_r H$ will be positive

Q2. In the following questions a statement of Assertion (A) followed by a statement of Reason (R) is given. Choose the correct option out of the choices given below each question.

- Both assertion and reason are correct and reason is the correct explanation of assertion.
 - Both assertion and reason are correct but reason is not a correct explanation of the assertion.
 - Assertion is correct but reason is incorrect.
 - Assertion is incorrect but reason is correct.
- i. **Assertion** : Spontaneous process is an irreversible process and may be reversed by some external agency.
Reason : Decrease in enthalpy is a contributory factor for spontaneity.
- ii. **Assertion** : Combustion of all organic compounds is an exothermic reaction.
Reason : The enthalpies of all elements in their standard state are zero.
- iii. **Assertion** : For every chemical reaction at equilibrium, standard Gibb's energy of reaction is zero.
Reason : At constant temperature and pressure, chemical reactions are

Q3.i. Complete the following analogy.

Extensive property: A :: Intensive property: B

a. A: Volume :: B: Free energy

b. A: Volume :: B: Temperature

c. A: Temperature ::

b. Volumes. A: Pressure :: B: Free energy

ii. Which of the following analogies is correct?

- For a reversible reaction ΔG : Zero :: For a spontaneous reaction ΔG : Negative
- For a reversible reaction ΔG : positive :: For a spontaneous reaction ΔG : Negative
- For a nonspontaneous reaction ΔG : Negative :: For a spontaneous reaction ΔG : Positive
- For a nonspontaneous reaction ΔG : Negative :: For a spontaneous reaction ΔG : Zero

Q4. Answer the following questions.

- i. What is meant by isolated system? Give an example.
- ii. Explain the Hess's law and its significance using suitable examples.
- iii. A reaction is found to endothermic and $\Delta S = +ve$. At what temperature (high or low) will reaction be spontaneous?
- iv. a. Define bond energy and entropy.
- v. ΔH for the reaction $H-C\equiv N_{(g)} + 2H_{2(g)} \rightarrow CH_3NH_{2(g)}$ is -150KJ . Calculate bond energy of $C\equiv N$ bond if bond energy of C-H bond is 414kJ mol^{-1} , bond energy of $C\equiv N$ is 293 kJ mol^{-1} and H-H bond energy is 435 kJ mol^{-1} .
- vi. What is effect of temperature on entropy?
- vii. Give an expression showing relationship between internal energy and enthalpy.
- viii. Why U and H are called heats of reaction?
- ix. Why the heat of neutralization for strong acid and base is always 57.1 kJ/mole ?
- x. Show $\Delta H = q_p$ and $\Delta U = q_v$.
- xi. What happens to the internal energy when work is done on the system?
- xii. Explain why E is a state function while q is not?
- xiii. On what factors does enthalpy change depend?

Q5. Read the passage given below and answer the questions that follow.

Thermodynamics involve energy changes in chemical reactions and other processes. Internal energy is total energy stored in a substance. We can specify absolute value of volume but not the absolute value of internal energy. We can measure only change in internal energy (ΔU). Work done on the system is taken as positive and work done by the system is taken as negative. Heat (q) absorbed by the system is +ve and heat given out by system is negative. $\Delta U = q + w$ according to first law of thermodynamics. ΔH (enthalpy change) is measured at constant pressure, ΔU is measured at constant volume. ΔH , ΔS (entropy change), ΔG (free energy change) and temperature help to decide spontaneity of the process.

- i. What is ΔU in adiabatic process?
- ii. If 701J of heat is absorbed by the system and 394 J of work is done by the system. What is value of ΔU ?
- iii. 2 litres of an ideal gas at a pressure of 10 atm expands isothermally into vacuum until its total volume is 10 litres. How much heat is absorbed and work done in the expansion?
- iv. For an equilibrium $H_2O(l) \rightleftharpoons H_2O(g)$, What are sign of ΔG , ΔH and ΔS ?
- v. For $N_2O_4(g) \rightleftharpoons 2NO_2(g)$. What is relationship between ΔH and ΔU ?
- vi. What is $C_p - C_v$ equal to?
- vii. State second law of thermodynamics.

UNIT-VII (EQUILIBRIUM)

Q1. Read the questions and tick the correct option.

- i. The pH of neutral water at 25°C is 7.0. As the temperature increases, ionization of water increases, however, the concentration of H^+ ion and OH^- ions are equal. What will be the pH of pure water at 60°C ?
 - a. Equal to 7.0
 - b. Greater than 7.0
 - c. Less than 7.0
 - d. Equal to zero
- ii. Acidity of BF_3 can be explained on the basis of which of the following concepts?
 - a. Arrhenius concept
 - b. Bronsted Lowry concept
 - c. Lewis concept
 - d. Bronsted Lowry as well as Lewis concept

- iii. The solubility product of AgCl in water is 1.5×10^{-10} . Its solubility in 0.01 M NaCl aqueous solution is:
- a. 1.5×10^{-8} b. 5×10^{-10} c. 5×10^{-7} d. 1×10^{-9}
- iv. Which of the following fluoro compounds is most likely to behave as a Lewis base?
- a. BF₃ b. PF₃ c. CF₄ d. SiF₄
- v. Which of the following statements about HCO₃⁻ is correct?
- a. It is a Bronsted acid.
 b. It can ionize in water to form CO₃²⁻(aq).
 c. It does not exist in aqueous solution
 d. It is a Bronsted base.

Q2. In the following questions a statement of Assertion (A) followed by a statement of Reason (R) is given. Choose the correct option out of the choices given below each question.

- a. Both assertion and reason are correct and reason is the correct explanation of assertion.
 b. Both assertion and reason are correct but reason is not a correct explanation of the assertion.
 c. Assertion is correct but reason is incorrect.
 d. Assertion is incorrect but reason is correct.
- i. **Assertion:** The vapour pressure of pure liquid has a fixed value at a particular temperature.
Reason: When equilibrium is reached, no more vapours are formed.
- ii. **Assertion:** A catalyst does not influence the value of the equilibrium constant.
Reason: Catalyst influences the rate of both forward and backward reaction equally.
- iii. **Assertion :** For any chemical reaction at a particular temperature, the equilibrium constant is fixed and is a characteristic property.
Reason : Equilibrium constant is independent of temperature.

Q3. i. Which of the following analogies is correct?

- a. Equilibrium: Dynamic :: Catalyst : does not alter the state of equilibrium
 b. Exothermic reaction: low temperature is favoured :: Endothermic reaction : low temperature is favoured.
 c. BF₃: Lewis acid :: NH₃ : Arrhenius base
 d. Melting of ice: endothermic process :: Manufacturing of ammonia
- ii. **Complete the following analogy.**
 H₂O : OH⁻ :: HCO₃⁻ : ?
- a. H₂CO₃ b. CO₃²⁻ c. CO₃⁻ d. H₃CO₃

Q4. Answer the following questions.

- i. Arrange the following in increasing order of pH:
 KNO₃(aq) , CH₃COONa (aq), NH₄Cl (aq), C₆H₅COONH₄ (aq)
- ii. How can you predict the following stages of a reaction by comparing the value of K_c and Q_c?
- a. Net reaction proceeds in the forward direction.
 b. Net reaction proceeds in the backward direction.
 c. No net reaction occurs.
- iii. On the basis of Le-Chatelier's principle explain how temperature and pressure can be adjusted to increase the yield of ammonia in the following reaction:
- $$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3 \quad \Delta H = -92.38 \text{ kJmol}^{-1}$$
- iv. For an equilibrium reaction, the rate constants for the forward and the backward direction are 2.38×10^{-4} and 8.15×10^{-5} respectively. Calculate the equilibrium constant for the reaction.
- v. Give reasons for the following statements.
- a. Ice melts slowly at higher altitudes.
 b. Gas fizzes out when soda water bottle is opened.

vi. What happens to the following equilibrium:



If nitrogen gas is added to it (i) at constant volume (ii) at constant pressure?

vii. Calculate the degree of dissociation of 0.5 M NH_3 at 25°C in a solution of $\text{pH}=12$.

18. For the reaction $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$, the partial pressures of N_2 and H_2 are 0.80 and 0.40 atmosphere respectively at equilibrium. The total pressure of the system is 2.80 atmospheres. What is K_p for the above reaction?

Q5. Read the passage given below and answer the questions that follow.

Arrhenius acids give H^+ ion in aqueous solution whereas bases give OH^- in aqueous solution. Bronsted acids are proton donor whereas Bronsted bases are proton acceptors. Acids, on donating proton form conjugate base whereas bases form conjugate acid after accepting proton. Buffer solution is a solution whose pH does not change by adding small amount of H^+ or OH^- . The decrease in conc. of one of the ion by adding other ion as common ion is called common ion effect. Lewis acids are electron deficient or +vely charged. Lewis bases are electron rich or negatively charged. K_{sp} (solubility product) is product of molar concentration of ions raised to power number of ions per formula of the compound in sparingly soluble salt. Precipitation occurs only if ionic product exceeds solubility product. Solubility of salt decreases in presence of common ion. K_w is ionic product of water (1×10^{-14} at 298 K). K_w increases with increase in temperature. pH is $-\log [\text{H}_3\text{O}^+]$ where $[\text{H}_3\text{O}^+] = C\alpha$ in mono protic acid 'C' is molar conc, ' α ' is degree of ionisation. A salt is said to be hydrolysed if pH of solution changes. K_H is hydrolytic constant. pH of salts of strong acid and strong base is equal to 7. pH of other salts can be <7 or >7 . pH of buffer solution can be calculated with the help of Henderson equation.

- The concentration of $[\text{H}_3\text{O}^+]$ is 4×10^{-4} . What is pH of solution? [$\log 4=0.6021$], $\log_{10}1=1$.
- What are conjugate acids of NH_2^- and NH_3 ?
- K_b for NH_3 is 1.80×10^{-5} . What will be K_a ? [$K_w = 1 \times 10^{-14}$]
- Show a relationship between K_a , K_{a1} and K_{a2} .

UNIT-VIII (REDOX REACTION)

Q1. Read the questions and tick the correct option.

- The oxidation number of an element in a compound is evaluated on the basis of certain rules. Which of the following rules is not correct in this respect?
 - The oxidation number of hydrogen is always +1.
 - The algebraic sum of all the oxidation numbers in a compound is zero.
 - An element in the free or the uncombined state bears oxidation number zero.
 - In all its compounds, the oxidation number of fluorine is - 1.
- Which of the following elements does not show disproportionation tendency?
 - Cl
 - Br
 - F
 - I
- Using the standard electrode potential, find out the pair between which redox reaction is not feasible.
 **E^0 values: $\text{Fe}^{3+}/\text{Fe}^{2+} = 0.77$; $\text{I}_2/\text{I}^- = +0.54$;
 $\text{Cu}^{2+}/\text{Cu} = +0.34$; $\text{Ag}^+/\text{Ag} = +0.80\text{V}$**
 - Fe^{3+} and I^-
 - Ag^+ and Cu
 - Fe^{3+} and Cu
 - Ag and Fe^{3+}
- The oxidation number of Mn is maximum in:
 - MnO_2
 - K_2MnO_4
 - MnO_4^{2-}
 - KMnO_4 .
- The reaction, $\text{P}_4 + 3 \text{NaOH} + 3 \text{H}_2\text{O} \longrightarrow 3 \text{NaH}_2\text{PO}_2 + \text{PH}_3$ is an example of
 - disproportionation reaction
 - neutralization reaction
 - double decomposition reaction
 - pyrolytic reaction

Q2. In the following questions a statement of Assertion (A) followed by a statement of Reason (R) is given. Choose the correct option out of the choices given below each question.

- Both assertion and reason are correct and reason is the correct explanation of assertion.
- Both assertion and reason are correct but reason is not a correct explanation of the assertion.
- Assertion is correct but reason is incorrect.
- Assertion is incorrect but reason is correct.

i. **Assertion:** The reaction $\text{MnO}_2 + 4\text{HCl} \longrightarrow \text{MnCl}_2 + 2\text{H}_2\text{O} + \text{Cl}_2$ is an example of redox reaction.

Reason: In this reaction HCl is reduced to Cl_2 whereas MnO_2 is oxidized to MnCl_2 .

ii. **Assertion:** A substance which gets reduced can act as oxidising agent.

Reason: In the reaction, $3\text{ClO}^- \rightarrow \text{ClO}_3^- + 2\text{Cl}^-$, Cl atom is oxidized as well as reduced.

Q3. i. Which of the following analogies is correct?

- Electrode on which reduction occurs : Cathode :: Ions having positive charge: Cation
- Device in which chemical energy is converted into electrical energy : Electrolytic cell :: Terminal potential difference when no current flows : EMF
- $\text{CuSO}_4 : \text{Ag}^+ :: \text{AgNO}_3 : \text{Zn}^{2+}$
- $\text{CrO}_5 : 6 :: \text{NaBH}_4 : 5$

ii. **Complete the following analogy:**

$\text{ClO}_3^- \longrightarrow \text{ClO}_2$: Oxidizing agent :: ?

- $\text{Mn}^{2+} \longrightarrow \text{MnO}_2$: Oxidizing agent
- $\text{Zn} \longrightarrow \text{ZnCl}_2$: Reducing agent
- $\text{SO}_4^{2-} \longrightarrow \text{S}^{2-}$: Oxidizing agent
- $\text{Cl} \longrightarrow \text{Cl}^-$: Oxidizing agent

Q4. Answer the following questions.

i. The half cell reactions with their oxidation potentials are

$\text{Pb}_{(s)} \longrightarrow \text{Pb}^{2+}_{(aq)} + 2e^- ; E^0_{\text{oxi.}} = +0.13 \text{ V}$, $\text{Ag}_{(s)} \longrightarrow \text{Ag}^+_{(aq)} + e^- ; E^0_{\text{oxi.}} = -0.80 \text{ V}$. Write the cell reaction and calculate its EMF.

ii. An iron rod is immersed in a solution containing 1.0 M NiSO_4 and 1.0 M ZnSO_4 . Predict giving reasons which of the following reactions is likely to be proceed?

- Fe reduces Zn^{2+} ions
- iron reduces Ni^{2+} ions. Given:

$E^0_{\text{Zn}^{2+}/\text{Zn}} = -0.76\text{V}$, $E^0_{\text{Fe}^{2+}/\text{Fe}} = -0.44\text{V}$ and $E^0_{\text{Ni}^{2+}/\text{Ni}} = -0.76\text{V}$

iii. Assign oxidation number to the underlined elements in the following species:

- K_2MnO_4
- H_2O_2

iv. MnO_4^{2-} undergoes disproportionation reaction in acidic medium but MnO_4^- does not. Give reason.

v. Write balanced chemical equation for the following reactions:

- Permanganate ion (MnO_4^-) reacts with sulphur dioxide gas in acidic medium to produce Mn^{2+} and hydrogen sulphate ion. (Balance by ion electron method).
- Reaction of liquid hydrazine (N_2H_4) with chlorate ion (ClO_3^-) in basic medium produces nitric oxide gas and chloride ion in gaseous state (Balance by oxidation number method).

vi. Copper dissolves in dilute nitric acid but not in dilute HCl. Explain.

vii. A mixture of FeCl_2 and SnCl_2 can exist together but that of FeCl_3 and SnCl_2 cannot. Explain.

- viii. Predict the product of electrolysis in each of the following:
- An aqueous solution of NaCl by using platinum electrodes.
 - An aqueous solution of AgNO₃ by using silver electrodes.

Q5. Read the passage given below and answer the questions that follow.

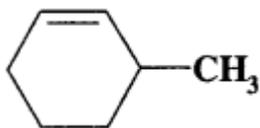
Redox reactions are reactions in which oxidation and reduction takes place simultaneously. Oxidation–reduction reactions are complementary i.e., whenever any substance is oxidised another substance is always reduced at the same time and *vice-versa*. Oxidation numbers are assigned in accordance with the set of rules. Oxidation number and ion electron methods both are used in balancing ionic equations. Redox reactions are classified as combination, decomposition, displacement and disproportionation reactions. The concept of redox couple and electrode processes is basis of electrolysis and electrochemical cells.

- Give an example of a combination redox reaction.
- Are all decomposition reactions are redox reactions? Justify.
- Define oxidation and reduction in terms of oxidation number.
- Name a compound of carbon whose valency oxidation number of 4.
- What is oxidation state of Ni in Ni(CO)₄.

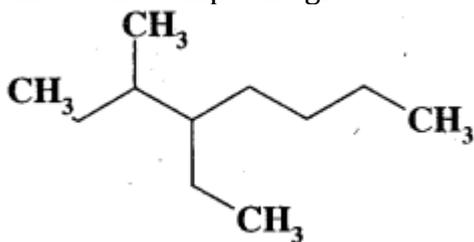
UNIT- XII (ORGANIC CHEMISTRY)

Q1. Read the questions and tick the correct option.

- Which of the following behaves both as a nucleophile and as an electrophile?
 - CH₃C ≡ N
 - CH₃OH
 - CH₂ = CHCH₃
 - CH₃NH
- The reaction is (CH₃)₃-Br → H₂O (CH₃)₃C-OH
 - Elimination reaction
 - Substitution reaction
 - Free radical reaction
 - Addition reaction
- The I.U.P.A.C. name of



- 3-Methyl cyclohexene
 - 6-methyl cyclohexene
 - 1-methyl cyclohex-2-ene
 - 1-methyl cyclohex5-ene.
- iv. Name of the compound given below is



- 4-ethyl-3-methyloctane
 - 3 -methyl-4-ethyloctane
 - 2, 3-diethylheptane
 - 5 - ethyl-6 -methyloctane.
- v. The C-H bond distance is longest in
- C₂H₂
 - C₂H₄
 - C₂H₆
 - C₂H₂Br₂

Q2. i. In the following questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- Assertion and reason both are correct statements and reason is correct explanation for assertion.
- Assertion and reason both are correct statements but reason is not correct explanation for assertion.
- Assertion is correct statement but reason is wrong statement.
- Assertion is wrong statement but reason is correct statement.

i. **Assertion:** Pent-1-ene and pent-2-ene are position isomers.

Reason: position isomers differ in the position of functional group or substituent.

- i. Which element is estimated by Carius method?
 a. Carbon b. Hydrogen c. Halogen d. Nitrogen
- ii. An organic compound which produces a bluish green coloured flame on heating in presence of copper is
 a. Chlorobenzene b. Benzaldehyde c. Aniline d. Benzoic acid
- iii. In the Dumas method, the nitrogen present in organic compound gets converted to
 a. Sodium Cyanide b. Gaseous Ammonia c. Dinitrogen Gas d. Ammonium Sulphate
- iv. Inductive effect involves
 a. displacement of σ electrons b. delocalization of π electrons
 c. delocalization of σ -electrons d. displacement of π -electrons
- v. Nucleophile is a species that should have
 a. a pair of electrons to donate b. positive charge
 c. negative charge d. electron deficient species

UNIT- XIII (HYDROCARBONS)

Q1. Read the questions and tick the correct option.

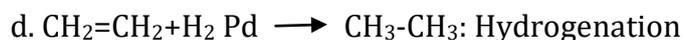
- i. The order of decreasing reactivity towards an electrophilic reagent, for the following:
 I. Benzene II. Toluene III. Chlorobenzene IV. Phenol would be:
 a. I>II>III>IV b. II>IV>I>III c. IV>III>II>I d. IV>II>I>III
- ii. Pure methane can be prepared by
 a. Soda lime decarboxylation b. Kolbes electrolytic method
 c. Wurtz reaction d. Reduction with H_2
- iii. Nitrobenzene on reaction with conc. HNO_3/H_2SO_4 at $80 - 100^\circ C$ forms which one of the following products?
 a. 1,2-Dinitrobenzene b. 1,3-Dinitrobenzene
 c. 1,4-Dinitrobenzene d. 1,2,4-Trinitrobenzene
- iv. The catalyst used in Friedel – Crafts reaction is
 a. Aluminium Chloride b. Anhydrous Aluminium Chloride
 c. Ferric Chloride d. Copper
- v. Tetrabromoethane on heating with Zn gives
 a. Ethyl bromide b. Ethane c. Ethene d. Ethyne

Q2. In the following questions, a statement of assertion(A) followed by a statement of reason (R) is given. Choose the correct answer out of the following choices.

- a. Assertion and reason both are correct statements and reason is correct explanation for assertion.
- b. Assertion and reason both are correct statements but reason is not correct explanation for assertion.
- c. Assertion is correct statement but reason is wrong statement.
- d. Assertion is wrong statement but reason is correct statement.
- i. **Assertion** : Boiling point of alkanes increases with increase in molecular weight.
Reason : van der Waal's forces increase with increase in molecular weight.
- ii. **Assertion** : Trans-pent-2-ene is polar but trans-but-2-ene is non-polar.
Reason : The polarity of cis-isomer is more than trans which are either non-polar or less polar.
- iii. **Assertion** : All the hydrogen atoms in $CH_2 = C = CH_2$ are attached to sp^2 hybridised carbon atom.
Reason : Central carbon atom is sp hybridized.

Q3. i. Choose the correct Analogy from the following.

- a. $CH_2 = CH_2 + H_2O \xrightarrow{H^+} CH_3CH_2OH$: Halogenation
- b. $3CH \equiv CH \longrightarrow C_6H_6$: Hydration
- c. $CH_2 = CH_2 + Cl_2 \longrightarrow Cl-CH_2-CH_2-Cl$: Condensation



ii. Complete the following analogy.

Ethane : _____ :: acetylene : unsaturated hydrocarbon

- a. unsaturated hydrocarbon
- b. saturated hydrocarbon
- c. aliphatic hydrocarbon
- d. aromatic hydrocarbon

Q4. Answer the following questions.

- i. Why do alkenes prefer to undergo electrophilic addition reaction while arenes prefer electrophilic substitution reactions? Explain.
- ii. An alkane C_8H_{18} is obtained as the only product on subjecting a primary alkyl halide to Wurtz reaction. On monobromination, this alkane yields a single isomer of a tertiary bromide. Write the structure of alkane and the tertiary bromide.
- iii. Arrange the following in increasing order of boiling point:
 - a. Pentane, 2-Methyl butane, 2,2-dimethylpropane
 - b. Butane, Ethane, Pentane, Propane
- iv. How will you convert the following:
 - a. Benzene to hexachlorobenzene
 - b. Ethene to Ethane-1,2-diol
 - c. Propene to Propane
 - d. Ethane to Chloroethane
- vi. Write short note on the following:
 - a. Wurtz reaction
 - b. Ozonolysis
 - c. Decarboxylation
 - d. Markovnikov Rule
 - e. Friedel-Craft alkylation

Q5. Read the passage given below and answer the questions that follow.

Organic reactions can be classified into four main categories. Substitution reactions, addition reactions, elimination reactions and rearrangement reactions. Substitution reactions can be further classified into free radical, nucleophilic and electrophilic substitution reactions. Addition reactions can be nucleophilic as well as electrophilic addition reactions. Dehydration, dehydrohalogenation, dehalogenation are examples of elimination reactions. Conversion by ammonium cyanate to urea is an example of rearrangement reactions. Reactions are classified on the basis to nature of intermediate species formed. Mechanism of reaction is exact path followed by the reaction involving all steps showing intermediates and slowest steps of the reaction which is rate determining step. Oxidation, reduction, combustions reactions are also important in hydrocarbons

- i. An organic compound on treatment with Br_2 in CCl_4 gives. bromo derivative of an alkene. The compound will be
 - a. $\text{CH}_3 - \text{CH} = \text{CH}_2$
 - b. $\text{CH}_2 - \text{CH} = \text{CH} - \text{CH}_2$
 - c. $\text{CH} \equiv \text{CH}$
 - d. $\text{CH}_2 = \text{CH}_2$
- ii. Which alkene on ozonolysis gives $\text{CH}_3\text{CH}_2\text{CHO}$ and CH_3COCH_3 ?
 - a. $\text{CH}_2 = \text{CH} - \text{C}(\text{CH}_3)_2$
 - b. $\text{CH}_3\text{CH}_2\text{CH} = \text{CHCH}_2\text{CH}_3$
 - c. $\text{CH}_3\text{CH}_2\text{CH} = \text{CH} - \text{CH}_3$
 - d. $(\text{CH}_3)_2\text{C} = \text{CHCH}_3$
- iii. The molecules having dipole moment are
 - a. 2,2-Dimethylpropane
 - b. Trans-Pent-2-ene
 - c. Cis-Hex-3-ene
 - d. 2,2,3,3-Tetramethylbutane
- iv. For an electrophilic substitution reaction, the presence of a halogen atom in the benzene ring;
 - a. deactivates the ring by inductive effect.
 - b. deactivates the ring by resonance.

- c. increases the charge density at ortho and para-positions relative to meta-position by resonance.
- d. directs the incoming electrophile to meta-position by increasing the charge density relative to ortho and para-positions.
- v. In an electrophilic substitution reaction of nitrobenzene ,the presence of nitro group
 - a. deactivates the ring by inductive effect.
 - b. activates the ring by inductive effect.
 - c. decreases the charge density at ortho and para positions of the ring related to meta-position by resonance.
 - d. increases the charge density at meta position relative to the ortho and para positions of the ring by resonance.