

CHANDIGARH
REGION

XI SCIENCE
SESSION 2021-22

CHEMISTRY SUPPORT
MATERIAL
TERM -1

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CHEMISTRY (043)

SYLLABUS FOR SESSION 2021-22 CLASS XI Term-I

S	UNIT	Periods	Marks
1	Some Basic Concepts of Chemistry	10	11
2	Structure of Atom	12	
3	Classification of Elements and Periodicity in Properties	6	4
4	Chemical Bonding and Molecular Structure	14	6
5	Redox Reactions	4	5
6	Hydrogen	4	
7	Organic Chemistry: Some basic Principles and Techniques	10	9
	TOTAL	60	35

Some Basic Concepts of Chemistry: General Introduction: Importance and scope of Chemistry. Atomic and molecular masses, mole concept and molar mass, percentage composition, empirical and molecular formula, chemical reactions, stoichiometry and calculations based on stoichiometry.

Structure of Atom: Bohr's model and its limitations, concept of shells and subshells, dual nature of matter and light, de Broglie's relationship, Heisenberg uncertainty principle, concept of orbitals, quantum numbers, shapes of s, p and d orbitals, rules for filling electrons in orbitals - Aufbau principle, Pauli's exclusion principle and Hund's rule, electronic configuration of atoms, stability of half-filled and completely filled orbitals

Classification of Elements and Periodicity in Properties: Modern periodic law and the present form of periodic table, periodic trends in properties of elements -atomic radii, ionic radii, inert gas radii, ionization enthalpy, electron gain enthalpy, electronegativity, valency. Nomenclature of elements with atomic number greater than 100.

Chemical Bonding and Molecular Structure:

Valence electrons, ionic bond, covalent bond, bond parameters, Lewis structure, polar character of covalent bond, covalent character of ionic bond, valence bond theory, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridization, involving s, p and d orbitals and shapes of some simple molecules, molecular orbital theory of homonuclear diatomic molecules(qualitative idea only), Hydrogen bond.

Redox Reactions:

Concept of oxidation and reduction, redox reactions, oxidation number, balancing redox reactions, in terms of loss and gain of electrons and change in oxidation number.

Hydrogen: Position of hydrogen in periodic table, occurrence, isotopes, hydrides-ionic covalent and interstitial; physical and chemical properties of water, heavy water, hydrogen as a fuel

Organic Chemistry: Some basic Principles and Techniques: General introduction, classification and IUPAC nomenclature of organic compounds. Electronic displacements in a covalent bond: inductive effect, electromeric effect, resonance and hyper conjugation. Homolytic and heterolytic fission of a covalent bond: free radicals, carbocations, carbanions, electrophiles and nucleophiles, types of organic reactions.

PRACTICALS

Term I: A 15-mark Practical would be conducted under the supervision of subject teacher. This would contribute to the overall practical marks for the subject.

OR

In case the situation of lockdown continues until Nov-Dec 2021, a *Practical Based Assessment (pen-paper)* of 15 marks would be conducted at the end of Term I.

Term-I Evaluation Scheme

S. No	Practical	Marks
1.	Volumetric Analysis	8
2.	Content Based experiment	2
3.	Class record and viva (Internal Examiner)	5
TOTAL		15

Micro-chemical methods are available for several of the practical experiments, wherever possible such techniques should be used.

A. Basic Laboratory Techniques

1. Cutting glass tube and glass rod
2. Bending a glass tube
3. Drawing out a glass jet
4. Boring a cork

B. Characterization of Chemical Substances (2 Marks)

1. Determination of melting point of an organic compound.
2. Determination of boiling point of an organic compound.

C. Quantitative Estimation (8 marks)

- i. Using a mechanical balance/electronic balance.
- ii. Preparation of standard solution of Oxalic acid.
- iii. Determination of strength of a given solution of Sodium hydroxide by titrating it against standard solution of Oxalic acid.
- iv. Preparation of standard solution of Sodium carbonate.
- v. Determination of strength of a given solution of hydrochloric acid by titrating it against standard Sodium Carbonate solution.

SYLLABUS FOR SESSION 2021-22 CLASS XI Term-II

S.No	UNIT	Periods	Marks
1	States of Matter: Gases and Liquids	9	15
2	Chemical Thermodynamics	14	
3	Equilibrium	12	
4	s -Block Elements	5	11
5	Some p -Block Elements	9	
6	Hydrocarbons	10	9
	TOTAL	59	35

States of Matter: Gases and Liquids: Three states of matter, intermolecular interactions, types of bonding, melting and boiling points, role of gas laws in elucidating the concept of the molecule, Boyle's law, Charles law, Gay Lussac's law, Avogadro's law, ideal behaviour, empirical derivation of gas equation, Avogadro's number, ideal gas equation and deviation from ideal behaviour.

Chemical Thermodynamics: Concepts of System and types of systems, surroundings, work, heat, energy, extensive and intensive properties, state functions.

First law of thermodynamics -internal energy and enthalpy, measurement of ΔU and ΔH , Hess's law of constant heat summation, enthalpy of bond dissociation, combustion, formation, atomization, sublimation, phase transition, ionization, solution and dilution. Second law of Thermodynamics (brief introduction)

Introduction of entropy as a state function, Gibb's energy change for spontaneous and non-spontaneous processes.

Third law of thermodynamics (brief introduction).

Equilibrium: Equilibrium in physical and chemical processes, dynamic nature of equilibrium, law of mass action, equilibrium constant, factors affecting equilibrium - Le Chatelier's principle, ionic equilibrium- ionization of acids and bases, strong and weak electrolytes, degree of ionization, ionization of poly basic acids, acid strength, concept of pH, buffer solution, solubility product, common ion effect (with illustrative examples).

s -Block Elements: Group 1 and Group 2 Elements -General introduction, electronic configuration, occurrence, anomalous properties of the first element of each group, diagonal relationship, trends in the variation of properties (such as ionization enthalpy, atomic and ionic radii), trends in chemical reactivity with oxygen, water, hydrogen and halogens, uses.

Some p -Block Elements: General Introduction to p -Block Elements

Group 13 Elements: General introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous properties of first element of the group, Boron - physical and chemical properties.

Group 14 Elements: General introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous behaviour of first elements. Carbon-catenation, allotropic forms, physical and chemical properties.

Hydrocarbons: Classification of Hydrocarbons Aliphatic Hydrocarbons:

Alkanes - Nomenclature, isomerism, conformation (ethane only), physical properties, chemical reactions.

Alkenes - Nomenclature, structure of double bond (ethene), geometrical isomerism, physical properties, methods of preparation, chemical reactions: addition of hydrogen, halogen, water, hydrogen halides (Markovnikov's addition and peroxide effect), ozonolysis, oxidation, mechanism of electrophilic addition.

Alkynes - Nomenclature, structure of triple bond (ethyne), physical properties, methods of preparation, chemical reactions: acidic character of alkynes, addition reaction of - hydrogen, halogens, hydrogen halides and water.

Aromatic Hydrocarbons: Introduction, IUPAC nomenclature, benzene: resonance, aromaticity, chemical properties: mechanism of electrophilic substitution. Nitration, sulphonation, halogenation, Friedel Craft's alkylation and acylation, directive influence of functional group in monosubstituted benzene. Carcinogenicity and toxicity.

PRACTICALS

Term II: At the end of Term II, a **15-mark Practical** would be conducted under the supervision of subject teacher. This would contribute to the overall practical marks for the subject.

OR

In case the situation of lockdown continues beyond December 2021, a *Practical Based Assessment (pen-paper) of 10 marks and Viva 5 marks* would be conducted at the end of Term II by the subject teacher. This would contribute to the overall practical marks for the subject.

TERM-II Evaluation Scheme

S. No	Practical	Marks
1.	Salt Analysis	8
2.	Content Based Experiment	2
3	Project Work and Viva(Internal)	5
TOTAL		15

A. Qualitative Analysis(Marks 8)

- a. Determination of one anion and one cation in a given salt

Cations- Pb^{2+} , Cu^{2+} , As^{3+} , Al^{3+} , Fe^{3+} , Mn^{2+} , Ni^{2+} , Zn^{2+} , Co^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} , Mg^{2+} , NH_4^+

Anions – $(\text{CO}_3)^{2-}$, S^{2-} , NO_2^- , SO_3^{2-} , SO_4^{2-} , NO_3^- , Cl^- , Br^- , I^- , PO_4^{3-} , $\text{C}_2\text{O}_4^{2-}$, CH_3COO^- (Note: Insoluble salts excluded)

- b. Detection of -Nitrogen, Sulphur, Chlorine in organic compounds.

B. Crystallization of impure sample of any one of the following: Alum, Copper Sulphate, Benzoic Acid. (Marks 2)

PROJECTS scientific investigations involving laboratory testing and collecting information from other sources.

CHAPTER – SOME BASIC CONCEPTS OF CHEMISTRY

MULTIPLE CHOICE QUESTIONS

Q.1 If Avogadro number N_A , is changed from $6.022 \times 10^{23} \text{ mol}^{-1}$ to $6.022 \times 10^{20} \text{ mol}^{-1}$, this would change

- (1) The ratio of chemical species to each other in a balanced equation
- (2) The ratio of elements to each other in a compound
- (3) The definition of mass in units of grams
- (4) The mass of one mole of carbon

Q.2 A mixture of gases contains H_2 and O_2 gases in the ratio of 1 : 4 (w/w). What is the molar ratio of the two gases in the mixture?

- (1) 2 : 1
- (2) 1 : 4
- (3) 4 : 1
- (4) 16 : 1

Q.3 1.0 g of magnesium is burnt with 0.56 g O_2 in a closed vessel. Which reactant is left in excess and how much? (At. wt. Mg = 24; O = 16)

- (1) Mg, 0.16 g
- (2) O_2 , 0.16 g
- (3) Mg, 0.44 g
- (4) O_2 , 0.28 g

Q.4 When 22.4 litres of $\text{H}_2(\text{g})$ is mixed with 11.2 litres of $\text{Cl}_2(\text{g})$, each at STP, the moles of $\text{HCl}(\text{g})$ formed is equal to

- (1) 1 mol of $\text{HCl}(\text{g})$
- (2) 2 mol of $\text{HCl}(\text{g})$
- (3) 0.5 mol of $\text{HCl}(\text{g})$
- (4) 1.5 mol of $\text{HCl}(\text{g})$

Q.5 6.02×10^{20} molecules of urea are present in 100 mL of its solution. The concentration of solution is

- (1) 0.01 M
- (2) 0.001 M
- (3) 0.1 M
- (4) 0.02 M

Q.6 Mole fraction of the solute in a 1.00 molal aqueous solution is

- (1) 1.7700
- (2) 0.1770
- (3) 0.0177
- (4) 0.0344

Q.7 Which has the maximum number of molecules among the following?

- (1) 8 g H₂ (2) 64 g SO₂
(3) 44 g CO₂ (4) 48 g O₃

Q.8 The number of atoms in 0.1 mol of a triatomic gas is ($N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$)

- (1) 6.026×10^{22} (2) 1.806×10^{23}
(3) 3.600×10^{23} (4) 1.800×10^{22}

Q.9 10 g of hydrogen and 64 g of oxygen were filled in a steel vessel and exploded. Amount of water produced in this reaction will be

- (1) 3 mol (2) 4 mol
(3) 1 mol (4) 2 mol

Q.10 An organic compound contains carbon, hydrogen and oxygen. Its elemental analysis gave C, 38.71% and H, 9.67%. The empirical formula of the compound would be

- (1) CH₄ O (2) CH₃ O
(3) CH₂ O (4) CHO

Q.11 An element, X has the following isotopic composition ; $^{200}\text{X} : 90\%$; $^{199}\text{X} : 8.0\%$; $^{202}\text{X} : 2.0\%$ The weighted average atomic mass of the naturally occurring element X is closest to :

- (1) 199 amu (2) 200 amu
(3) 201 amu (4) 202 amu

Q.12 Given the numbers : 161 cm, 0.161 cm, 0.0161 cm. The number of significant figures for the three numbers is

- (1) 3, 3 and 4 respectively (2) 3, 4 and 4 respectively
(3) 3, 4 and 5 respectively (4) 3, 3 and 3 respectively

Q.13. The number of atoms in 4.25 g of NH₃ is approximately

- (1) 4×10^{23} (2) 2×10^{23}
(3) 1×10^{23} (4) 6×10^{23}

Q.14 2.5 litre of 1 M NaOH solution mixed with another 3 litre of 0.5 M NaOH solution. Then find out molarity of resultant solution.

(3) 20 (4) 3

22. Which of the following is dependent on temperature?

- (1) Molality (2) Molarity
(3) Mole fraction (4) weight %age

23. What is the molality of pure water?

- (1) 1 (2) 18
(3) 55.5 (4) none of these

24. The number of significant figures in 0.0101 is:

- (1) 3 (2) 2
(3) 4 (4) 1

25. Two different oxides of a metal contain 20% and 27% oxygen by weight. This is in accordance with the law of:

- (1) conservation of mass (2) constant composition
(3) multiple proportion (4) reciprocal proportion

26. Two oxides of an element contain 57.1% and 72.7% of oxygen. If the first oxide is MO, the second oxide is:

- (1) MO (2) M₂O
(3) MO₃ (4) MO₂

27. Calculate the correct no. of significant figures: $4.26 - (15.635 / 5.0)$

- (1) 1.16 (2) 1.12
(3) 1.2 (4) 1.133

28. How many significant figures are there in π .

- (1) 3 (2) 2
(3) infinite (4) 1

29. What is the symbol for SI unit of mole?

- (1) mole (2) m
(3) mol (4) none of these

38. The formula which gives the simplest whole number ratio of the atoms of various elements present in one molecule of compound is

(1) molecular formula

(2) empirical formula

(3) mole formula

(4) none of these

39. The no. of atoms in 52 mol of argon is:

(1) 13 atoms

(2) 3.13×10^{25} atoms

(3) 13.3×10^{25} atoms

(4) none of these

40. The density of water is 1 g/ml. The density of water in SI units is:

(1) 1

(2) 100

(3) 1000

(4) 10

ASSERTION-REASON TYPE QUESTIONS

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

- 1) Assertion and reason both are correct statements and reason is correct explanation for assertion.
- 2) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
- 3) Assertion is correct statement but reason is wrong statement.
- 4) Assertion is wrong statement but reason is correct statement.

Q.41 A : 1 a.m.u. = 1.66×10^{-24} gram.

R : Actual mass of one atom of C-12 is equal to 1.99×10^{-23} g

Q.42 A : Number of atoms in 2 mole of NH_3 is equal to number of atoms in 4 mole of CH_4 .

R : Both are chemically similar species.

Q.43 A : Mass of 1 gram molecule of H_2SO_4 is 98 gram.

R : One gram atom contains N_A atoms.

Q.44 A : One mole of sucrose reacts completely with oxygen produces 268.8 litre of carbon dioxide at STP.

R : Amount of oxygen required for reaction is 268.8 litre.

Q.45 A : When 4 moles of H_2 reacts with 2 moles of O_2 , then 4 moles of water is formed.

R : O_2 will act as limiting reagent.

Q.46 A : Ratio of empirical formula mass and molecular formula mass may be a whole number.

R : Molecular formula mass = $n \times$ empirical formula mass, where n is the simplest whole number.

Q.47 A : For a given solution (density = 1 gm/ml), molality is greater than molarity.

R : Molarity involves volume of solution while molality involves mass of solvent.

Q.48 A : 1 gram of salt in 1 m³ of solution has concentration of 1 ppm.

R : ppm is defined as number of parts by mass of solute per million parts of solution.

Q.49 A:22 Carat gold is a compound.

R:A compound has fixed composition of the elements present in it.

Q.50 A:Significant figures for 0.200 is 3 where for 200 is 1.

R:Zero at the end or right of a number are significant provided they are not on the right side of the decimal point.

19.(2)

20. (1): Volume of oxygen in one litre of air = $21/100 \times 1000 = 210$ mL

Therefore, no. of moles = $210/22400 = 0.0093$ mol

21. (4) : Haber's process, $N_2 + 3H_2 \rightarrow 2NH_3$

2 moles of NH_3 are formed by 3 moles of H_2 .

20 moles of NH_3 will be formed by 30 moles of H_2 .

22.(2)

23.(3)

24.(1)

25.(3)

26.(4)

27.(3)

28.(3)

29.(3)

30.(3)

31.(2)

32.(1)

33.(1)

34.(1)

35.(2)

36.(1)

37(1) Mass of Fe = $100 \times 0.33 / 100 = 0.33$ g

\therefore Moles of Fe = $0.33 / 56 = 5.89 \times 10^{-3}$ mole \therefore

Number of atom of Fe = $5.89 \times 10^{-3} \times 6.022 \times 10^{23} = 0.035 \times 10^{23}$ atom

38.(2)

39.(2)

40.(3)

41. (2) Both are correct but R is not explanation of A

42. (4) Number of atoms in $\text{NH}_3 = 2 \times 4 \times N_0 = 8$

N_0 Number of atoms in $\text{CH}_4 = 4 \times 5 \times N_0 = 20 N_0$

Both are chemically different

Both A and R are incorrect.

43. (2) mass of 1 g molecule means 1 mol of $\text{H}_2\text{SO}_4 = 98 \text{ g}$

1 g atom = 1 mol atom = N_0

Both are correct but R is not explanation of A.

44. (2) Both are correct but reason is not correct explanation of Assertion

45.(3) 4 mol of H_2 when reacts with 2 moles O_2 produces moles of H_2O

When moles are taken in above reaction H will act on LR.

A is correct but R is wrong

46. (2) mol. formula = $n \times$ Empirical formula.

mol. mass = $n \times$ formula mass (for ionic solids).

Both A and R are correct but R is not correct explanation of A

47. (1) If density ρ is 1 g/mL

\therefore mass of solution > mass of solvent

Molality = moles/ volume of solution

Molality = moles/ mass of solvent

As weight of solvent is less therefore molality will be more.

Both A and R are correct R is the correct explanation of A

48. (1) Both are A and R correct R is correct explanation of A

49.(4)

50.(3)

PREPARED BY: JAGDISH SINGH

PGT CHEMISTRY

KV DAPPAR

CHAPTER: STRUCTURE OF ATOM

MULTIPLE CHOICE QUESTIONS

- For which of the following set of quantum numbers, an electron will have the highest energy?
 - 3, 2, +1, +1/2
 - 4, 2, -1, +1/2
 - 4, 1, 0, -1/2
 - 5, 0, 0, +1/2.
- Which of the following atoms or ion/atom have identical ground state configuration?
 - Li⁺ and He⁺
 - Cl⁻ and Ar
 - Na and K
 - F⁺ and Ne.
- A g-sub shell is characterized by
 - n=5
 - l= 4
 - m=3
 - l= 5.
- Which expression represents de-Broglie relationship?
 - $h/mv = p$
 - $h/mv = \lambda$
 - $\lambda = h/mp$
 - $m\lambda = v/p$.
- The number of spherical nodes for 4d orbital is
 - Zero
 - One
 - Two
 - Three.
- The configuration $1s^2, 2s^2, 2p^5, 3s^1$ shows
 - Ground state of fluorine
 - Excited state of fluorine
 - Excited state of neon
 - Excited state of O₂⁻ ion.
- The electronic configuration of Cu⁺² ion is;
 - [Ar] 4s¹ 3d⁸
 - [Ar] 4s² 3d¹⁰ 4p¹
 - [Ar] 4s¹ 3d¹⁰
 - [Ar] 3d⁹
- Which of the following orbitals has dumb-bell shape;
 - s
 - p
 - d
 - f
- The total number of orbitals in a shell having principle quantum number 'n' is;
 - 2n,
 - n²,
 - 2n²,
 - (n+1).
- Bohr's radius for H-atom(n=1) is approximately 0.53A⁰. The radius of the first excited (n=2) is;
 - 0.13 A⁰
 - 1.06A⁰,
 - 4.77A⁰
 - 2.12A⁰.
- The species which is not paramagnetic among the following is;
 - Cl⁻,
 - Be⁻
 - Ne⁺²
 - As⁺
- What is the wavelength of light. Given energy = 3.03×10^{-19} j, $h = 6.62 \times 10^{-34}$ js and $c = 3.0 \times 10^8$ m/s?
 - 6.54nm
 - 654nm
 - 0.654nm
 - 65.4 nm
- The following quantum numbers are possible for how many electrons?
n=3, l=2, m=+2;
 - 1
 - 2
 - 18
 - 4
- Azimuthal quantum number defines;
 - e/m ratio of electron
 - Spin of electron
 - Angular momentum of electron
 - Magnetic momentum of an electron.

15. The correct order of increasing energy of atomic orbitals is ;
- a. $5p < 4f < 6s < 5d$ c. $4f < 5p < 5d < 6s$
 b. $5p < 6s < 4f < 5d$ d. $5p < 5d < 4f < 6s$.
16. Iso-electronic species are;
- a. F^-, O^{2-} c. F^-, O^+
 b. F^-, O d. F^-, O^{+2}
17. Quantum numbers $n=2, l=1$ represent;
- a. 1s orbital c. 2p orbital
 b. 2s orbital d. 3s orbital.
18. The quantum number 'm' of a free gaseous atom is associated with;
- a. The effective volume of the orbital c. The spatial orientation an orbital
 b. The shape of orbital d. the energy of the orbital in the absence of the magnetic field.
19. The value of Plank's constant is 6.62×10^{-34} js. The velocity of light is 3×10^8 m/s. which value is closest to the wavelength in nanometers of a quantum of light with frequency of $8 \times 10^{15} \text{ s}^{-1}$?
- a. 2×10^{-25} c. 40
 b. 5×10^{-18} d. 3×10^7 .
20. For principle quantum number 'n=4', the number of orbitals having 'l=3' is;
- a. 3 b. 7 c. 5 d. 9.
21. The energy of second Bohr's orbit of hydrogen atom is -328 kJ/mol. Hence the energy of fourth orbit would be;
- a. -41 kJ/mol c. -164 kJ/mol
 b. -82 kJ/mol d. -1312 kJ/mol.
22. The orientation of an atom is governed by;
- a. Principle quantum number c. Spin quantum number
 b. Azimuthal quantum number d. Magnetic QUANTM NUMBER.
23. What is the maximum of electrons in an atom that can have the quantum numbers, $n=4, m_l=+1$?
- a. 4 b. 15 c. 3 d. 1 e. 6
24. Consider the following sets of quantum number;

S. No.	n	l	m	s
I	3	0	0	+1/2
II	2	2	1	+1/2
III	4	3	-2	-1/2
IV	1	0	-1	-1/2
V	3	2	3	-1/2

Which of the following sets of quantum number is not possible?

- a. I, II, III, IV c. I and III
 b. II, IV, V d. II, III and IV.
25. The measurement of the electron position is associated with an uncertainty in momentum which is equal to 10^{-18} g cm /s . The uncertainty in electron velocity(cm/s) is; ($m_e = 9.1 \times 10^{-28} \text{ g}$)
- a. 10^8 c. 10^9
 b. 10^{11} d. 10^6 .
26. Which of the following ion have electronic configuration; {Ar} $3d^6$?
- a. Ni^{+3} b. Mn^{+3} c. Fe^{3+} d. Co^{+3} .
27. Deuterium nucleus contains;
- a. $1p+1n$ b. $2p+0n$ c. $1p+1e$ d. $2p+2n$.
28. The line spectrum of He^+ ion will resemble that of;
- a. Hydrogen atom c. Helium atom
 b. Li^+ ion d. Lithium atom.

Assertion Reason type questions. Type-11

- a. Statement 1 is true, statement 2 is also true and statement 2 is correct explanation of s1.
 - b. Statement 1 is true, statement 2 is also true and statement 2 is not correct explanation of s1.
 - c. Statement 1 is true, statement 2 is false.
 - d. Statement 2 is true, statement 1 is false.
11. Statement-1: 4d orbital has lower energy than 3d orbital.
Statement-2: s- orbital is spherically symmetrical and remains closer to the nucleus and has lower energy than 3d orbital.
 12. Statement-1: An electron can never be found in the nucleus.
Statement-2: Uncertainty in the position of an electron is greater than 10^{-15} .
 13. Statement-1: An atom is electrically neutral.
Statement-2: Number of electrons is equal to the number of neutrons.
 14. Statement-1: In potassium atom, the 19th electron enters to 4s orbital and not in 3d orbital.
Statement-2: Orbital energies are compared with the help of (n+l) rule.
 15. Statement-1: Fe^{+2} has 24 electrons and its electronic configuration represents that of Cr(24).
Statement-2: All the 5 unpaired electrons, in the 3d sub shell give stability to the ion.

CASE STUDY

1. According to Louis de Broglie, a French physicist, every moving material particle has a dual nature i.e. wave and particle nature. The two characters are correlated by de Broglie relation, $\lambda = \frac{h}{mv(p)}$. Here λ represents wave nature while p or mv accounts for particle nature. Since h is constant, the two characters are inversely proportional to each other. This relationship or equation is valid mainly for microscopic particles such as electron, protons, neutrons, atoms, molecules or ions. It does not apply to semi micro or macro particles.

1. It travelling with equal speeds, the longest wavelength of the following matter waves is for;
a. An electron b. a proton c. a neutron d. an α particle.
2. Which of the following is not correct?
a. All electromagnetic radiations travel with the same speed.
b. Matter waves have generally velocity less than electromagnetic waves.
c. Matter waves are emitted by material particles.
d. Electromagnetic waves are associated with electric and magnetic fields but matter waves are not.
3. A particle A moving with a certain velocity has a de Broglie wavelength of $1A^0$. If the particle B has the mass 25% that of particle A and velocity 75% that of A, the de Broglie wavelength will be;
a. $1A^0$ b. $5.3A^0$ c. $3A^0$ d. $0.2A^0$.
4. A body of mass 10mg is moving with a velocity of 100 m/s. the wavelength associated with the wave would be;
a. $6.63 \times 10^{-35}\text{m}$ c. $6.63 \times 10^{-37}\text{m}$
b. $6.63 \times 10^{-31}\text{m}$ d. $6.63 \times 10^{-34}\text{m}$.
5. For particles having same kinetic energy, the de Broglie wavelength is;

- a. Directly proportional to velocity.
- b. Inversely proportional to velocity
- C. independent of mass and velocity
- d. Meaningless.

2. We can pin point an Aeroplane moving in the sky. Whatever may be its speed i.e. we can locate both its exact position as well as direction. However, it is not possible to do so in case of a moving microscopic particle such as electron. In fact, we cannot see any such particles without disturbing it. This has been stated by Heisenberg in the form of uncertainty principle. The mathematical form of the principle is; $\Delta x \cdot \Delta p \geq \frac{h}{4\pi}$ (constant). Since the product of Δx and $\Delta p(m\Delta v)$ is constant, if one is very small, other is bound to be large. The principle as such has no significance in daily life since it applies to those particles which we cannot see.

- 6. Heisenberg's Uncertainty principle rules out the exact simultaneous measurement of
 - a. Probability and intensity.
 - b. Energy and velocity
 - C. charge density and radius.
 - d. position and momentum.
- 7. If the uncertainty in the position of electron is zero, the uncertainty in its momentum would be;
 - a. Zero
 - b. Greater than $\frac{h}{4\pi}$
 - c. less than $\frac{h}{4\pi}$
 - d. Infinite.
- 8. Given the mass of electron is 9.1×10^{-31} kg and velocity of electron is 2.2×10^6 m/s, if the uncertainty in its velocity is 0.1%, the uncertainty in position would be;
 - a. 26 nm
 - b. 32 nm
 - c. 48 nm
 - d. 50 nm.
- 9. If uncertainty in position and momentum are equal, then the uncertainty in velocity is
 - a. $\frac{1}{2m} \sqrt{\frac{h}{2\pi}}$
 - b. $\sqrt{\frac{h}{2\pi}}$
 - c. $\sqrt{\frac{h}{\pi}}$
 - d. none of the above.

3. The hydrogen -like species Li^{+2} is in a spherically symmetrical state S_1 with one radial node. Upon absorbing light, the ion undergoes transition to a state S_2 . The state S_2 has one radial node and its energy is equal to the ground state energy of the hydrogen atom.

- 10. The state S_1 is
 - a. 1s
 - b. 2s
 - c. 2p
 - d. 3s.
- 11. Energy of the state S_1 in units of the hydrogen atom ground state energy is;
 - a. 0.75
 - b. 1.50
 - c. 2.25
 - d. 4.50
- 12. The orbital angular momentum quantum number of the state S_2 is;
 - a. 0
 - b. 1
 - c. 2
 - d. 3.

MARKING SCHEME: CHEMISTRY-XI, STRUCTURE OF ATOM

QUESTION NUMBER	ANSWER	
1	B	
2	B	
3	C	
4	B	
5	B	
6	C	
7	D	
8	B	
9	B	
10	D	
11	A	
12	B	
13	A	
14	C	
15	B	
16	A	
17	C	
18	C	
19	C	
20	B	
21	B	
22	D	
23	E	
24	B	
25	C	
26	D	
27	A	
28	A	
29	A	
30	C	
31	A	
32	B	
MCQ		
ASSERTION REASON TYPE-I		
1	C	
2	A	
3	A	
4	A	
5	C	
6	C	
7	A	
8	A	
9	C	
10	A	
ASSERTION REASON TYPE-II		
11	B	
12	A	
13	C	
14	A	

15	D	
CASE STUDY BASED QUESTIONS		
1	A	
2	C	
3	C	
4	B	
5	A	
6	D	
7	D	
8	A	
9	A	
10	B	
11	C	
12	B	

**PREPARED BY : LAXMI NARAYAN
PGT CHEMISTRY**

KV1 PATIALA

CHAPTER: CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES

CASE STUDY

Each question has one correct option. Choose the correct option.

1. In the modern periodic table, elements are arranged in order of increasing atomic numbers which related to the electronic configuration. Depending upon the type of orbital's receiving the last electron, the elements in the periodic table have been divided into four blocks, viz, s,p,d and f. The modern periodic table consists of 7 periods and 18 groups. Each period begin with filling of a new energy shell. In accordance with the Aufbau principle the seven periods (1 to 7) have 2, 8, 8,18,18,32 and 32 elements resp. The seventh period is still incomplete. To avoid the periodic table beings too long, the two series of f- block elements, called lanthanoids and actinoids are place at the bottom of the main body of the periodic table.
 - (i) The element with atomic no. 57 belongs to
(a) s-block (b) p-block (c) d-block (d) f-block
 - (ii) The elements of the p-block in the 6th periods is represented by the outermost electronic configuration
(a) $7s^27p^6$ (b) $5f^46d^{10}7s^27p^0$ (c) $4f^{14}5d^{10}6s^26p^6$ (d) $4f^{14}5d^{10}6s^26p^4$
 - (iii) Which of the elements whose atomic number are given below, cannot be accommodate in the present set up of the long form of the periodic table.
(a) 107 (b) 118 (c) 126 (d) 102
 - (iv) The electronic configuration of the element which is just above the element with atomic number 43 in the same group is
(a) $1s^22s^22p^63s^23p^63d^54s^2$ (b) $1s^22s^22p^63s^23p^63d^54s^24p^6$
(c) $1s^22s^22p^63s^23p^63d^64s^2$ (d) $1s^22s^22p^63s^23p^63d^74s^2$
 - (v) The elements with atomic numbers 35,53 and 85 are all _____
(a) noble gases (b) halogens (c) heavy metals (d) light metals

ASSERTION REASON QUESTIONS

2. 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 statements but reason is wrong statement.
- (d) Assertion is wrong statements but reason is correct statement.

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

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

(ii) Assertion (A): boron has a smaller first ionization enthalpy than beryllium.

Reason(R): The penetration of a 2s electron to the nucleus is more than 2p electron hence 2p electron is more shielded by inner core of electrons than the 2s electrons.

(iii) Assertion (A): electron gain enthalpy is general, become less negative as we go down a group.

Reason(R): size of atom increases on going down the group and added electron would be farther from the nucleus.

(iv) Assertion (A): Cu, Ag and Au are known as coinage metals.

Reason(R): coinage metals are d-block elements.

(v) Assertion (A): Lanthanum ($Z=57$) is lanthanoid.

Reason(R): Valence electron are present in 4-f orbital.

3. Modern periodic law is

- (a) The physical and chemical properties of the elements are periodic function of their atomic numbers
- (b) The physical and chemical properties of the elements depend upon the energy of the electrons
- (c) The physical and chemical properties of the elements depend upon atomic wt.
- (d) None of these.

4. Which of the following statements about modern periodic table is incorrect?

- (a) The p-block has 6 columns because a maximum of 6 electrons can occupy all the orbitals in the p-subshell.
- (b) The d-block has 8 columns because a maximum of 8 electrons can occupy all the orbitals in the d-subshell.
- (c) Each block contains a number of columns equal to number of electrons that can occupy the subshell
- (d) The block indicates the value of azimuthal quantum number for the last subshell which received electrons

5. IUPAC name of element having atomic number 108 is
 (A) Unniloctium (B) Ununoctium (C) Nilniloctinium (D) Ununoctinium
6. When a neutral atom is converted into a cation its
 (a) Atomic weight increases (b) Atomic weight decreases (c) Size increases (d) Size decreases.
7. Of the following, which one is a correct statement?
 (a) Ionic radius of a metal is same as its atomic radius
 (b) The ionic radius of a metal is greater than its atomic radius
 (c) The atomic radius of a non-metal is more than its ionic radius
 (d) The ionic radius of a metal is less than its atomic radius
8. Which of the following N^{3-} , O^{2-} , F^{-} is largest in size?
 (a) N^{3-} (b) O^{2-} (c) F^{-} (d) All of these.
9. Which of the following is not correct for iso-electronic ions?
 (a) They have the same number of electrons around their nuclei.
 (b) Higher the atomic number, higher will be positive charge in a series of Iso-electronic ions of same period.
 (c) Iso-electronic ions have same electric charge.
 (d) An iso-electronic series may have both positively and negatively charged ions.
10. The radii of F, F^{-} , O and O^{2-} are in the order:
 (a) $O^{2-} > O > F^{-} > F$ (b) $F^{-} > O^{2-} > F > O$ (c) $O^{2-} > F^{-} > O > F$ (d) $O^{2-} > F^{-} > F > O$.
11. The electronic configuration of an element is $1s^2 2s^2 2p^6 3s^2 3p^3$. What is the atomic Number of the element, which is just below the above element in the periodic table?
 (a) 36 (b) 49 (c) 33 (d) 34.
12. Which of the following has the greatest electron affinity?
 (a) I (b) Br (c) F (d) Cl
13. The valence shell electronic configuration of transition elements is
 (a) ns^1 (b) $ns^2 np^5$ (c) $ns^{0-2} (n-1) d^{1-10}$ (d) $ns^2 (n-1) d^{10}$
14. Which one of the following is correct order of the size of iodine species?
 (a) $I^+ > I > I^{-}$ (b) $I > I^{-} > I^+$ (c) $I > I^{-} > I^+$ (d) $I > I^+ > I^{-}$

15. Identify the correct order of the size of the following:
- (a) $\text{Ca}^{2+} < \text{K}^+ < \text{Ar} < \text{Cl}^- < \text{S}^{2-}$ (b) $\text{Ar} < \text{Ca}^{2+} < \text{K}^+ < \text{Cl}^- < \text{S}^{2-}$
- (c) $\text{Ca}^{2+} < \text{Ar} < \text{K}^+ < \text{Cl}^- < \text{S}^{2-}$ (d) $\text{Ca}^{2+} < \text{K}^+ < \text{Ar} < \text{S}^{2-} < \text{Cl}^-$
16. Eka-aluminum and Eka-silicon are known as
- (a) Gallium and Germanium (b) Aluminum and Silicon
- (c) Iron and Sulphur (d) Boron and Technetium
17. The element with highest electron affinity will belong to
- (a) Period 2, group 17 (b) Period 3, group 17
- (c) Period 2, group 18 (d) Period 2, group 1
18. Which is mismatched regarding the position of the element as given below?
- (a) X(Z = 89) - f block, 6th period (b) Y(Z = 100) - f block, 7th period
- (c) Z(Z = 115) - d block, 7th period (d) Both (1) & (3)
19. The electronic configurations of the elements X, Y, Z and J are given below. Which element has the highest metallic character?
- (a) X = 2, 8, 4 (b) Y = 2, 8, 8 (c) Z = 2, 8, 8, 1 (d) J = 2, 8, 8, 7
20. The electronegativity follows the order
- (a) $\text{F} > \text{O} > \text{Cl} > \text{Br}$ (b) $\text{F} > \text{Cl} > \text{Br} > \text{O}$ (c) $\text{O} > \text{F} > \text{Cl} > \text{Br}$ (d) $\text{Cl} > \text{F} > \text{O} > \text{Br}$
21. The symbol of element with atomic number $Z = 109$
- (a) Unp (b) Uns (c) Uno (d) Une
22. Fill in the blanks questions:
- (a) During the addition of second electron to oxygen, energy is _____.
- (b) All lanthanoids and actinoids belongs to _____ block elements.
- (c) An elements of group 13 which forms basic oxide is _____.
- (d) The formula of compound formed with elements (M) having $Z=114$ and fluorine is _____.
- (e) Amongst halogens, the element having highest electronegativity is _____.
23. What are transition elements? Name two transition elements.
24. What is meant by electron gain enthalpy?
25. Match the following, regarding nature of the oxides
- | | |
|--------------------------|-----------------|
| Column-I | Column-II |
| 1. H_2O | (i) Basic |
| 2. Na_2O | (ii) Amphoteric |
| 3. ZnO | (iii) Acidic |
| 4. SO_3 | (iv) Neutral |

- (a) 1(ii), 2(i), 3(iii), 4(iv) (b) 1(iv), 2(i), 3(iii), 4(ii)
 (c) 1(iv), 2(i), 3(ii), 4(iii) (d) 1(ii), 2(i), 3(iv), 4(iii)

26. Which statements(s) is /are false for the periodic classification of elements?

- (a) The properties of the elements are the periodic function of their atomic numbers.
 (b) Non-metallic elements are lesser in number than the metallic elements.
 (c) The first ionization energies of the elements along a period do not vary in regular manner with increase in atomic number
 (d) For transition elements, the d-electrons are filled monotonically with increase in atomic number.
 (e) both c and d

27. Total number of elements present in 5th period of modern periodic table is

- (a) 2 (b) 8 (c) 18 (d) 32

28. Pd has exceptional electronic configuration of $4d^{10} 5s^0$. It belongs to

- (a) 4th period, group 11 (b) 5th period, group 10
 (c) 6th period, group 9 (d) 3rd period, group 16

29. Which of the following statements is incorrect?

- (a) The ionization potential of nitrogen is greater than that of oxygen
 (b) The electron affinity of fluorine is greater than that of chlorine
 (c) The ionization potential of Mg is greater than aluminium
 (d) The electronegativity of fluorine is greater than that of chlorine.

30. Identify the wrong statement in the following:

- (a) Atomic radius of the elements increases as one moves down the first group of the periodic table
 (a) Atomic radius of the elements decreases as one moves across from left to right in the 2nd period of the periodic table
 (b) Amongst isoelectronic species, smaller the positive charge on the cation, smaller is the ionic radius
 (c) Amongst isoelectronic species, greater the negative charge on the anion, larger is the ionic radius.

31. What is the value of electron gain enthalpy of Na^+ if IE_1 of Na = 5.1 eV?

- (a) +2.55 eV (b) +10.2 eV (c) -5.1 eV (d) -10.2 eV

32. Which of the following represents the correct order of increasing electron gain enthalpy

with negative sign for the elements O, S, F and Cl ?

- (a) $\text{Cl} < \text{F} < \text{O} < \text{S}$ (b) $\text{O} < \text{S} < \text{F} < \text{Cl}$ (c) $\text{F} < \text{S} < \text{O} < \text{Cl}$ (d) $\text{S} < \text{O} < \text{Cl} < \text{F}$

33. The correct order of the decreasing ionic radii among the following is electronic species

are

- (a) $\text{Ca}^{2+} > \text{K}^+ > \text{S}^{2-} > \text{Cl}^-$ (b) $\text{Cl}^- > \text{S}^{2-} > \text{Ca}^{2+} > \text{K}^+$
(c) $\text{S}^{2-} > \text{Cl}^- > \text{K}^+ > \text{Ca}^{2+}$ (d) $\text{K}^+ > \text{Ca}^{2+} > \text{Cl}^- > \text{S}^{2-}$

34. Among the elements Ca, Mg, P and Cl, the order of increasing atomic radii is
(a) $\text{Mg} < \text{Ca} < \text{Cl} < \text{P}$ (b) $\text{Cl} < \text{P} < \text{Mg} < \text{Ca}$ (c) $\text{P} < \text{Cl} < \text{Ca} < \text{Mg}$ (d) $\text{Ca} < \text{Mg} < \text{P} < \text{Cl}$

35. Amongst the elements with following electronic configurations, which one of them may

have the highest ionization energy?

- (a) Ne $[\text{3s}^2\text{3p}^2]$ (b) Ar $[\text{3d}^{10}\text{4s}^2\text{4p}^3]$ (c) Ne $[\text{3s}^2\text{3p}^1]$ (d) Ne $[\text{3s}^2\text{3p}^3]$

36. Which one of the following is correct order of the size of aluminium species?

- (1) $\text{Al} > \text{Al}^+ > \text{Al}^{2+}$ (2) $\text{Al}^{2+} > \text{Al}^+ > \text{Al}$ (3) $\text{Al}^{2+} = \text{Al}^+ = \text{Al}$ (4) All of these

37. Ionic radii are

- (a) Inversely proportional to effective nuclear charge
(b) Inversely proportional to square of effective nuclear charge
(c) Directly proportional to effective nuclear charge
(d) Directly proportional to square of effective nuclear charge

38. Four successive members of the first row transition elements are listed below with their

atomic numbers. Which one of them is expected to have the highest third ionisation enthalpy?

- (a) Vanadium ($Z = 23$) (b) Chromium ($Z = 24$) (c) Manganese ($Z = 25$) (d) Iron ($Z = 26$)

39. The element with $Z=120$ (yet not discovered) will be an/a

(a) inner transition elements (b) transition metals (c) alkaline earth metals (d) alkali metals

40. The element having greatest difference between its first and second ionization enthalpies

- (a) Ca (b) K (c) Ba (d) Sc

41. The properties of the elements such as atomic or ionic radii, ionization enthalpy, electron

gain enthalpy and electronegativity are directly or indirectly related to their electronic configuration and are called periodic properties. A part of the periodic table is given below:

C	N	O	F
	P	S	Cl
		Se	Br
			I

Answer the following questions:

(i) Which of the following has highest ionization enthalpy?

- (a) N (b) P (c) O (d) C

(ii) Bromine belongs to period:

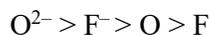
- (a) third (b) fourth (c) fifth (d) second
- (iii) Which of the following has largest size;
- (a) N (b) O (c) S (d) P
- (iv) The highest ionization enthalpy is of
- (a) P (b) O (c) N (d) S
- (v) Which of the following is not correct?
- (a) Electron gain enthalpy $\text{Cl} > \text{F} > \text{I}$
- (b) Atomic size: $\text{N} > \text{O} < \text{F}$
- (c) Ionization enthalpy: $\text{N} > \text{O} > \text{F}$
- (d) Ionic size: $\text{N}^{3-} > \text{O}^{2-} > \text{F}^-$
42. The chemistry of lithium is very similar to that of magnesium even though they are placed in different groups. Its reason is:
- (a) Both are found together in nature
- (b) Both have nearly the same size
- (c) Both have similar electronic configuration
- (d) The ratio of their charge and size (i.e. charge density) is nearly the same.
43. The element californium belongs to a family of:
- (a) Alkali metal family
- (b) Actinide series
- (c) Alkaline earth family
- (d) Lanthanide series
44. On the Paulings electro negativity scale the element next to F is
- (a) N (b) Cl (c) O (d) Ne.
45. Which of the following forms the most stable gaseous negative ion?
- (a) F (b) Cl (c) Br (d) I
46. The reduction in atomic size with increase in atomic number is a characteristic of elements of-
- (a) d-block
- (b) f-block
- (c) Radioactive series
- (d) High atomic masses
47. Which of the following oxides is amphoteric in character?
- (a) SnO_2

- (b) CO_2
- (c) SiO_2
- (d) CaO

48. Which of the following properties generally decreases along a period?
- (a) Ionization Energy
 - (b) Me Representative elements are those which belong totallic Character
 - (c) Electron Affinity
 - (d) Valency.
49. Representative elements are those which belong to
- (a) p and d – Block
 - (b) s and d – Block
 - (c) s and p – Block
 - (d) s and f – Block
50. Identify the group which is not a Dobereiner triad
- (a). Li, Na, K (b). Be, Mg, Cr (c). Ca, Sr, Ba (d). Cl, Br, I

ANSWER KEY

1. (i) c. The configuration of atomic no. 57 is $5d^1 6s^2$
(ii) c the last elements of p- pblock elements is ${}_{83}\text{Rn}$ with electronic configuration $4f^{14}5d^{10}6s^26p^6$ (iii) c. in the present form of periodic table, elements till 118 atomic number are accommodated. (iv)
a. ${}_{25}\text{Mn}$ (v) p- block elements.
2. (i) b
(ii) c
(iii) b.
(iv) b.
(v) d.
3. Answer (a)
According to modern periodic law physical and chemical properties are periodic function of their atomic number.
4. Answer (b)
d-block has 10 column because d-subshell have five orbitals and contain maximum 10 electrons.
5. Answer (a) for 108
 $1 = \text{un } 0 = \text{nil } 8 = \text{oct} + \text{ium } 108 = \text{Unniloctium}$
6. Answer (d)
When an electron is removed from neutral atom nuclear charge per electron increases. As
a
result
Size decreases.
 $186 \text{ pm} \quad 95 \text{ pm}$
 $\text{Na} \rightarrow \text{Na}^+$
7. Answer (d)
Metals are electropositive in nature i.e., loose e^- , therefore its ionic radius will be less than the atomic
Radius i.e., nuclear charge per electron decreases
8. Answer (a)
More the negative charge more will be the size because attraction per electron decreases. N^{3-}
have maximum negative charge have maximum size.
9. Answer (c)
Iso-electronic have same number of electrons not same iso-electric charge. For example N^{3-}
 O^{2-} F^- are Iso-electronic but have different charge.
10. Answer (c)
Left to right size decreases due to increase in effective nuclear charge. Size of $\text{O} > \text{F}$
 O is more size, F is less size but O^{2-} have more charge than F^- O^{2-} have more size than F^- .
Size of anion is always more than neutral charges.



11. Answer (c)

Electronic configuration represents 'P'. $1s^2, 2s^2, 2p^6, 3s^2, 3p^3 = 15$ down the group add $18e^-$

because 3rd period have 18 elements. Atomic number of element below is 33.

12. Answer (d)

Smaller the size more will be the electron affinity due to more attraction towards new Electron but as

size of F is less it is expected to have more electron affinity but actually F have 7 e^- in outermost shell

(and have smaller size) cause repulsion towards new e^- .

$\text{Cl} > \text{F}$

Cl (more electron affinity), F (less electron affinity)

13. Answer (c)

Transition elements = d-block elements i.e., $ns^{0-2}(n-1)d^{1-10}$

14. Answer (b)

Size of anion is more than parent atom due to less effective nuclear charge on outermost electrons.

Size of cation is less due to more effective nuclear charge.

$\text{I}^- > \text{I} > \text{I}^+$ size order.

15. Answer (a)



Smaller size due to more effective nuclear charge and more the positive charge smaller will

be the size Larger size due to less

effective nuclear charge attraction per electron decreases

16. Answer (a)

Eka – Aluminium = Gallium

Eka – Silicon = Germanium

[Eka means have configuration similar] Name given by Mendeleev.

17. Answer (b)

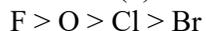
Highest electron affinity will be of Cl that is present in group 17 and 3rd period.

18. Answer (d)

19. Answer (c)

Element Z have 1 electron in 4th shell it will easily lose to get noble gas configuration.

20. Answer (1)



Down the group electronegativity decreases

Left to right electronegativity increases F have more electron affinity than 'O', O have more than Cl

due to same size Cl and Br have less.

21. d.

22. (a) sulphur (b) f (c) thallium (d) MF_4 (e) fluorine.

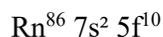
23. Partially filled of d- orbitals. Sc and Ti or any two elements belongs to d- block elements.

24. correct definition

25. (c) 1(iv), 2(i), 3(ii), 4(iii)

H_2O Neutral ZnO = amphoteric

- Na_2O = Basic SO_3 = Acidic
26. (e) both c and d
- 27 (d).
2, 8, 8, 18, 18, 32
28. Answer (b)
 $\text{Pd} = 4d^{10}, 5s^0$ member of 4d series i.e., 5th period and 10th group.
29. Answer (2)
Electron affinity of F is less than chlorine because of smaller size more will be the repulsion towards new electron.
30. Answer (c)
In isoelectronic species i.e., same number of electrons.
more the positive charge; smaller will be the size
more the negative charge; larger will be the size
31. Answer (c)
Electron gain enthalpy is negative of I.E. i.e., -5.1 eV
32. Answer b
33. Answer c
34. Answer (b)
Mg P Cl left to right size decreases
down the group size increases
i.e., $\text{Ca} > \text{Mg} > \text{P} > \text{Cl}$
35. Answer d Half filled stability $3s^2 3p^3$
36. Answer (1)
Size of positive charge atom i.e., cation is always lesser than parent atom due to increase in
Effective Nuclear charge i.e., $\text{Al} > \text{Al}^+ > \text{Al}^{2+}$
37. Answer a
38. Answer (c)
 $\text{Mn} = 25 = 4s^2, 3d^5$ after removing 2 electrons from 4s Mn will get stable configuration i.e.,
 $3d^5$ 3rd I.E. will be more
39. Answer (c)
40. Answer (b)
41. (i) a
(ii) b
(iii) d
(iv) c
(v) b
42. Answer: (d) The ratio of their charge and size (i.e. charge density) is nearly the same
Explanation:
The chemistry of lithium is very similar to that of magnesium even though they are placed in
different groups because of diagonal relationship.
43. Answer: (b) Actinide series
Explanation:
Atomic number of californium is 98 and its electronic configuration is



so it is a f-block element and as it is in 7th period, it is a part of actinide series.

44. Explanation: Answer (c) O

Pauling explained electro negativity as the power of an atom in a molecule to attract electrons towards it. When we analyse the trend in periodic table, we can see that the degree of electro negativity decreases while going down the groups, while it increases across the periods. In the case of a covalent bond, based on the bond energies, Pauling calculated the differences in electro negativity between atoms in the bond and assigned a value of 4 to fluorine, which is the most electro negative element, and others were calculated with respect to that value. Hence, on Pauling's scale, the element next to fluorine is Oxygen.

45. Answer: (b) Cl

Explanation:

The element which forms the most stable gaseous negative ion is fluorine.

46. Answer: (b) f-block

Explanation:

The reduction in atomic size with increase in atomic number is a characteristic of elements of

f-block. It is known as lanthanoid contraction and actinoid contraction. This is due to poor shielding of electrons present in f subshell.

47. Answer: (a) SnO_2

Explanation:

CaO is basic; CO_2 is acidic; SiO_2 is weakly acidic. SnO_2 is amphoteric.

48. Answer: (b) Metallic Character

Explanation:

The IE, EA increases along the period. The valency initially increases then decreases.

The metallic character decreases along the period.

49. Answer: (c) s and p – Block

Explanation:

Elements in which all the inner shells are complete but outer shell is incomplete is known as representative elements i.e. Those elements which have less than 8 electrons in outermost shell are representative.

s and p block elements except inert gas is known as representative elements.

50. Answer b

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PGT CHEMISTRY

CHAPTER –CHEMICAL BONDING AND MOLECULAR STRUCTURE

MULTIPLE CHOICE QUESTIONS

Q-1 Which of the following does not obey the octet rule

- (a) CO (b) NH_3 (c) H_2O (d) PCl_5

Q-2 H_2S is more acidic than H_2O , due to

- (a) O is more electronegative than S (b) O – H bond is stronger than S – H bond

- (c) O – H bond is weaker than S – H bond (d) None of these

Q-3 Carbon tetrachloride has no net dipole moment because of

- (a) Its planar structure
(b) Its regular tetrahedral structure
(c) Similar sizes of carbon and chlorine atoms
(d) Similar electron affinities of carbon and chlorine

Q-4 Pick out the molecule which has zero dipole moment

- (a) NH_3 (b) H_2O (c) BCl_3 (d) SO_2

Q-5 Which of the following is the most polar

- (a) CCl_4 (b) CHCl_3 (c) CH_3OH (d) CH_3Cl

Q-6 Dipole moment is shown by

- (a) 1, 4-dichlorobenzene (b) cis 1, 2-dichloroethene
(c) trans 1, 2-dichloroethene (d) Carbon tetra chloride

Q-7 BF_3 and NF_3 both molecules are covalent, but BF_3 is non-polar and NF_3 is polar. Its reason is

- (a) In uncombined state boron is metal and nitrogen is gas
(b) B – F bond has no dipole moment whereas N – F bond has dipole moment
(c) The size of boron atom is smaller than nitrogen
(d) BF_3 is planar whereas NF_3 is pyramidal

Q-8 Which type of overlapping results the formation of a π bond

- (a) Axial overlapping of s – s orbitals
orbitals
- (b) Lateral overlapping of p – p orbitals
- (c) Axial overlapping of p – p orbitals
- (d) Axial overlapping of s – p orbital

Q-9 Which of the following is not correct

- (a) A sigma bond is weaker than π bond
- (b) A sigma bond is stronger than π bond
- (c) A double bond is stronger than a single bond
- (d) A double bond is shorter than a single bond

Q-10 In the series ethane, ethylene and acetylene, the C – H bond energy is

- (a) The same in all the three compounds
- (b) Greatest in ethane
- (c) Greatest in ethylene
- (d) Greatest in acetylene

Q-11 Which molecule is not linear

- (a) BeF_2
- (b) BeH_2
- (c) CO_2
- (d) H_2O

Q-12 In which of the following the central atom does not use sp^3 hybrid orbitals in its bonding

- (a) BeF_3^-
- (b) OH_3^+
- (c) NH_2^-
- (d) NF_3

Q-13 Which of the following hybridization results in non-planar orbitals

- (a) sp^3
- (b) dsp^2
- (c) sp^2
- (d) sp

Q-14 Which of the following statement is not correct

- (a) Hybridization is the mixing of atomic orbitals prior to their combining into molecular orbitals
- (b) sp^2 hybrid orbitals are formed from two P atomic orbitals and one S atomic orbital
- (c) $d^2 sp^3$ hybrid orbitals are directed towards the corners of a regular octahedron
- (d) dsp^3 hybrid orbitals are all at 90° to one another

Q-15 In XeF_4 hybridization is

- (a) $sp^3 d^2$
- (b) sp^3
- (c) $sp^3 d$
- (d) $sp^3 d^3$

Q-16 The compound 1, 2-butadiene has

- (a) Only sp hybridized carbon atoms
- (b) Only sp^2 hybridized carbon atoms

(c) Both sp and sp^2 hybridized carbon atoms (d) sp^2 , sp and sp^3 hybridized carbon atoms

Q-17 The correct order of the O – O bond length in H_2O_2 , O_3 and O_2 is

- (a) $O_2 > O_3 > H_2O_2$ (b) $O_3 > H_2O_2 > O_2$
(c) $H_2O_2 > O_3 > O_2$ (d) $O_2 > H_2O_2 > O_3$

Q-18 Which of the following hybridization has maximum s-characters

- (a) sp^3 (b) sp^2 (c) sp (d) None of these

Q-19 Hybridization involves

- (a) Addition of an electron pair (b) Mixing up of atomic orbitals
(c) Removal of an electron pair (d) Separation of orbitals

Q-20 The shapes of BCl_3 , PCl_5 and ICl_3 molecules are all

- (a) Triangular (b) Pyramidal (c) T – shaped (d) All above are incorrect

Q-21 Out of the following hybrid orbitals, the one which forms the bond at angle 120° , is

- (a) $d^2 sp^3$ (b) sp^3 (c) sp^2 (d) sp

Q-22 The correct order of hybridization of the central atom in the following species NH_3 , $[PtCl_4]^{-2}$, PCl_5 and BCl_3 is

- (a) sp^2 , dsp^2 , sp , sp^3 (b) sp^3 , dsp^2 , sp^3d , sp^2
(c) sp^3 , sp^2 , sp^3 , dsp^2 (d) dsp^2 , sp^3 , sp , dsp^2

Q-23 N_2 and O_2 are converted into monocations N_2^+ and O_2^+ respectively. Which is wrong

- (a) In N_2 , the N – N bond weakens (b) In O_2 , the O – O bond order increases
(c) In O_2 , paramagnetism decreases (d) N_2^+ becomes diamagnetic

Q-24 Structure of IF_4^+ and hybridization of iodine in this structure are

- (a) sp^3d , Linear (b) $sp^3 d^2$, T-shaped
(c) sp^3d Irregular tetrahedral (d) $sp^3 d^2$, Octahedral

Q-25 Bond length of ethane (I), ethene (II), acetylene (III) and benzene (IV) follows the order

- (a) $I > II > III > IV$ (b) $I > II > IV > III$
(c) $I > IV > II > III$ (d) $III > IV > II > I$

Q-34 Resonance is due to

- (a) Delocalization of sigma electrons (b) Delocalization of pi electrons
(c) Migration of H atoms (d) Migration of protons

Q-35 The number of possible resonance structures for CO_3^{2-} is

- (a) 2 (b) 3 (c) 6 (d) 9

Q-36 H_2O is a liquid while H_2S is gas due to

- (a) Covalent bonding (b) Molecular attraction
(c) H – bonding (d) H – bonding and molecular attraction

Q-37 The boiling point of a compound is raised by

- (a) Intramolecular hydrogen bonding (b) Intermolecular hydrogen bonding
(c) Covalent bonding (d) Ionic covalent

Q-38 The reason for exceptionally high boiling point of water is

- (a) Its high specific heat (b) Its high dielectric constant
(c) Low ionization of water molecules (d) Hydrogen bonding in the molecules of water

Q-39 The paramagnetic molecule at ground state among the following is

- (a) H_2 (b) O_2 (c) N_2 (d) CO

Q-40 In O_2^{-2} , O_2 and O_2^{-1} molecular species, the total number of antibonding electrons respectively are:-

- (a) 7, 6, 8 (b) 1, 0, 2 (c) 6, 6, 6 (d) 8, 6, 7

Q-41 The bond length the species O_2^+ , O_2 and O_2^- are in the order

- (a) $\text{O}_2^+ > \text{O}_2^- > \text{O}_2$ (b) $\text{O}_2 > \text{O}_2^- > \text{O}_2^+$ (c) $\text{O}_2^+ > \text{O}_2 > \text{O}_2^-$ (d) $\text{O}_2^- > \text{O}_2 > \text{O}_2^+$

ASSERTION AND REASON TYPE QUESTION

Read the assertion and reason carefully to mark the correct option out of the options given below

- (a) If both assertion and reason are true and the reason is the correct explanation of the assertion. (b) If both assertion and reason are true but reason is not the correct explanation of the assertion. (c) If assertion is true but reason is false. (d) If the assertion and reason both are false. (e) If assertion is false but reason is true.

Q-42 Assertion : A resonance hybrid is always more stable than any of its canonical structures

Reason : This stability is due to delocalization of electrons

Q-43 Assertion : All F – S – F angle in SF₄ greater than 90° but less than 180°

Reason : The lone pair-bond pair repulsion is weaker than bond pair-bond pair repulsion

Q-44 Assertion : BF₃ has greater dipole moment than H₂S .

Reason : Fluorine is more electronegative than Sulphur.

Q-45 Assertion : Ortho nitrophenol molecules are associated due to the presence of intermolecular hydrogen bonding while Para nitrophenol involves intramolecular, hydrogen bonding

Reason : Ortho nitrophenol is more volatile than the para nitrophenol

Q-46 Assertion : The bond order of F₂ molecule is 1.

Reason : in F₂ molecule the number of electrons in the antibonding M.O. is two less than in bonding M.O.

Q-47 Assertion : Nitrogen molecule diamagnetic.

Reason : N₂ molecule have unpaired electrons

Q-48 Assertion : Geometry of SF₄ molecule can be termed as distorted tetrahedron, a folded square or see saw.

Reason : Four fluorine atoms surround or form bond with sulphur molecule.

Q-49 Assertion : σ is strong while π is a weak bond.

Reason : Atoms rotate freely about π bond.

Q-50 Assertion : The bond order of helium is always zero.

Reason : The number of electrons in bonding molecular orbital and antibonding molecular orbital is equal.

ANSWER KEY

CHEMICAL BONDING AND MOLECULAR STRUCTURE

1(d)	2(b)	3(b)	4(c)	5(c)	6(b)	7(d)	8(b)	9(a)	10(d)
11(d)	12(a)	13(a)	14(d)	15(a)	16(d)	17(c)	18(c)	19(b)	20(d)
21(c)	22(b)	23(c)	24(c)	25(c)	26(d)	27(b)	28(d)	29(d)	30(c)
31(c)	32(b)	33(c)	34(b)	35(b)	36(c)	37(b)	38(d)	39(b)	40(d)
41(d)	42(a)	43(c)	44(e)	45(e)	46(a)	47(c)	48(b)	49(c)	50(a)

Case study answer Key

(1) d

(2) b

(3)a

(4) b

(5)b

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CASE BASED

Hydrogen is the most abundant element in the universe and the third most abundant element on the surface of the globe. Hydrogen was discovered by Henry Cavendish and named by Lavoisier. Hydrogen is the first lightest and smallest, non-metallic element in the periodic table. Hydrogen has the same electronic configuration as alkali metals as it has only one valence electron. It is also electropositive in nature like these metals. Hydrogen is a good reducing agent like alkali metals. Hydrogen shows +1 oxidation state similar to alkali metals. Hydrogen also forms the cation H^+ as M^+ is formed by alkali metals by losing one electron. Hydrogen has a great affinity for non-metals and it combines with them to form a number of compounds like oxides and halides.

Q1. Why does H^+ ion always get associated with other atoms or molecules?

- (a) Ionisation enthalpy of hydrogen resembles that of alkali metals.
- (b) Its reactivity is similar to halogens.
- (c) It resembles both alkali metals and halogens.
- (d) Loss of an electron from hydrogen atom results in a nucleus of very small size as compared to other atoms or ions. Due to small size it can not exist freely.

Q2. Hydrogen resembles halogens in many respects for which several factors are responsible. Of the following factors which one is most important in this respect?

- (a) Its tendency to lose an electron to form a cation.
- (b) Its tendency to gain a single electron in its valence shell to attain stable electronic configuration.
- (c) Its low negative electron gain enthalpy value.
- (d) Its small size.

Q3. Which of the following statements are not true for hydrogen?

- (a) It exists as diatomic molecule.
- (b) It has one electron in the outermost shell.
- (c) It can lose an electron to form a cation which can freely exist.
- (d) It forms a large number of covalent compounds by sharing an electron.

Q4. Which of the following statements about hydrogen are correct?

- (a) Hydrogen has three isotopes of which Deuterium is the most common.
- (b) Hydrogen never acts as cation in ionic salts.
- (c) Hydrogen ion, H^+ , exists freely in solution.
- (d) Dihydrogen does not act as a reducing agent.

Compounds of hydrogen with less electronegative elements are known as hydrides. So when hydrogen reacts with any other element the product formed is considered to be a hydride. Hydrides are mainly divided into three major types or groups. The categories are decided based on what elements the hydrogen forms bonds with or simply on the basis of chemical bonding. The three types of hydrides are ionic, covalent, and metallic hydrides.

Q5. Which of the following hydrides is electron-precise hydride?

- (i) B_2H_6
- (ii) NH_3
- (iii) H_2O
- (iv) CH_4

Q6. Metal hydrides are ionic, covalent or molecular in nature. Among LiH, NaH, KH, RbH, CsH, the correct order of increasing ionic character is

- (i) $LiH > NaH > CsH > KH > RbH$
- (ii) $LiH < NaH < KH < RbH < CsH$
- (iii) $RbH > CsH > NaH > KH > LiH$
- (iv) $NaH > CsH > RbH > LiH > KH$

Q7. Elements of which of the following group (s) of periodic table do not form hydrides.

- (i) Groups 7, 8, 9
- (ii) Group 13
- (iii) Groups 15, 16, 17
- (iv) Group 14

Q8. Only one element of _____ forms hydride.

- (i) group 6
- (ii) group 7
- (iii) group 8
- (iv) group 9

Water is the chemical substance with chemical formula H_2O , one molecule of water has two hydrogen atoms covalently bonded to a single oxygen atom. It is a colourless and tasteless liquid. The molecules of water have extensive hydrogen bonds resulting in unusual properties in the condensed form. Water reacts with a lot of substances to form different compounds.

Q9. Some of the properties of water are described below. Which of them is/are not correct?

- (i) Water is known to be a universal solvent.
- (ii) Hydrogen bonding is present to a large extent in liquid water.
- (iii) There is no hydrogen bonding in the frozen state of water.
- (iv) Frozen water is heavier than liquid water.

Q10. The freezing point of heavy water is

- (i) 0°C
- (ii) 3.8°C
- (iii) 4°C
- (iv) 1°C

Q11. Water shows anomalous behavior between

- (i) 0 to 4°C
- (ii) 0 to 5°C
- (iii) 0 to -4°C
- (iv) 4 to 0°C

Q12. Which of the following statement(s) is/are correct in the case of heavy water?

- (i) Heavy water is used as a moderator in nuclear reactor.
- (ii) Heavy water is more effective as solvent than ordinary water.
- (iii) Heavy water is more associated than ordinary water.
- (v) Heavy water has lower boiling point than ordinary water.

ASSERTION AND REASON TYPE QUESTION

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 options given below each question.

- (i) Statements A and R both are correct and R is the correct explanation of A.
- (ii) A and R both are correct but R is not the correct explanation of A.
- (iii) A is correct but R is not correct.
- (iv) A and R both are false.

Q13. Assertion (A) : Permanent hardness of water is removed by treatment with washing soda.

Reason (R) : Washing soda reacts with soluble magnesium and calcium sulphate to form insoluble carbonates.

Q14. Assertion (A) : Some metals like platinum and palladium, can be used as storage media for hydrogen.

Reason (R) : Platinum and palladium can absorb large volumes of hydrogen.

Q15. Assertion (A) : Water in liquid state is more stable than ice at room temperature.

Reason (R) : Water in liquid form has higher entropy than ice.

Q16. Assertion (A) : Water has high boiling point.

Reason (R) : Water shows hydrogen bonding.

Q17. Assertion (A) : Some metals like platinum and palladium, can be used as storage media for hydrogen.

Reason (R) : Platinum and palladium can absorb large volumes of hydrogen.

Q18. Assertion (A) : HF form extensive hydrogen bonding.

Reason (R) : F has highest tendency to form hydrogen bonding.

Q19. Assertion (A) : Density of ice is less than water.

Reason (R) : Ice has open cage structure.

Q20. Assertion (A) : Water can act as acid as well as base.

Reason (R) : Water can accept as well as donate H^+ ion.

Q21. Assertion (A) : When Na reacts with H_2O , H_2 gas is release.

Reason (R) : P_4O_{10} on hydrolysis produce H_3PO_3 .

Q22. Assertion (A) : CH_4 is a covalent hydrides.

Reason (R) : CH_4 is Electron precise type hydrides.

Q 23. Assertion (A) : H_2 gas is use in metallurgical process.

Reason (R) : H_2 gas is use as fuel.

MULTIPLE CHOICE QUESTIONS

Q 24. D_2O has higher value of following physical parameters than H_2O , except

- (i) Molecular Mass
- (ii) Melting Point
- (iii) Density
- (iv) Dielectric Constant

Q 25. Which one is ionic hydride in nature?

- (i) CrH
- (ii) NH_3
- (iii) H_2O
- (iv) NaH

Q 26. The electronic configuration of 'D' (Isotope of Hydrogen)

- (i) $1s^2$
- (ii) $1s^2 2s^1$
- (iii) $1s1$
- (iv) $1s^2 2s^2 2p^1$

Q 27. Which group forms hydride?

- (i) 6
- (ii) 7
- (iii) 8
- (iv) 9

Q 28. Which of the following hydrides are generally nonstoichiometric in nature?

- (i) Ionic Hydrides
- (ii) Molecular Hydrides
- (iii) Interstitial Hydrides
- (iv) All of the Above.

Q 29. Hydrogen is the most abundant element on earth after _____.

- (i) Oxygen
- (ii) Carbon
- (iii) Sulphur
- (iv) None of the Above

Q 30. Hydrogen is a good _____ agent.

- (i) Oxidizing
- (ii) Reducing
- (iii) Acidic
- (iv) Basic

ANSWERS

1. (d) $H \rightarrow H^+ + e^-$ H^+ has a very small size ($\sim 1.5 \times 10^{-3}$ pm) compared to normal atomic and ionic sizes of 50 to 220 pm. It does not exist freely and is always associated with other atoms or molecules.
2. (b) Halogens have the tendency to gain one electron and acquire inert gas configuration. Hydrogen also accepts one electron and acquires helium configuration.
3. (c) It can lose an electron to form a cation which cannot freely exist.
4. (b) Hydrogen never acts as cation in ionic salts because it acts as anion in ionic salts.
5. (iv)
6. (ii)
7. (i)
8. (i)
9. (iii), (iv)
10. (ii)
11. (i)
12. (i), (iii)
13. (i)
14. (i)
15. (ii)
16. (i)
17. (i)
18. (i)
19. (i)
20. (i)
21. (iii)
22. (i)
23. (ii)
24. (iv)
25. (iv)
26. (iii)
27. (i)
28. (iii)
29. (i)
30. (ii)

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CHAPTER: ORGANIC CHEMISTRY - SOME BASIC PRINCIPLES AND TECHNIQUE

I. MULTIPLE CHOICE QUESTIONS

- Which of the following carbon cation has least stability?
 - Methyl
 - Ethyl
 - Isopropyl
 - Tert- butyl
- An electrophilic reagent is:
 - Electron deficient species
 - Electron rich species
 - Negatively charged species
 - A Lewis base
- Which type of the following carbo- cation will be more stable?
 - $(\text{CH}_3)_2\text{CH}^+$
 - Ph_3C^+
 - $\text{CH}_2=\text{CHCH}_2^+$
 - CH_3CH_2
- The shape of carbo-cation is
 - Planar
 - Linear
 - Pyramidal
 - Tertahedral
- The common name of 2- butanone is
 - Acetone
 - Butyraldehyde
 - Acetic anhydride
 - Ethyl methyl ketone
- The molecule in which the distance between neighbouring carbon atom is least is
 - C_6H_6
 - C_2H_2
 - C_2H_4
 - C_2H_6
- Among the following the one having longest chain is
 - Neopentane
 - Isopentane
 - 2- methypentane
 - 2,2- dimethylbutane
- The IUPAC name of compound having formula $(\text{CH}_3)_3\text{C}-\text{CH}=\text{CH}_2$ is
 - 3,3,3 – trimethyl-1- propene
 - 1,1,1- trimethyl-3-propene
 - 3,3- dimethyl -1- butene
 - 1,1- dimethyl -3- butene

9. The general formula of cycloalkanes is
- $C_n H_{2n}$
 - $C_n H_{2n-1}$
 - $C_n H_{2n+1}$
 - $C_{n+1} H_{n+2}$
10. Which of the following is not a cyclic compound?
- Anthracene
 - Pyrole
 - Phenol
 - Neopentane
11. Which of the following hybridization has maximum s character?
- sp
 - sp^2
 - sp^3
 - All have same s- character
12. Which of the following is not an isomer of but-1-yne?
- But-2-yne
 - But-2-ene
 - Buta-1,3- diene
 - Methyl cyclopropene
13. How many Sigma and Pi bonds are there in the molecule of tetracyanoethene
 $[(NC)_2C=C(CN)_2]$
- 9 Sigma ,7 pi
 - 5 sigma, 9 pi
 - 5 Sigma ,8 pi
 - 9 Sigma , 9 pi
14. Which out of the following series contain only nucleophile?
- H_2O , SO_3 , H_3O^+
 - NH_3 , H_2O , $R-O-H$
 - NH_3 , H_2O , $AlCl_3$
 - None of the above
15. Which of the following species has electron releasing (+ Inductive) Effect?
- $-NO_2$
 - $-COOH$
 - $(CH_3)_2CH^-$
 - All the above
16. Which of the following is not an electrophile?
- Carbocation
 - SO_3
 - Carbene
 - Thioalcohol
17. Which of the following is an example of elimination reaction?
- Chlorination of methane
 - Dehydration of alcohol
 - Nitration of benzene
 - Hydroxylation of ethylene

18. Which of the following is correct IUPAC name?
- 3-Ethyl-4,4-dimethylheptane
 - 4,4-Dimethyl-3-ethylheptane
 - 5-Ethyl-4,4-dimethylheptane
 - 4,4-Bis (methyl) -3- ethylheptane
19. In which of the following functional group isomerism is not possible?
- Alcohol
 - Aldehyde
 - Alkyl halide
 - Cyanides
20. Which of the following organic compounds was first synthesized?
- Urea
 - Ethylene
 - Methane
 - Acetic acid
21. In methane molecule the four hydrogen atoms are arranged as
- Square planar
 - Square pyramid
 - Tetrahedral
 - Octahedral
22. Which one of the following is most resonance stabilized?
- Phenoxide
 - Ethoxide
 - Tert- Butoxide
 - n-butoxide
23. The most stable carbanion is
- Methyl carbanion
 - Primary carbanion
 - Secondary carbanion
 - Tertiary carbanion
24. Heterolytic fission of carbon- chlorine bond produces
- Two free radicals
 - Two carbocations
 - Two carbanion
 - One cation and one anion
25. Inductive effect refers to
- Electron displacement along a carbon chain
 - Complete transfer of one of the shared pairs of electron to one of the atoms joined by a double bond.
 - Complete transfer of electrons and unshared
 - None of the above
26. The number of structural isomers of C_6H_{14} is
- 4
 - 5
 - 6
 - 7

27. Hyperconjugation involves overlapping of the following orbitals
- σ - σ
 - σ - ρ
 - ρ - ρ
 - π - π
28. The kind of localisation involving sigma bond orbital is called
- Hybridization
 - Conjugation
 - Hyperconjugation
 - Conformation
29. Peroxide effect of addition of HBr to alkenes occurs through a stable
- Carbocation
 - Carbanion
 - Carbon radical
 - Unsaturation
30. Due to the presence of an unpaired electron free radicals are
- Chemically reactive
 - Chemically inactive
 - Anions
 - Cations

II. ASSERTION – REASON TYPE

General Instructions:

- 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 the correct explanation of assertion
 - C = assertion is correct but reason is incorrect
 - D = assertion is incorrect but reason is correct.
1. **Assertion:** Allyl free radical is more stable than simple free radical.
Reason : The free radical is stabilized by resonance.
 2. **Assertion :** In allene (C_3H_4), all carbon atoms are sp^2 hybridised.
Reason : all the three carbon atoms are joined by double bond.
 3. **Assertion :** alkanes having more than three carbon atoms exhibit chain isomerism.
Reason: All carbon atom in alkane or sp^3 hybridised.
 4. **Assertion :** butane and 2 – methylbutane are homologous.
Reason: butane is a straight chain alkane while 2-methylbutane is a branched chain alkane.
 5. **Assertion :** Methylene has a sextet of electrons
Reason: Methylene behaves as a nucleophile
 6. **Assertion :** $CH_3C^+=O$ behaves as electrophile
Reason: In this species, O has two pairs of electrons.
 7. **Assertion :** All the C- C bond length in benzene are equivalent.
Reason: the resonance energy of benzene is about 150.6 /mol
 8. **Assertion:** all the carbon atoms in $H_2C=CH_2$ are sp^2 hybridised.
Reason: in this molecule all the carbon atoms are attached to each other by double bonds.
 9. **Assertion :** Pent -1- ene and Pent -2- ene are position isomers.
Reason: position isomers differ in the position of functional group or a substituent.
 10. **Assertion:** All compounds having C=C bond exhibit geometrical isomerism.
Reason: Rotation about C=C bond is restricted.

III. CASE STUDY BASED QUESTIONS

1. Nucleophiles or nucleophilic reagents are electron donating species. The name nucleophile means nucleus loving. Nucleophiles are electron rich, that is, they normally possess an unshared electron pair which they can donate. They are either negative ions or neutral molecules with free electron pairs to donate. The attack reasons of low electron density (positive centre) in the substrate.
 - a. Which of the following is not a nucleophile.
 - i. Cl^-
 - ii. NH_2^-
 - iii. OH^-
 - iv. CH_3^+
 - b. Nucleophiles act as
 - i. Lewis acid
 - ii. Lewis base
 - iii. Conjugate acid
 - iv. Conjugate base
 - c. Nucleophiles attack at
 - i. Region of high electron density
 - ii. Region of low electron density
 - iii. Electron donating species
 - iv. None of the above
 - d. Which of the following behaves as both nucleophile and electrophile.
 - i. CH_3NH_2
 - ii. CH_3CN
 - iii. CH_3OH
 - iv. CH_3Cl
 - e. The most stable carbocation is
 - I. Methyl carbocation
 - II. Primary carbocation
 - III. Secondary carbocation
 - IV. Tertiary carbocation
2. Carbene intermediates are produced by the photolysis of diazomethane (CH_2N_2) or ketene ($\text{CH}_2=\text{C}=\text{O}$). They are also produced by the reaction of CHX_3 with base or by Simmons-Smith reaction. There are two types of carbenes, singlet and triplet. They are so called due to their spin state.
 - a. Spin state of carbene is determined by using formula:
(where S is the sum of all electron spin numbers)
 - i. $S + 2$
 - ii. $2S + 1$
 - iii. $2S + 2$
 - iv. $S + 1$
 - b. Singlet and triplet carbene are same in
 - i. Type of hybridization
 - ii. Number of unpaired electron pairs
 - iii. Number of Sigma bonds

- iv. Bond angle
- c. Photolysis is a type of
 - i. Decomposition reaction
 - ii. Elimination reaction
 - iii. Substitution reaction
 - iv. Addition reaction
- d. Which of the following is incorrect about carbene
 - I. It is intermediate product
 - II. It is highly reactive
 - III. It can exist freely
 - IV. It is neutral
- e. How many Sigma and Pi bonds are there in Ketene ($\text{CH}_2=\text{C}=\text{O}$)
 - i. $4\sigma, 2\pi$
 - ii. $5\sigma, 2\pi$
 - iii. $2\sigma, 2\pi$
 - iv. None of the above.

ANSWER KEY

I. Multiple choice questions

1. A
2. A
3. B
4. A
5. D
6. B
7. C
8. C
9. A
10. D
11. A
12. B
13. D
14. B
15. C
16. D
17. B
18. A
19. C
20. A
21. C
22. A
23. A
24. D
25. A
26. B
27. B
28. C
29. C
30. A

II. Assertion – Reason Type

1. A
2. D
3. B
4. B
5. C
6. C
7. B
8. D
9. A
10. D

III. Case study

1. A. iv

- B. i
- C. ii
- D. iii
- E. iv
- 2. A. ii
- B. iii
- C. i
- D. iii
- E. i

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PGT CHEMISTRY

KV FRIDKOT

CHAPTER : REDOX REACTIONS

MULTIPLE CHOICE QUESTIONS

Q.1. The colorless solution of silver nitrate slowly turns brown on adding copper chips to it because of

- (a) Dissolution of Copper
- (b) Oxidation of $\text{Ag}^+ \rightarrow \text{Ag}$
- (c) Reduction of Cu^{2+} ions
- (d) Oxidation of Cu atoms.

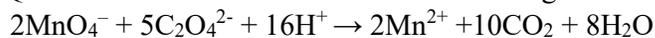
Q.2. The oxidation process involves

- (a) Increase in oxidation number
- (b) Decrease in oxidation number
- (c) No change in oxidation number
- (d) none of the above

Q.3. The oxidation number of Mn is maximum in

- (a) MnO_2 (b) K_2MnO_4
- (c) Mn_3O_4 (d) KMnO_4 .

Q.4. KMnO_4 reacts with oxalic acid according to the equation



Here 20 mL of 0.1 M KMnO_4 is equivalent to

- (a) 50 mL of 0.5 M $\text{C}_2\text{H}_2\text{O}_4$
- (b) 20 mL of 0.1 M $\text{C}_2\text{H}_2\text{O}_4$
- (c) 20 mL of 0.5 M $\text{C}_2\text{H}_2\text{O}_4$
- (d) 50 mL of 0.1 M $\text{C}_2\text{H}_2\text{O}_4$

Q.5. Which of the following reactions does not involve either oxidation or reduction?

- (a) $\text{VO}_2^+ \rightarrow \text{V}_2\text{O}_3$
- (b) $\text{Na} \rightarrow \text{Na}^+$
- (c) $\text{CrO}_2^{4-} \rightarrow \text{Cr}_2\text{O}_7^{2-}$
- (d) $\text{Zn}^{2+} \rightarrow \text{Zn}$

Q.6. The number of moles of KMnO_4 reduced by one mole of KI in alkaline medium is

- (a) One
- (b) Two
- (c) Five
- (d) One fifth.

Q.7. Which of the following processes does not involve oxidation of iron?

- (a) Formation of $\text{Fe}(\text{CO})_5$ from Fe.
- (b) Liberation of H_2 from steam by iron at high temperature.
- (c) Rusting of iron sheets.
- (d) Decolorization of blue CuSO_4 solution by iron.

Q.8. The oxidation state of Cr in $\text{Cr}(\text{CO})_6$ is

- (a) 0 (b) 2 (c) 2 (d) 6

Q.9. Which of the following processes does not involve either oxidation or reduction?

- (a) Formation of slaked lime from quick lime
- (b) Heating Mercuric Oxide
- (c) Formation of Manganese Chloride from Manganese oxide
- (d) Formation of Zinc from Zinc blende

- Q.10. The oxidation number of Cl in Cl_2O_7 is
 (a) + 7 (b) + 5 (c) + 3 (d) - 7
- Q.11. A metal ion M^{3+} loses 3 electrons, its oxidation number will be
 (a) +3 (b) +6 (c) 0 (d) -3
- Q.12. The oxidation number of Sulphur in $\text{Na}_2\text{S}_4\text{O}_6$ is
 (a) 1.5 (b) 2.5 (c) 3 (d) 2
- Q.13. In oxygen di fluoride the oxidation number of oxygen is
 (a) -2 (b) -1 (c) +2 (d) +1, -2
- Q.14. Which of the following is a redox reaction?
 (a) $\text{NaCl} + \text{KNO}_3 \rightarrow \text{NaNO}_3 + \text{KCl}$
 (b) $\text{CaC}_2\text{O}_4 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{C}_2\text{O}_4$
 (c) $\text{Mg}(\text{OH})_2 + 2\text{NH}_4\text{Cl} \rightarrow \text{MgCl}_2 + 2\text{NH}_4\text{OH}$
 (d) $\text{Zn} + 2\text{AgCN} \rightarrow 2\text{Ag} + \text{Zn}(\text{CN})_2$
- Q.15. Which reaction is not feasible?
 (a) $2\text{KI} + \text{Br}_2 \rightarrow 2\text{KBr} + \text{I}_2$
 (b) $2\text{KBr} + \text{I}_2 \rightarrow 2\text{KI} + \text{Br}_2$
 (c) $2\text{KBr} + \text{Cl}_2 \rightarrow 2\text{KCl} + \text{Br}_2$
 (d) $2\text{H}_2\text{O} + 2\text{F}_2 \rightarrow 4\text{HF} + \text{O}_2$
- Q.16. 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?
 (a) The oxidation number of hydrogen is always +1.
 (b) The algebraic sum of all the oxidation numbers in a compound is zero.
 (c) An element in the free or the uncombined state bears oxidation number zero.
 (d) In all its compounds, the oxidation number of fluorine is -1.
- Q.17. The largest oxidation number exhibited by an element depends on its outer electronic configuration. With which of the following outer electronic configurations the element will exhibit largest oxidation number?
 (a) $3d^1 4s^2$ (b) $3d^2 4s^2$ (c) $3d^5 4s^1$ (d) $3d^5 4s^2$
- Q.18. Which of the following elements does not show disproportionation tendency?
 (a) Cl (b) Br (c) F (d) I
- Q.19. What is known as Autooxidation?
 (a) Formation of H_2O by the oxidation of H_2O_2 .
 (b) Formation of H_2O_2 by the oxidation of H_2O .
 (c) Both (1) and (2) are true
 (d) None of the above
- Q.20. The tendency of an electrode to lose electrons is known as
 (a) Electrode Potential (b) Reduction Potential
 (c) Oxidation Potential (d) E.M.F.
- Q.21. What is n-factor?
 (a) Equal to product of Number of moles of electrons when Lost or gained by one mole of reductant or oxidant
 (b) When Number of moles of electrons Lost or gained by one mole of reductant or oxidant is not same.
 (c) Equal to Number of moles of electrons Lost or gained by one mole of reductant or oxidant
 (d) None of the above

Q.22. Oxidation numbers of P in PO_4^{3-} , of S in SO_4^{2-} and that of Cr in $\text{Cr}_2\text{O}_7^{2-}$ are respectively

- (a) +3, +6 and +5 (b) +5, +3 and +6
(c) -3, +6 and +6 (d) +5, +6 and +6

Q.23. Oxidation state of Fe in Fe_3O_4 is

- (a) $5/4$ (b) $4/5$ (c) $3/2$ (d) $8/3$

Q.24. The oxide, which cannot act as a reducing agent is

- (a) CO_2 (b) ClO_2 (c) NO_2 (d) SO_2

Q.25. For the feasibility of redox reaction in a cell, the e.m.f. should be

- (a) Positive (b) Fixed (c) Zero (d) Negative.

ASSERTION AND REASON TYPE QUESTION

Read the assertion and reason carefully to mark the correct option out of the options given below:

(A). If both assertion and reason are true and the reason is the correct explanation of the assertion.

(B). If both assertion and reason are true but reason is not the correct explanation of the assertion.

(C). If assertion is true but reason is false.

(D). If assertion is false but reason is true.

(E). If the assertion and reason both are false.

Q.26. Assertion: Fluorine exists only in -1 oxidation state.

Reason: Fluorine has $2s^2 2p^5$ configuration.

Q.27. Assertion: Redox reactions are called neutralization reactions.

Reason: the number of electrons gained or lost in the reaction are balanced.

Q.28. Assertion: HClO_4 is a stronger acid than HClO_3 .

Reason: Oxidation state of Cl in HClO_4 is +VII and in HClO_3 is +V.

Q.29. Assertion: In a reaction $\text{Zn(s)} + \text{CuSO}_4(\text{aq}) \rightarrow \text{ZnSO}_4(\text{aq}) + \text{Cu(s)}$,

Zn is a reductant but itself get oxidized.

Reason: In a redox reaction, oxidant is reduced by accepting electrons and reductant is oxidized by losing electrons.

Q.30. Assertion: oxidation number of phosphorus in P_4 is zero.

Reason: Phosphorus has Oxidation State zero in all its compounds.

Q.31. Assertion: Oxidation number of carbon in CH_2O is zero.

Reason: CH_2O formaldehyde, is a covalent compound.

Q.32. Assertion: The oxidation numbers are artificial, they are useful as a "book-keeping" device of electrons in reactions.

Reason: The oxidation numbers do not usually represent real charges on atoms, they are simply conventions that indicate what the maximum charge could possibly be on an atom in a molecule.

Q.33. Assertion: oxygen has Oxidation state of -2 in both O_2 and O_3 .

Reason: oxygen is assigned and Oxidation State of -2 in almost all its compounds.

Q.34. Assertion: H_2SO_4 cannot act as reducing agent.

Reason: Sulphur cannot increase its oxidation number beyond + 6.

Q.35. Assertion: Oxidation involves loss of electrons and reduction involves gain of electrons.

Reason: The overall reaction in which oxidation and reduction occurs simultaneously is called redox reaction.

Q.36. Assertion: copper sulphate solution is not stored in zinc vessel.

Reason: zinc forms Complex with copper sulphate.

Q.37. Assertion: a substance which gets reduced can act as reducing agent.

Reason: oxidizing agent itself gets oxidized.

Q.38. Assertion (A): The decomposition of hydrogen peroxide to form water and oxygen is an example of disproportionation reaction.

Reason (R): The oxygen of peroxide is in -1 oxidation state and it is converted to zero oxidation state in O_2 and -2 oxidation state in H_2O .

Q.39. Assertion (A): Among halogens fluorine is the best oxidant.

Reason (R): Fluorine is the most electronegative atom.

Q.40. Assertion (A): In the reaction between potassium permanganate and potassium iodide, (acidic medium) permanganate ions act as oxidizing agent.

Reason (R): Oxidation state of manganese changes from $+2$ to $+7$ during the reaction.

CASE-BASED/PASSAGE-BASED INTEGRATED QUESTIONS

I. Read the given passage and answer the questions that follow: (QUESTION 41-45)

Redox reactions are reactions in which oxidation and reduction takes place simultaneously. Oxidation number 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.

Q.41. What are oxidation number of each individual Br in Br_3O_8 ?

Q.42. If electrolysis of CuSO_4 solution is carried out using Cu electrodes, what will be reaction taking place at anode.

Q.43. What is oxidation number of Cr in CrO_5 ?

Q.44. Give one example of disproportionation reaction.

Q.45. $\text{MnO}_4^{2-} + \text{H}^+ \rightarrow \text{MnO}_4^- + \text{MnO}_2 + \text{H}_2\text{O}$ [Balance this reaction]

II. Read the following passage and answer the questions that follow:(QUESTION 46-50)

Redox reactions are important class of reactions which are taking place in our daily life.

Metals are good

reducing agents because they can lose electrons easily whereas non-metals are good oxidizing agents which can gain electrons easily. In electrolytic cells, electricity is passed to bring about redox reaction. All rechargeable batteries act as electrolytic cells while recharging. Electrochemical cells produce electricity as a result of redox reaction. Salt bridge is used in electrochemical cell to complete internal circuit and prevents accumulation of charges.

Q.46. What is electrochemical cell?

Q.47. Give one example of rechargeable cells widely used in vehicles.

Q.48. Highly reactive metals are obtained by electrolysis of their molten ores, why?

Q.49. What is direction of flow of current and electrons?

Q.50. What is standard electrode potential?

ANSWER KEY

Answer 1: (d) Oxidation of Cu atoms.

Explanation:

When copper turnings are added to silver nitrate solution, the solution becomes brown in color after sometime because copper is more reactive than silver so it displaces silver from silver nitrate solution and form copper nitrate solution.

Answer 2: (a) Increase in oxidation number

Explanation:

Oxidation process Involves:-

Addition of O₂ or electronegative element

Removal of H/electropositive element

Loss of electrons

Increase in oxidation number

Answer 3: (d) KMnO₄.

Explanation:

The electronic configuration of Mn is:

Mn(25) = [Ar]3d⁵ 4s², 4p⁰

In excited state, it can lose its all 7 electrons.

Hence, maximum oxidation state exhibited by Mn is +7 which is in KMnO₄.

Answer 4: (d) 50 mL of 0.1 M C₂H₂O₄

Explanation:

$2\text{MnO}_4^- + 5\text{C}_2\text{O}_4^{2-} + 16\text{H}^+ \rightarrow 2\text{Mn}^{2+} + 10\text{CO}_2 + 8\text{H}_2\text{O}$

Therefore, 2 moles of MnO₄⁻ equivalent to 5 moles of C₂O₄²⁻

20 mL of 0.1 M KMnO₄ = 2 moles of KMnO₄

Also, 50 mL of 0.1 M C₂H₂O₄ equivalent to 5 mol of C₂O₄²⁻

Therefore, these are equivalent.

Answer 5: (c) CrO₂⁴⁻ → Cr₂O₇²⁻

Explanation:

In VO₂⁺ → V₂O₃, V is reduced from +4 to +3 oxidation state.

In Na → Na₂⁺, Na is oxidised from 0 to +1 oxidation state.

In CrO₄²⁻ → Cr₂O₇²⁻, Cr remains in same oxidation state +6.

In Zn²⁺ → Zn, Zn is reduced from +2 to 0 oxidation state.

Answer 6: (b) Two

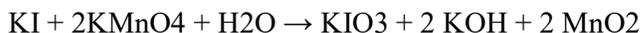
Explanation:

In alkaline medium the reduction of KMnO₄ with KI will takes place as

$2\text{KMnO}_4 + \text{H}_2\text{O} \rightarrow 2\text{KOH} + 2\text{MnO}_2$

$\text{KI} + 3[\text{O}] \rightarrow \text{KIO}_3$

Hence the overall reaction is



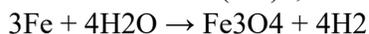
So, one mole of KI will reduced two moles of KMnO₄

Answer 7: (a) Formation of Fe(CO)₅ from Fe.

Explanation:

Oxidation number of Fe in Fe(CO)₅ is zero.

In both Fe and Fe(CO)₅, the oxidation state of iron is zero.

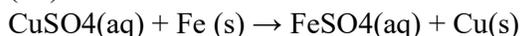


team

rusting



(+3)



(0) (+2)

Answer 8: (a) 0

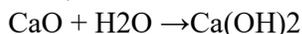
Explanation:

CO (carbonyl) is a neutral ligand, hence oxidation state of Cr in Cr (CO)₆ is zero

Answer 9: (a) Formation of slaked lime from quick lime

Explanation:

Here, in this reaction



Oxidation number doesn't change so its not a redox reaction.

Answer 10: (a) + 7

Explanation:

Cl show different oxidation state as -1 to +7 due to vacant d orbital. As oxygen is more electronegative than Cl. Oxygen size is small hence its more electronegative and show -2 oxidation states.

Here Cl₂O₇ then equation is: $2x + 7 \times (-2) = 0$

$x = +7$ hence oxidation state of Cl is +7. I think you get your answer how to find oxidation state.

Answer 11 : B

M³⁺ on losing 3 elections will become M⁶⁺ and O.N = + 6.

Answer 12: B

Na₂S₄O₆ Let O.N. of S be x then $2 \times (+1) + 4 \times (x) + 6 \times (2)$

= 0 $x = 2.5$. By chemical bonding method the two S. atoms have O.N. + 5 and two S.

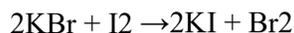
Atoms have O.N. zero

Answer 13: C

Let oxidation state of oxygen in OF₂ = $xx + (1 \times 2) = 0x = +2$

Answer 14: D

Answer 15: B



Reaction is not possible because Br⁻ ion is not oxidised in Br₂, with I₂, due to higher Electrode (oxidation) potential of I₂ than bromine

Answer 16: (a) Oxidation number of hydrogen is -1 in metal hydrides like NaH.

Answer 17: (d) Highest O.N. of any transition element = $(n - 1)d$ electrons + ns electrons.

Therefore, larger the number of electrons in the 3d orbitals, higher is the maximum O.N.

- (a) $3d^1 4s^2 = 3$; ‘
 (b) $3d^2 4s^2 = 3 + 2 = 5$;
 (c) $3d^5 4s^1 = 5 + 1 = 6$
 (d) $3d^5 4s^2 = 5 + 2 = 7$

Answer 18: (c) Being the most electronegative element, F can only be reduced and hence it always shows an oxidation number of -1. Further, due to the absence of d-orbitals, it cannot be oxidized and hence it does not show +ve oxidation numbers. In other words, F cannot be simultaneously oxidized as well as reduced and hence does not show disproportionation reactions. Thus, option (c) is correct.

Answer 19 : (b) Formation of H_2O_2 by the oxidation of H_2O .

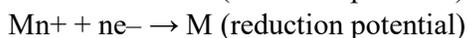
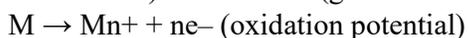
Explanation:

Autoxidation is any oxidation that occurs in presence of oxygen. The term is usually used to describe the degradation of organic compounds in air (as a source of oxygen). Autoxidation produces hydroperoxides and cyclic organic peroxides. These species can react further to form many products. The process is relevant to many phenomena including aging, paint, and spoilage of foods, degradation of petrochemicals, and the industrial production of chemicals. Autoxidation is important because it is a useful reaction for converting compounds to oxygenated derivatives, and also because it occurs in situations where it is not desired (as in the destructive cracking of the rubber in automobile tires or in rancidification). Water automatically gets oxidised to hydrogen peroxide.

Answer 20.: (c) Oxidation Potential

Explanation:

The magnitude of the electrode potential of a metal is a measure of its relative tendency to lose or gain electrons. i.e., it is a measure of the relative tendency to undergo oxidation (loss of electrons) or reduction (gain of electrons).



Answer 21: (c) Equal to Number of moles of electrons Lost or gained by one mole of reductant or oxidant.

Explanation:

For redox reaction it is considered as change in their oxidation number or change in their reduction number in both side of a chemical reaction.

Answer 22. D

Answer 23. D

Answer 24. A

Answer 25. A

Answer 26. B

Answer 27. D

Answer 28. B

Answer 29. A

Answer 30. C

Answer 31. B

Answer 32. A

Answer 33. D

Answer 34. A

Answer 35. A

Answer 36. C

Answer 37. E

Answer 38. A

Answer 39. B

Answer 40. C

Ans 41. +6, +4, +6

Ans 42. $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$

Ans 43. +6 . It has peroxide linkage.

Ans 44. $2\text{Cu}^+ \rightarrow \text{Cu}^{2+} + \text{Cu}$

Ans 45. $3\text{MnO}_4^{2-} + 4\text{H}^+ \rightarrow 2\text{MnO}_4^- + \text{MnO}_2 + 2\text{H}_2\text{O}$

Ans 46. The cell in which chemical energy of redox reaction is converted into electrical energy.

Ans 47. Lead storage battery.

Ans 48. It is because these metals are good reducing agents, cannot be obtained by chemical reduction.

Ans 49. Electrons flow from anode to cathode whereas current flows from cathode to anode.

Ans 50. When concentration of each species is unity, any gas involved is at 1 bar, temperature is 298 K, the potential of electrode is called standard electrode potential measured with respect to standard hydrogen electrode.

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TERM -II

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CHAPTER : STATES OF MATTER

MULTIPLE CHOICE QUESTIONS

1. A container with a pin-hole contains equal moles of $\text{H}_{2(g)}$ and $\text{O}_{2(g)}$. Find the fraction of oxygen gas escaped at the same time when one-fourth of hydrogen gas escapes

- (a) 1/16
- (b) 1/4
- (c) 1/2
- (d) 1/8

2. What are the conditions for gas like Carbon monoxide to obey the ideal gas laws?

- (a) low temperature and low pressure
- (b) low temperature and high pressure
- (c) high temperature and low pressure
- (d) High temperature and high pressure

3. The state of matter that shows the uniformity of Behaviour:

- (a) Solid Liquid
- (b) Liquid
- (c) Gas
- (d) None of the Above

4. The value of universal gas constant R depends on

- (a) Temperature of Gas
- (b) Volume of Gas
- (c) Number of Moles of Gas
- (d) Units of Volume, Temperature and Pressure

5. Which of the following statement is wrong for gases?

- (a) Gases do not have definite shape and volume
- (b) Volume of the gas is equal to the volume of the container confining the gas
- (c) Confined gas exert uniform pressure on the wall of the container in all directions
- (d) Mass of the gas cannot be determined by weighing a container in which it is contained

6. The volume of 2.8 g of carbon monoxide at 27°C and 0.0821 atm is

- (a) 30 L
- (b) 3 L
- (c) 0.3 L
- (d) 1.5 L

7. How many of the know elements exist as gases at 25°C?
- (a) 9
 - (b) 11
 - (c) 12
 - (d) 15
8. The rise or fall of a liquid within a tube of small bore is called:
- (a) Surface Tension
 - (b) Capillary Action
 - (c) Viscosity
 - (d) Formation of Curvature
9. The law, which states that at constant temperature, the volume of a given mass of gas is inversely proportional is pressure, is known as:
- (a) Boyles law
 - (b) Charles law
 - (c) Combine gas law
 - (d) Avogadro's law
10. When you heat a sample of gas, what happens to the particles that make up the gas?
- (a) The particles move faster.
 - (b) The particles break apart
 - (c) The particles get smaller
 - (d) The particles become more dense
11. A person living in Shimla observed that cooking food without using pressure cooker takes more time. The reason for this observation is that at high altitude:
- (a) pressure increases
 - (b) temperature decreases
 - (c) pressure decreases
 - (d) temperature increases
12. Which of the following property of water can be used to explain the spherical shape of rain droplets?
- (a) viscosity
 - (b) surface tension
 - (c) critical phenomena
 - (d) pressure
13. The interaction energy of London force is inversely proportional to sixth power of the distance between two interacting particles but their magnitude depends upon
- (a) charge of interacting particles
 - (b) mass of interacting particles
 - (c) Polarisability of interacting particles
 - (d) strength of permanent dipoles in the particles.
14. Dipole-dipole forces act between the molecules possessing permanent dipole. Ends of dipoles possess 'partial charges'. The partial charge is
- (a) more than unit electronic charge
 - (b) equal to unit electronic charge
 - (c) less than unit electronic charge
 - (d) double the unit electronic charge

15. The pressure of a 1:4 mixture of dihydrogen and dioxygen enclosed in a vessel is one atmosphere. What would be the partial pressure of dioxygen?
- 0.8×10^5 atm
 - 0.008 Nm^{-2}
 - $8 \times 10^4 \text{ Nm}^{-2}$
 - 0.25 atm
16. As the temperature increases, average kinetic energy of molecules increases. What would be the effect of increase of temperature on pressure provided the volume is constant?
- increases
 - decreases
 - remains same
 - becomes half

17. Gases possess characteristic critical temperature which depends upon the magnitude of intermolecular forces between the particles. Following are the critical temperatures of some gases.

Gases	H ₂	He	O ₂	N ₂
Critical temperature in Kelvin	33.2	5.3	154.3	126

From the above data what would be the order of liquefaction of these gases? Start writing the order from the gas liquefying first

- H₂, He, O₂, N₂
 - He, O₂, H₂, N₂
 - N₂, O₂, He, H₂
 - O₂, N₂, H₂, He
18. What is SI unit of viscosity coefficient (η)?
- Pascal
 - Nsm^{-2}
 - $\text{km}^{-2} \text{ s}$
 - N m^{-2}

19. Atmospheric pressures recorded in different cities are as follows:

cities	Shimla	Bangalore	Delhi	Mumbai
P in N/m ²	1.01×10^5	1.2×10^5	1.02×10^5	1.21×10^5

Consider the above data and mark the place at which liquid will boil first.

- Shimla
 - Bangalore
 - Delhi
 - Mumbai
20. Increase in kinetic energy can overcome intermolecular forces of attraction. How will the viscosity of liquid be affected by the increase in temperature?
- Increase
 - No effect
 - Decrease
 - No regular pattern will be followed

21. How does the surface tension of a liquid vary with increase in temperature?
- (a) Remains same
 - (b) Decreases
 - (c) Increases
 - (d) No regular pattern is followed
22. With regard to the gaseous state of matter which of the following statements are correct?
- (a) Complete order of molecules
 - (b) Complete disorder of molecules
 - (c) regular motion of molecules
 - (d) Fixed position of molecules
23. Which of the following figures does represent 1 mole of dioxygen gas at STP?
- (a) 16 grams of gas
 - (b) 22.7 litres of gas
 - (c) 3.011×10^{23} dioxygen molecules
 - (d) 11.2 litres of gas
24. Under which of the following two conditions applied together, a gas deviates most from the ideal behaviour?
- (i) Low pressure
 - (ii) High pressure
 - (iii) Low temperature
 - (iv) High temperature
- a) I and ii b) ii and iii c) iii and iv d) i and iv
25. Which of the following changes decrease the vapour pressure of water kept in a sealed vessel?
- (a) Decreasing the quantity of water
 - (b) Adding salt to water
 - (c) Decreasing the volume of the vessel to one-half
 - (d) increasing the temperature of water
26. If 1 gram of each of the following gases are taken at STP, which of the gases will occupy greatest volume ?
- (a) CO
 - (b) H₂O
 - (c) CH₄
 - (d) NO
27. A gas would be most likely to obey the ideal gas law at
- (a) Low T and high P
 - (b) High T and high P
 - (c) Low T and low P
 - (d) High T and low P
28. If P is the pressure and d is the density of gas, then P and d are related as:
- (a) $P \propto 1/d$
 - (b) $P \propto d$
 - (c) $P \propto d^2$
 - (d) $P \propto 1/d^2$

29. A gas can be liquefied
(a) above its critical temperature (b) at its critical temperature
(c) below its critical temperature (d) at any temperature
30. Which of the following gas is expected to have highest value of Van der Waal's constant 'a'
(a) NH₃ (b) H₂ (c) N₂ (d) He
31. The compressibility factor (Z) for an ideal gas is:
(a) 1.5 (b) 1.0 (c) 2.0 (d) zero
32. Two separate bulbs contain ideal gas A and B. The density of A is twice that of B. The molecular mass of A is half that of B. If the two gases are at the same temperature, the ratio of pressure of A to that of B is:
(a) 2 (b) 1/2 (c) 4 (d) 1/4
33. At which temperature the volume of a gas is expected to be zero.
(a) 0 °C (b) 273 K (c) -273°C (d) 273°C
34. Dominance of strong attractive forces among the molecules of the gas:
(a) Depends on Z and indicates that Z=1
(b) Depends on Z and indicates that Z >1
(c) Depends on Z and indicates that Z < 1
(d) Is independent of Z
35. Which of the following properties of liquid increases on increasing temperature:
(a) Vapour pressure (b) Viscosity
(c) Surface tension (d) Boiling Point

ASSERTION AND REASON TYPE QUESTION

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.

36 . Assertion (A): Three states of matter are the result of balance between intermolecular forces and thermal energy of the molecules.

Reason (R): Intermolecular forces tend to keep the molecules together but thermal energy of molecules tends to keep them apart.

- (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.

37. Assertion (A): At constant temperature, pV vs V plot for real gases is not a straight line.

Reason (R) : At high pressure all gases have $Z > 1$ but at intermediate pressure most gases have $Z < 1$.

- (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.

38 . Assertion (A): The temperature at which vapour pressure of a liquid is equal to the external pressure is called boiling temperature.

Reason (R) : At high altitude atmospheric pressure is high.

- (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.

39 . Assertion (A): Gases do not liquefy above their critical temperature, even on applying high pressure.

Reason (R) : Above critical temperature, the molecular speed is high and intermolecular attractions cannot hold the molecules together because they escape because of high speed.

- (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.

40. Assertion (A): At critical temperature liquid passes into gaseous state imperceptibly and continuously.

Reason (R) : The density of liquid and gaseous phase is equal to critical temperature.

- (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.

41. Assertion (A): Liquids tend to have maximum number of molecules at their surface.

Reason (R) : Small liquid drops have spherical shape.

- (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.

CASE STUDY

The bends, also known as decompression sickness (DCS) or Caisson disease, occurs in scuba divers or high altitude or aerospace events when dissolved gases (mainly nitrogen) come out of solution in bubbles and can affect just about anybody area including joints, lung, heart, skin and brain.

Decompression sickness (DCS) is caused by the formation of bubbles of GAS that occur with changes in pressure during scuba diving. It is also experienced in commercial divers who breathe heliox (a special mixture of oxygen and helium), and astronauts and aviators who experience rapid changes in pressure from sea level. Scuba diving will be the focus of this article, as it is the most common activity that may result in the bends.

Nitrogen or any gas from a diver's air tank increases in pressure as a diver descends. For every 33 [feet](#) in ocean water, the pressure due to nitrogen goes up another 11.6 pounds per square inch. As the pressure due to nitrogen increases, more nitrogen dissolves into the tissues. The longer a diver remains at depth, the more nitrogen dissolves. Unlike the oxygen in the air tank a diver uses to swim underwater, the nitrogen gas is not utilized by the body and builds up over time in body tissues. The underlying cause of symptoms throughout the body is due mainly to nitrogen bubbles being released when the diver returns to sea level and blocking blood flow and disrupting blood vessels and nerves by stretching or tearing them. They may also cause [emboli](#), blood coagulation and the release of vasoactive compounds.

A clear example to illustrate this bubble formation process is that of a bottle of carbonated soda. A bottle of carbonated soda is filled with gas (carbon dioxide), which cannot be seen because it is dissolved in solution under pressure. When the bottle is opened, the pressure is released and the gas leaves the solution in the form of bubbles. A diver returning to the surface is similar to opening the bottle of soda. As a diver swims to the surface, the pressure decreases. The nitrogen, which has dissolved in tissues, wants again to leave, because the body can hold only a certain amount based on that nitrogen pressure. If a diver surfaces too fast, the excess nitrogen will come out rapidly as gas bubbles. Depending on which organs are involved, these bubbles produce the symptoms of decompression sickness.

42. Scuba divers feels bending in deep waters because—

- a) Nitrogen gas get dissolve in the blood due to pressure
- b) Sea water is not good for divers
- c) Oxygen gas dissolve less in sea water
- d) Excess salt water get help in respiration

43. Dissolving of a gas depends on –

- a) Molecular mass of the gas
- b) Pressure on the gas
- c) Temperature applied
- d) All of above

44. It is not easy to cook food on high altitudes because-
- a) Vapour pressure of water get decrease
 - b) Vapour pressure of water get increase
 - c) Atmosphere pressure get increase
 - d) None
45. An old person feels good in the early morning
- a) Morning is good for sleeping
 - b) Dissolving of oxygen is better in blood during morning
 - c) Food get digested easily in morning
 - d) In morning he can feel the nature
46. Fish found in cold oceans in abundance
- a) It is easy to breathe in cold water
 - b) Fish likes cold water
 - c) Cold water contain good amount of oxygen
 - d) There are less chances to get caught in cold water
47. carbonated water /soft drinks used to drinks cold because
- a) Cold soda water contains less pollutants
 - b) Cold soda water get dissolved CO₂ easily in it.
 - c) Cold soda water is easy to drink
 - d) Cold soda water is tasty
48. We use pressure cooker for cooking ---
- a) It is cheap
 - b) It increase the boiling point of water.
 - c) It decrease the boiling point of water
 - d) It cooked food is delicious

49. Mountaineers use to carry oxygen cylinders with them while climbing on a mountain –

- a) It helps in climbing
- b) Due to low pressure of air
- c) To increase weight on high altitudes
- d) It is an exercise for mountaineers

50. Divers feels high weight on their body when they dive deeper in sea –

- a) Water is very heavy
- b) Due to pressure exerted by water
- c) due to oxygen cylinder
- d) due to sea currents

51. Water can boil at ----- 0C

- a) 50
- b) 100
- c) 80
- d) all

ANSWER KEY

1. a

2. c

3. c

4. d

5. (d) Mass of the gas cannot be determined by weighing a container in which it is contained

Explanation:

Mass of the gas = mass of the cylinder including gas – mass of empty cylinder. So mass of a gas can be determined by weighing the container in which it is enclosed. Thus, the statement (d) is wrong for gases.

6. (b) 3 L

Explanation:

According to the ideal gas equation, we have

$$PV = nRT$$

$$PV = (w/M) RT$$

$$V = (w/M) \times (RT/P)$$

Given values are:

$$w = 2.8 \text{ g}$$

$$M = \text{Molar mass of CO} = 28 \text{ g mol}^{-1}$$

$$T = 27^\circ\text{C} = (273 + 27) = 300 \text{ K}$$

$$P = 0.821 \text{ atm}$$

$$R = 0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1}$$

Putting the values in the formula we get :

$$V = (2.8 \text{ g} / 28 \text{ g mol}^{-1}) \times (0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1}) \times (300 \text{ K}) / (0.821 \text{ atm})$$

$$= 3 \text{ L}$$

7. b

8. b

9. a

10. a

11. c

12. b

13. c

14. c

15. C $8 \times 10^4 \text{ N m}^{-2}$

$$p_{\text{O}_2} = x_{\text{O}_2} \times P_{\text{total}}$$

$$\text{Given: } P_{\text{total}} = 1 \text{ atm}, x_{\text{O}_2} = 54$$

$$\begin{aligned} p_{O_2} &= 54 \times 1 = 0.8 \text{ atm} \\ (\because 1 \text{ atm} &= 1.01325 \times 10^5 \text{ Pa or N m}^{-2}) \\ &= 0.8 \times 10^5 \text{ N m}^{-2} = 8 \times 10^4 \text{ N m}^{-2}. \end{aligned}$$

- 16. a
- 17. d
- 18. b
- 19. a
- 20. c
- 21. b
- 22. b
- 23. b
- 24. b
- 25. b
- 26. a
- 27. d
- 28. b
- 29. c
- 30. b
- 31. c
- 32. c
- 33. c
- 34. c
- 35. a
- 36. a
- 37. b
- 38. c
- 39. a
- 40. a
- 41. d
- 42. a
- 43. d
- 44. a

45.b

46. a

47. b

48.b

49.b

50. b

51. d

PREPARED BY: KULDEEP KUMAR

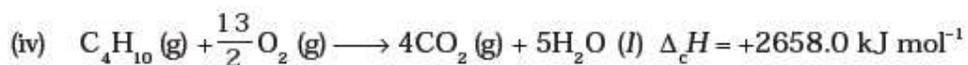
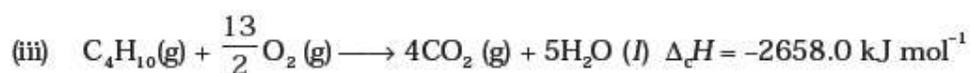
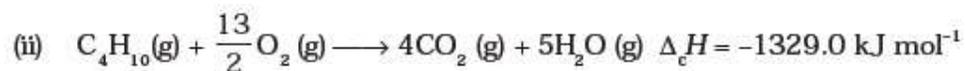
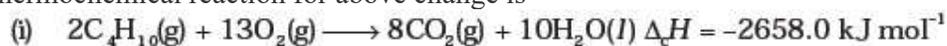
PGT CHEMISTRY

KV DBN SHIKAR

CHAPTER- CHEMICAL THERMODYNAMICS

MULTIPLE CHOICE QUESTIONS

- Thermodynamics is not concerned about _____.
 - (i) energy changes involved in a chemical reaction.
 - (ii) the extent to which a chemical reaction proceeds.
 - (iii) the rate at which a reaction proceeds.
 - (iv) the feasibility of a chemical reaction.
- Which of the following statements is correct?
 - (i) The presence of reacting species in a covered beaker is an example of open system.
 - (ii) There is an exchange of energy as well as matter between the system and the surroundings in a closed system.
 - (iii) The presence of reactants in a closed vessel made up of copper is an example of a closed system.
 - (iv) The presence of reactants in a thermos flask or any other closed insulated vessel is an example of a closed system.
- The state of a gas can be described by quoting the relationship between _____.
 - (i) pressure, volume, temperature
 - (ii) temperature, amount, pressure
 - (iii) amount, volume, temperature
 - (iv) pressure, volume, temperature, amount
- The volume of gas is reduced to half from its original volume. The specific heat will be _____.
 - (i) reduce to half
 - (ii) be doubled
 - (iii) remain constant
 - (iv) increase four times
- During complete combustion of one mole of butane, 2658 kJ of heat is released. The thermochemical reaction for above change is



6. $\Delta_f U^\ominus$ of formation of $\text{CH}_4(\text{g})$ at certain temperature is -393 kJ mol^{-1} . The value of $\Delta_f H^\ominus$ is

- (i) zero (ii) $< \Delta_f U^\ominus$
- (iii) $> \Delta_f U^\ominus$ (iv) equal to $\Delta_f U^\ominus$

7. 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.

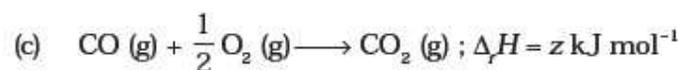
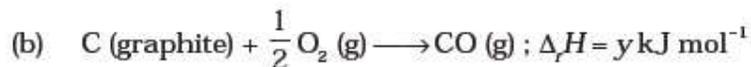
- (i) $q = 0, \Delta T \neq 0, w = 0$ (ii) $q \neq 0, \Delta T = 0, w = 0$
- (iii) $q = 0, \Delta T = 0, w = 0$ (iv) $q = 0, \Delta T < 0, w \neq 0$

8. The entropy change can be calculated by using the expression $\Delta S = (q_{\text{rev}}/T)$.

When water freezes in a glass beaker, choose the correct statement amongst the following :

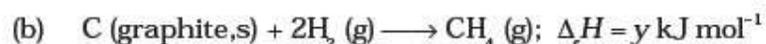
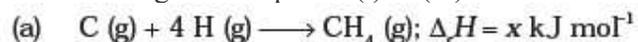
- (i) ΔS (system) decreases but ΔS (surroundings) remains the same.
- (ii) ΔS (system) increases but ΔS (surroundings) decreases.
- (iii) ΔS (system) decreases but ΔS (surroundings) increases.
- (iv) ΔS (system) decreases and ΔS (surroundings) also decreases.

9. 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.



- (i) $z = x + y$ (ii) $x = y - z$
- (iii) $x = y + z$ (iv) $y = 2z - x$

10. Consider the reactions given below. On the basis of these reactions find out which of the algebraic relations given in options (i) to (iv) is correct?



- (i) $x = y$ (ii) $x = 2y$
- (iii) $x > y$ (iv) $x < y$

11. The enthalpies of elements in their standard states are taken as zero. The enthalpy of formation of a compound

- (i) is always negative
- (ii) is always positive
- (iii) may be positive or negative
- (iv) is never negative

12. Enthalpy of sublimation of a substance is equal to

- (i) enthalpy of fusion + enthalpy of vapourisation
- (ii) enthalpy of fusion
- (iii) enthalpy of vapourisation
- (iv) twice the enthalpy of vapourisation

13. Which of the following is not correct?

- (i) ΔG is zero for a reversible reaction
- (ii) ΔG is positive for a spontaneous reaction
- (iii) ΔG is negative for a spontaneous reaction
- (iv) ΔG is positive for a non-spontaneous reaction

14. Which one of the following thermodynamic quantities is not a state function?

- (i) Gibbs free energy (ii) Enthalpy
(iii) Entropy (iv) Work

15. All of the following have a standard heat of formation value of zero at 25°C and 1.0 atm except:

- (i) $N_2(g)$ (ii) $Fe(s)$
(iii) $Ne(g)$ (iv) $H_2(g)$

16. Which statement is true for reaction? $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$

- (i) $S = +ve$ (ii) $H > U$
(iii) $H < U$ (iv) $H = U$

17. The heat of combustion of yellow phosphorous is -9.91 KJ and the red phosphorous is -8.78 KJ. The heat of transition of yellow phosphorous to red phosphorous is :

- (i) -9.91 kJ (ii) -8.78 kJ
(iii) -9.34 kJ (iv) -1.13 kJ

18. Entropy of universe is :

- (i) Increasing (ii) decreasing
(iii) Constant (iv) None of these

19. Which is state function?

- (i) q (ii) w
(iii) $q + w$ (iv) None of these

20. According to second law of thermodynamics

- (i) $\Delta S_{\text{total}} = +ve$ (ii) $\Delta S_{\text{total}} = -ve$
(iii) $\Delta S_{\text{system}} = +ve$ (iv) $\Delta S_{\text{system}} = -ve$

21. An adiabatic expansion of an ideal gas always has

- (i) Decrease in temperature (ii) $q = 0$
(iii) $W = 0$ (iv) $\Delta H = 0$.

22. For an endothermic reaction ΔS is positive, the reaction is

- (i) feasible when $T\Delta S > \Delta H$ (ii) feasible when $\Delta H > T\Delta S$
(iii) feasible at all temperature (iv) Not feasible at all

23. In thermodynamics a process is called reversible when

- (i) Surroundings and system change into each other
(ii) There is no boundary between system and surroundings
(iii) The surroundings are always in equilibrium with the system
(iv) The system changes into surroundings spontaneously

24. Which one of the following statement is false?

- (i) Work is a state function
(ii) Temperature is a state function
(iii) Change in the state is completely defined when the initial final states are specified
(iv) Work appears at the boundary of the system

25. Molar heat capacity of water in equilibrium with ice at constant pressure is

- (i) zero (ii) infinity
(iii) $40.45 \text{ kJ K}^{-1} \text{ mol}^{-1}$ (iv) $75.48 \text{ JK}^{-1} \text{ mol}^{-1}$

26. In which of the following process, the process is always non-feasible?

- (i) $\Delta H > 0, \Delta S > 0$ (ii) $\Delta H < 0, \Delta S > 0$
(iii) $\Delta H > 0, \Delta S < 0$ (iv) $\Delta H < 0, \Delta S < 0$

27. Internal energy does not include

- (i) Nuclear energy (ii) Vibrational energy
(iii) Rotational energy (iv) Energy of gravitational pull

28. Enthalpy of $\text{CH}_4 + 12 \text{O}_2 \rightarrow \text{CH}_3\text{OH}$ is negative.

If enthalpy of combustion of CH_4 and CH_3OH are x and y respectively then which reaction is correct?

- (i) $x > y$ (ii) $x < y$
(iii) $x = y$ (iv) $x \geq y$

29. The heat required to raise the temperature of a body by 1 K is called

- (i) Specific heat (ii) Thermal capacity
(iii) Water equivalent (iv) Molar heat capacity

30. In a reaction involving only solids and liquids, which of the following is true?

- (i) $\Delta H < \Delta E$ (ii) $\Delta H = \Delta E$ (iii) $\Delta H > \Delta E$ (iv) $\Delta H = \Delta E + RT\Delta 11$

31. If $K < 1.0$, what will be the value of ΔG° of the following?

- (i) 1.0 (ii) zero (iii) Negative (iv) Positive

32. Change in enthalpy for the reaction $2\text{H}_2\text{O}_2(\text{l}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + \text{O}_2(\text{g})$ if the heat of formation of $\text{H}_2\text{O}_2(\text{l})$ and $\text{H}_2\text{O}(\text{l})$ are -188 kJ mol^{-1} and -283 kJ mol^{-1} . Therefore the heat of formation of CO in kJ mol^{-1} is

- (i) +172.5 (ii) -110.5 (iii) -1070 (iv) -676.5

33. Compounds with high heat of formation are less stable because

- (i) It is difficult to synthesise them
(ii) Energy rich state leads to instability
(iii) High temperature is required to synthesise them
(iv) Molecules of such compounds are distorted

MULTIPLE CHOICE QUESTIONS (TYPE-II)

In the following questions two or more options may be correct.

- Thermodynamics mainly deals with
 - (i) interrelation of various forms of energy and their transformation from one form to another.
 - (ii) energy changes in the processes which depend only on initial and final states of the microscopic systems containing a few molecules.
 - (iii) how and at what rate these energy transformations are carried out.
 - (iv) the system in equilibrium state or moving from one equilibrium state to another equilibrium state.
- In an exothermic reaction, heat is evolved, and system loses heat to the surrounding. For such system
 - (i) q_p will be negative
 - (ii) $\Delta_r H$ will be negative
 - (iii) q_p will be positive
 - (iv) $\Delta_r H$ will be positive
- The spontaneity means, having the potential to proceed without the assistance of external agency. The processes which occur spontaneously are
 - (i) flow of heat from colder to warmer body.
 - (ii) gas in a container contracting into one corner.
 - (iii) gas expanding to fill the available volume.
 - (iv) burning carbon in oxygen to give carbon dioxide.
- For an ideal gas, the work of reversible expansion under isothermal condition can be calculated by using the expression $w = -nRT \ln(V_f/V_i)$
A sample containing 1.0 mol of an ideal gas is expanded isothermally and reversibly to ten times of its original volume, in two separate experiments.
The expansion is carried out at 300 K and at 600 K respectively. Choose the correct option.
 - (i) Work done at 600 K is 20 times the work done at 300 K.
 - (ii) Work done at 300 K is twice the work done at 600 K.
 - (iii) Work done at 600 K is twice the work done at 300 K.
 - (iv) $\Delta U = 0$ in both cases.
- Consider the following reaction between zinc and oxygen and choose the correct options out of the options given below :
 $2 \text{Zn(s)} + \text{O}_2\text{(g)} \longrightarrow 2 \text{ZnO(s)}; \Delta H = -693.8 \text{ kJ mol}^{-1}$
 - (i) The enthalpy of two moles of ZnO is less than the total enthalpy of two moles of Zn and one mole of oxygen by 693.8 kJ.
 - (ii) The enthalpy of two moles of ZnO is more than the total enthalpy of two moles of Zn and one mole of oxygen by 693.8 kJ.
 - (iii) $693.8 \text{ kJ mol}^{-1}$ energy is evolved in the reaction.
 - (iv) $693.8 \text{ kJ mol}^{-1}$ energy is absorbed in the reaction.

ASSERTION AND REASON TYPE QUESTIONS

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 for each question.

- (i) A and R both are correct, and R is correct explanation of A.
- (ii) A and R both are correct, but R is not the correct explanation of A.
- (iii) A is true but R is false.
- (iv) A and R both are false.

1. Assertion (A): Enthalpy of graphite is lower than that of diamond.

Reason (R): Entropy of graphite is greater than that of diamond.

2. Assertion (A): Enthalpy of formation of $\text{H}_2\text{O}(\text{l})$ is greater than that of $\text{H}_2\text{O}(\text{g})$.

Reason (R): Enthalpy change is negative for condensation reaction, $\text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$

3. Assertion (A): ΔH and ΔU are same for the reaction N_2

$(\text{g}) + \text{O}_2$

$(\text{g}) \rightarrow 2\text{NO}(\text{g})$

Reason (R): All the reactants and products are gases.

4. Assertion (A): if both ΔH° and ΔS° are positive than the reaction will be spontaneous at high temperature

Reason (R): All processes with positive entropy change are spontaneous.

5. Assertion (A): Enthalpy of formation of HCl is equal to bond energy of HCl.

Reason (R): Enthalpy of formation and bond energy both involve the formation of one mole of HCl from the elements.

CASE STUDY

Read the following passage and answer the questions given below:

We can measure the transfer of heat from one system to another which causes a change in temperature. The magnitude of change in temperature depends upon the heat capacity of the substance. The enthalpy change of reaction remains the same irrespective of the number of steps is Hess's law. It helps to calculate the enthalpy of formation, combustion, and other enthalpy changes. Enthalpy change can also be calculated by using bond enthalpies. The first law gives the law of conservation of energy but does not give the direction of the reaction. The second law states, the entropy of the universe is continuously increasing due to spontaneous processes taking place in it. ΔH and ΔS (entropy change) cannot decide the spontaneity of the process. We need ΔG (free energy change) which is -ve for spontaneous, +ve for non-spontaneous. $\Delta G = 0$ for the process in equilibrium. ΔG is related to the equilibrium constant. If $\Delta G = -ve$, 'K' is +ve and vice versa. The third law of thermodynamics states the entropy of a perfectly crystalline substance is zero at zero kelvin.

Que (i). We can determine $\Delta H_{\text{lattice}}$ with the help of the cycle. Name the cycle.

Que (ii). How can we calculate the enthalpy of the solution?

Que (iii) What is the molar heat capacity of water in equilibrium with ice at constant pressure?

Que (iv). ΔH_f° of O_3 , CaO , NH_3 , and HI are +142.2, - 643.9, -46, +25.95 $kJ\ mol^{-1}$.

Arrange these in increasing order of stability.

Que (v). Standard entropy of X_2 , Y_2 , and XY_3 are 60, 40, and 50 $JK^{-1}\ mol^{-1}$ respectively.

For the reaction $1/2X_2 + 2/3 Y_2 \rightarrow XY_3$, $\Delta H = -30\ kJ$ to be at what temperature, the process will be at equilibrium.

Que (vi). What are the signs of ΔH and ΔS for the process to be always spontaneous?

Que (vii). Give the mathematical expression for the second law of thermodynamics.

ANSWER KEY

MCQ (Type-I)

Q.No.	Ans	Q.No.	Answer								
1	(iii)	2	(iii)	3	(iv)	4	(iii)	5	(iii)	6	(ii)
7	(iii)	8	(iii)	9	(iii)	10	(ii)	11	(iii)	12	(i)
13	(ii)	14	(iv)	15	(iv)	16	(i)	17	(iv)	18	(iii)
19	(iv)	20	(i)	21	(ii)	22	(ii)	23	(ii)	24	(ii)
25	(ii)	26	(ii)	27	(ii)	28	(ii)	29	(ii)	30	(ii)
31	(ii)	32	(ii)	33	(ii)						

MCQ (Type-II)

Q.No.	Answer	Q.No.	Answer	Q.No.	Answer
1	(i), (iv)	2	(i), (ii)3		(iii), (iv)
4	(iii), (iv)	5	(i), (iii)		

ASSERTION REASON

Ans: 1. (ii) 2. (i) 3. (ii) 4. (iii) 5. (i)

CASE STUDY

Ans (i). The cycle is the Born-Haber cycle.

Ans (ii). $\Delta H^\circ_{\text{solution}} = \Delta H^\circ_{\text{lattice}} + \Delta H^\circ_{\text{hydration}}$.

Ans (iii). ∞ (infinity).

Ans (iv). $\text{O}_3 < \text{HI} < \text{NH}_3 < \text{CaO}$

Ans (v).

Ans (vi). $\Delta H = -\text{ve}$, $\Delta S = +\text{ve}$.

Ans (vii). $\Delta S_{\text{total}} > 0$

CHAPTER EQUILIBRIUM

MULTIPLE CHOICE QUESTIONS

1) Which compound is electron deficient?

- a) CH₄ b) CCl₄ c) BCl₃ d) PCl₅

2) The strongest conjugate base is

- a) SO₄²⁻ b) Cl⁻ c) NO₃⁻ d) CH₃COO⁻

3) Which of the following is not a lewis acid?

- a) SiF₄ b) C₂H₄ c) BF₃ d) FeCl₃

4) In liquid gas equilibrium the pressure of the vapours above the liquid is constant at

- a) Constant Temperature b) Low Temperature c) High Temperature d) None of these

5) A base as defined by bronsted theory, is a substance which can

- a) Accept a Proton
a) Gain a pair of electrons
b) Donate electrons
c) Lose a pair of electrons

6) BF₃ is an acid according to

- a) Arrhenius concept
b) Lewis concept
c) Bronsted lowry concept
d) None of these

7) Which of the following salts will give highest PH in water?

- a) KCl. b) NaCl. c) Na₂CO₃
d) CuSO₄

8) Conjugate base for bronsted Acid H₂O and HF are

- a) H₃O⁺ and HF₂⁺ b) OH⁻ and H₂F⁺ c) H₃O⁺ and F⁻ d) OH⁻ and F⁻

9) Which of the following cannot act both as bronsted acid and as bronsted base?

- a) HCO₃⁻ b) NH₃. c) HCl d) HSO₄⁻

10) Would gaseous HCl be considered as an Arrhenius acid?

- a) No
- b) Yes
- c) Not known
- d) Gaseous HCl does not exist

11) Which one of the following information can be obtained on the basis of Le chatelier principle?

- a) Entropy change in a reaction
- b) Dissociation constant of a weak acid
- c) Equilibrium constant of a chemical reaction
- d) Shift in equilibrium position on changing value of a constraint

12) The reaction quotient Q_c is used to

- a) Calculate equilibrium concentration
- b) Predicting the direction of the reaction
- c) Calculate equilibrium constant
- d) Predict the extent of a reaction on the basis its magnitude

13) If a system is at equilibrium the rate of forward to the reverse reaction is

- a) Equal
- b) Less
- c) High
- d) At equilibrium

14) Which one of the following is not true about the reversible reaction?

- a) Number of moles of reactants and products are not equal
- b) It can be obtained only in a closed container
- c) It cannot be influenced by a catalyst
- d) The reaction doesn't proceed to completion

15) In exothermic reaction lowering of temperature will shift the equilibrium to

- a) Left
- b) Right
- c) Equally in both the directions
- d) None of these

16) A catalystthe energy of activation

- a) Increases
- b) Decreases
- c) Has no effect on
- d) None of these

17) NH_3 is prepared by the reaction $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$. $\Delta H = -21.9 \text{ Kcal}$. The maximum yield of NH_3 is obtained

- a) At high temperature and low pressure
- b) At low temperature and high pressure
- c) At high temperature and high pressure
- d) None of these

18) When high pressure is applied to the following reversible reaction: $\text{N}_2 + \text{O}_2 \rightleftharpoons 2\text{NO}$. The equilibrium will.....

- a) Shifts to forward direction
- b) Shifts to backward direction
- c) No change
- d) Both a and b

19) The value of K_cupon the initial concentration of the reaction

- a) Depends
- b) Does not depend
- c) Partially depends
- d) None of these

20) The degree of ionisation of weak electrolyte is suppressed by the addition of another electrolyte containing a common ion. This phenomenon is called... ..

- a) Solubility product
- b) Common ion effect
- c) Le chatelier principle
- d) None of these

21) We know that the relationship between K_c and K_p is

$$K_p = K_c (RT)^{\Delta n}$$

What would be the value of Δn_g for the reaction



- (a) 1
- (b) 0.5
- (c) 1.5
- (d) 2

22) For the reaction $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI (g)}$, the standard free energy is $\Delta G^\ominus > 0$. The equilibrium constant (K) would be _____.

- (a) $K = 0$
- (b) $K > 1$
- (c) $K = 1$
- (d) $K < 1$

23) Which of the following is not a general characteristic of equilibria involving physical processes?

- (a) Equilibrium is possible only in a closed system at a given temperature.
- (b) All measurable properties of the system remain constant.
- (c) All the physical processes stop at equilibrium.
- (d) The opposing processes occur at the same rate and there is dynamic but stable condition.

24) PCl_5 , PCl_3 and Cl_2 are at equilibrium at 500K in a closed container and their concentrations are $0.8 \times 10^{-3} \text{ mol L}^{-1}$, $1.2 \times 10^{-3} \text{ mol L}^{-1}$ and $1.2 \times 10^{-3} \text{ mol L}^{-1}$ respectively.

The value of K_c for the reaction $\text{PCl}_5 \text{ (g)} \rightleftharpoons \text{PCl}_3 \text{ (g)} + \text{Cl}_2 \text{ (g)}$ will be

- (a) $1.8 \times 10^{-3} \text{ mol L}^{-1}$
- (b) 1.8×10^{-3}
- (c) $1.8 \times 10^{-3} \text{ L mol}^{-1}$
- (d) 0.55×10^4

25) Which of the following statements is incorrect?

- (a) In equilibrium mixture of ice and water kept in perfectly insulated flask mass of ice and water does not change with time.
- (b) The intensity of red colour increases when oxalic acid is added to a solution containing iron (III) nitrate and potassium thiocyanate.
- (c) On addition of catalyst the equilibrium constant value is not affected.
- (d) Equilibrium constant for a reaction with negative ΔH value decreases as the temperature increases.

26) The pH of neutral water at 25°C is 7.0. As the temperature increases, ionisation of water increases, however, the concentration of H^+ ions 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

27) The ionisation constant of an acid, K_a , is the measure of strength of an acid. The K_a values of acetic acid, hypochlorous acid and formic acid are 1.74×10^{-5} , 3.0×10^{-8} and 1.8×10^{-4} respectively. Which of the following orders of pH of 0.1 mol dm^{-3} solutions of these acids is correct?

- a) acetic acid > hypochlorous acid > formic acid
- b) hypochlorous acid > acetic acid > formic acid
- c) formic acid > hypochlorous acid > acetic acid
- d) formic acid > acetic acid > hypochlorous acid

28) K_{a1} , K_{a2} and K_{a3} are the respective ionisation constants for the following reactions.



The correct relationship between K_{a1} , K_{a2} and K_{a3} is

- a) $K_{a3} = K_{a1} \times K_{a2}$
- b) $K_{a3} = K_{a1} + K_{a2}$
- c) $K_{a3} = K_{a1} - K_{a2}$
- d) $K_{a3} = K_{a1} / K_{a2}$

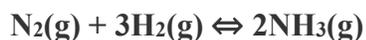
29) What will be the value of pH of 0.01 mol dm^{-3} CH_3COOH ($K_a = 1.74 \times 10^{-5}$)?

- a) 3.4
- b) 3.6
- c) 3.9
- d) 3.0

30) K_a for CH_3COOH is 1.8×10^{-5} and K_b for NH_4OH is 1.8×10^{-5} . The pH of ammonium acetate will be

- a) 7.005
- b) 4.75
- c) 7.0
- d) Between 6 and 7

31) On increasing the pressure, in which direction will the gas phase reaction proceed to re-establish equilibrium, is predicted by applying the Le Chatelier's principle. Consider the reaction.



Which of the following is correct, if the total pressure at which the equilibrium is established, is increased without changing the temperature?

- a) K will remain same
- b) K will decrease
- c) K will increase
- d) K will increase initially and decrease when pressure is very high

32) What will be the correct order of vapour pressure of water, acetone and ether at 30°C . Given that among these compounds, water has maximum boiling point and ether has minimum boiling point?

- a) Water < ether < acetone
- b) Water < acetone < ether
- c) Ether < acetone < water
- d) Acetone < ether < water

33) At 500 K, equilibrium constant, K_c , for the following reaction is 5.



What would be the equilibrium constant K_c for the reaction



- a) 0.04
- b) 0.4
- c) 25
- d) 2.5

34) In which of the following reactions, the equilibrium remains unaffected on addition of small amount of argon at constant volume?

- a) $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$
- b) $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$
- c) $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$
- d) The equilibrium will remain unaffected in all the three cases.

35) The solubility of $\text{Ca}_3(\text{PO}_4)_2$ in water is y mol/L. Its solubility product is:

- (a) $6y^2$
- (b) $36y^4$
- (c) $64y^5$
- (d) $108y^5$

36). What is the pH of a 0.10 M solution of barium hydroxide, $\text{Ba}(\text{OH})_2$?

- a) 11.31
- (b) 11.7
- (c) 13.30
- (d) None of these

37) The pH of a 10^{-10} M NaOH solution is nearest to

- (a) 10
- (b) 7
- (c) 4
- (d) -10

38) Among the following the weakest Bronsted base is

- (a) F^-
- (b) Cl^-
- (c) Br^-
- (d) I^-

39) . In a reversible chemical reaction at equilibrium, if the concentration of any one of the reactants is doubled, then the equilibrium constant will

- (a) Also be Doubled
- (b) Be Halved
- (c) Remain the Same
- (d) Become One-Fourth

40) . Solubility of M_2S salt is 3.5×10^{-6} then find out solubility product.

- (a) 1.7×10^{-6}
- (b) 1.7×10^{-16}
- (c) 1.7×10^{-18}
- (d) 1.7×10^{-12}

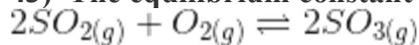
41) Find the pH of a solution when 0.01 M HCl and 0.1 M NaOH are mixed in equal volumes

- (a) 12.65
- (b) 1.04
- (c) 7.0
- (d) 2.0

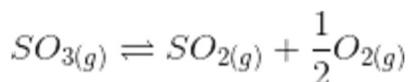
42) Which of the following aqueous solution will be the best conductor of electricity?

- (a) NH_3
- (b) CH_3COOH
- (c) HCl
- (d) $\text{C}_6\text{H}_{12}\text{O}_6$

43) The equilibrium constant is 278 for the reaction



at the same temperature, what will be the equilibrium constant for the following reaction?

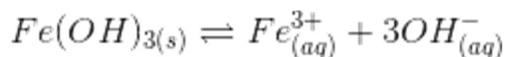


- (a) 6×10^{-2}
- (b) 1.8×10^{-3}
- (c) 1.3×10^{-5}
- (d) 3.6×10^{-5}

44) Amines behave as

- (a) Lewis Acids
- (b) Lewis Base
- (c) Aprotic Acid
- (d) Neutral Compound

45) Find the increase in equilibrium concentration of Fe^{3+} ions if OH^- ions concentration decreases to 1/4th in the following reaction



- (a) 8 times
- (b) 16 times
- (c) 4 times
- (d) 64 times

46) On increasing the concentration of reactants in a reversible reaction, then equilibrium constant will

- (a) depend on the concentration
- (b) increase
- (c) unchanged
- (d) decrease

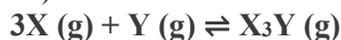
47) Find the conjugate acid of NH_2^-

- (a) NH_3
- (b) NH_4OH
- (c) NH_4^+
- (d) NH_2^-

48) When two reactants A and B are mixed to give products C and D, the reaction quotient (Q_c) at initial stage of the reaction

- (a) Is zero
- (b) Decreases with time
- (c) Is independent of time
- (d) Increases with time.

49) For the chemical reaction



the amount of X_3Y at equilibrium is affected by

- (a) Temperature and pressure
- (b) Pressure only
- (c) Temperature only
- (d) Temperature, pressure and catalyst.

50) $\text{ZnCO}_3(\text{s}) \rightleftharpoons \text{ZnO}(\text{s}) + \text{CO}_2(\text{g})$ Expression of equilibrium constant in terms of partial pressure of the above reaction is

- (a) $K_p = [\text{ZnO}][\text{CO}_2][\text{ZnCO}_3]$
- (b) $K_p = [\text{ZnO}]p[\text{CO}_2]p[\text{ZnCO}_3]$
- (c) $K_p = p^2(\text{ZnO})p(\text{CO}_2)$
- (d) $K_p = p_{\text{CO}_2}$

51) For the chemical reaction:



- (a) atm^{-2}
- (b) atm^{-3}
- (c) atm^{-1}
- (d) Dimensionless

52) In which manner, the increase of the pressure will affect the following equilibrium?



- (a) Shifts in the forward direction
- (b) Shifts in the reverse direction
- (c) Increase the yield of hydrogen
- (d) No effect.

53) K_p/K_c for the reaction $\text{CO (g)} + 1/2 \text{O}_2 \text{(g)} \rightleftharpoons \text{CO}_2 \text{(g)}$ is

- (a) 1
- (b) RT
- (c) $(1/RT)^{1/2}$
- (d) $(RT)^{1/2}$

54) In the reaction $\text{PCl}_5 \text{(g)} \rightleftharpoons \text{PCl}_3 \text{(g)} + \text{Cl}_2 \text{(g)}$ the equilibrium concentrations of PCl_5 and PCl_3 are 0.4 and 0.2 mole/litre respectively. If the value of K_c is 0.5, what is the concentration of Cl_2 in moles/ litre?

- (a) 2.0
- (b) 1.5
- (c) 1.0
- (d) 0.5

55) The reaction quotient (Q) for the reaction

$\text{N}_2 \text{(g)} + 3\text{H}_2 \text{(g)} \rightleftharpoons 2\text{NH}_3 \text{(g)}$ is given by

$$Q = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3}$$

The reaction will proceed from right to left if

- (a) $Q = K_c$.
- (b) $Q < K_c$
- (c) $Q > K_c$.
- (d) $Q = 0$

56) In which of the following equilibrium, change in the volume of the system does not alter the number of moles?

- (a) $\text{N}_2 \text{(g)} + \text{O}_2 \text{(g)} \rightleftharpoons 2\text{NO (g)}$
- (b) $\text{PCl}_5 \text{(g)} \rightleftharpoons \text{PCl}_3 \text{(g)} + \text{Cl}_2 \text{(g)}$
- (c) $\text{N}_2 \text{(g)} + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3 \text{(g)}$
- (d) $\text{SO}_2\text{Cl}_2 \text{(g)} \rightleftharpoons \text{SO}_2 \text{(g)} + \text{Cl}_2 \text{(g)}$

57) 1 mole of N_2 and 2 moles of H_2 are allowed to react in a 1 dm^3 vessel. At equilibrium 0.8 mole of NH_3 is formed. The concentration of H_2 in the vessel is

- (a) 0.6 mole
- (b) 0.8 mole
- (c) 0.2 mole
- (d) 0.4 mole.

58) The rate of forward reaction is two times that of the reverse reaction at a given temperature and identical concentration, $k_{(\text{equilibrium})}$ is

- (a) 0.5
- (b) 1.5
- (c) 2.5
- (d) 2.0

59) For a reversible reaction, if the concentrations of the reactants are doubled, the equilibrium constant will be

- (a) halved
- (b) doubled
- (c) the same
- (d) one fourth

**60) If $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$; K , then
 $2\text{N}_2(\text{g}) + 6\text{H}_2(\text{g}) \rightleftharpoons 4\text{NH}_3$; K^{-1}**

- (a) K^2
- (b) \sqrt{K}
- (c) $1/\sqrt{K}$
- (d) $1/K^2$

61) In the case of a gaseous homogeneous reaction, the active mass of the reactant is obtained by the expression

- (a) PV/RT
- (b) P/RT
- (c) RT/P
- (d) $nV RT$

62) For the reaction $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3 + \text{heat}$

- (a) $K_p = K_c(RT)^{-2}$
- (b) $K_p = K_c$
- (c) $K_p = K_cRT$
- (d) $K_p = K_c (RT)^{-1}$

63) What happens to the yield of this reaction when temperature is increased?

$\text{N}_2 + \text{O}_2 \rightleftharpoons 2\text{NO}$; 43 k cal

- (a) increases
- (b) decreases
- (c) remains same
- (d) none of these

64) The pH of 10^{-8} M HCl is

- (a) 8
- (b) 7
- (c) between 7 and 8
- (d) 6.98

65) The K_{sp} for HgS, Ag₂S and CuS are 10^{-54} , 10^{-44} and 10^{-37} respectively. The solubilities are in the order

- (a) HgS > Ag₂S > CuS
- (b) HgS < CuS < Ag₂S
- (c) CuS > Ag₂S > HgS
- (d) Ag₂S > HgS > CuS

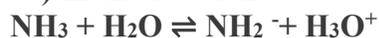
66) Aluminium chloride is

- (a) Bronsted Lowry acid
- (b) Arrhenius acid
- (c) Lewis acid
- (d) Lewis base

67) An acid according to Bronsted concept is a substance which can

- (a) lose a pair of electrons
- (b) donate protons
- (c) gain a pair of electrons
- (d) accept protons.

68) In the reaction



The conjugate base of NH₃ is

- (a) H₃O⁻
- (b) NH₂⁻
- (c) H₂O
- (d) None of these

69) In the reaction



the Lewis base is

- (a) I₂
- (b) I⁻
- (c) I₃⁻
- (d) None of these

70) The pH of a 0.005 M aqueous solution of sulphuric acid is

- (a) 0.005
- (b) 2
- (c) 1
- (d) 0.01

71) CO₂ is

- (a) Lewis acid
- (b) Lewis base
- (d) Bronsted acid
- (d) Bronsted base.

72) Solubility of an MX_2 type electrolyte is $0.5 \times 10^{-4} \text{ mol L}^{-1}$, then K_{sp} of the electrolyte is

- (a) 5×10^{-12}
- (b) 25×10^{-10}
- (c) 1×10^{-13}
- (d) 5×10^{-13}

73) When rain is accompanied by a thunderstorm, the collected rain water will have pH value

- (a) slightly higher than that when the thunderstorm is not there.
- (b) uninfluenced by the thunderstorm
- (c) which depends upon the amount of dust in air
- (d) slightly lower than that of rain water without thunderstorm.

ASSERTION AND REASON TYPE QUESTIONS :-

Directions:- In the following questions, a statement of assertion is followed by a statement of reason Mark the correct choice as:

- a) If both assertion and reason are true and reason is the correct explanation of assertion
- b) If both assertion and reason are true and reason is the not the correct explanation of assertion
- c) If assertion is true but reason is false
- d) If both assertion and reason are false

74) **Assertion** :- The strength of haloacids increases in the order $\text{HI} < \text{HBr} < \text{HCl} < \text{HF}$

Reason :- strength of acid HA depends only on the electronegativity difference between H and A

75) **Assertion** :- benzoic acid is stronger than acetic acid

Reason :- K_a for benzoic acid is 6.5×10^{-5} and for acetic acid is 1.74×10^{-5}

76) **Assertion** :- a solution of NH_4Cl in water is acidic in nature

Reason :- ammonium ions undergo hydrolysis to form Ammonium hydroxide

77) **Assertion** :- weak acids have a very strong conjugate base while strong acid have a very weak conjugate base

Reason:-conjugate acids and bases are differ by only one proton

78) **Assertion** :- if the reaction quotient for a particular reaction is greater than K_c than the reaction will Proceed in the direction of reactants

Reason:- Reaction Quotient is defined in the same way as the equilibrium constant K_c except that the concentrations in Q_c are not necessarily the equilibrium values.

79) Assertion :- The pH of NH_4Cl solution in water is less than 7 and pH of CH_3COONa Solution is more than 7

Reason :- NH_4Cl is a salt of weak base NH_4OH and strong acid HCl whereas CH_3COONa is a salt of weak acid CH_3COOH and strong base NaOH

80) Assertion :- when Ice and water are kept in perfectly insulated flask at 273 Kelvin and at atmospheric pressure, there is no change in the mass of ice and water

Reason :- the system is in static equilibrium

81) Assertion :- the equilibrium constant for the reverse reaction is equal to the inverse of the equilibrium constant for the forward reaction

Reason :- The value of the equilibrium constant is independent of the initial concentrations of the reactant and the products

82) Assertion :- K_p can be less than, greater than or equal to K_c

Reason:- Relation between K_p and K_c depends on the change in number of moles of the gaseous reactants and products (Δn)

83) Assertion :- For the reaction $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$, $K_p = K_c$

Reason :- Concentrations of gaseous reactants and products is taken as unity.

ANSWER KEY: -

Question Number	Answers
1	c) BCl_3
2	d) CH_3COO^-
3	b) C_2H_4
4	a) Constant Temperature
5	a) Accept a Proton
6	b) Lewis concept
7	c) Na_2CO_3
8	d) OH^- and F^-
9	c) HCl
10	a) No
11	d) Shift in equilibrium position on changing value of a constraint
12	b) Predicting the direction of the reaction
13	a) Equal
14	d) The reaction doesn't proceed to completion
15	b) Right
16	b) Decreases
17	b) At low temperature and high pressure
18	c) No change

19	b) Does not depends
20	b) Common ion effect
21	(d) 2
22	(d) $K < 1$
23	(c) All the physical processes stop at equilibrium
24	(a) $1.8 \times 10^{-3} \text{ mol L}^{-1}$
25	(b) The intensity of red colour increases when oxalic acid is added to a solution containing iron (III) nitrate and potassium thiocyanate
26	c) Less than 7.0
27	d) formic acid > acetic acid > hypochlorous acid
28	a) $K_{a3} = K_{a1} \times K_{a2}$
29	a) 3.4
30	c) 7.0
31	a) K will remain same
32	b) Water < acetone < ether
33	a) 0.04

34	d)The equilibrium will remain unaffected in all the three cases.
35	(d) 108 y^5
36	(c) 13.30
37	(b) 7
38	(d) I^-
39	(c) Remain the Same
40	(b) 1.7×10^{-16}
41	(a) 12.65
42	(c) HCl
43	(a) 6×10^{-2}
44	(b) Lewis Base
45	(d) 64 times
46	(c) unchanged
47	(a) NH_3
48	(d) Increases with time.
49	(a) Temperature and pressure
50	(d) $K_p = p_{\text{CO}_2}$
51	(a) atm^{-2}
52	(b) Shifts in the reverse direction
53	(c) $(1/RT)^{1/2}$
54	(c) 1.0

55	(c) $Q > K_c$
56	(a) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$
57	(b) 0.8 mole
58	(d) 2.0
59	(c) the same
60	(d) $1/K^2$
61	(b) P/RT
62	(a) $K_p = K_c(RT)^{-2}$
63	(a) increases
64	(d) 6.98
65	(b) $HgS < CuS < Ag_2S$
66	(c) Lewis acid
67	(b) donate protons
68	(b) NH_2^-
69	(b) I^-
70	(b) 2
71	(a) Lewis acid
72	(d) 5×10^{-13}
73	(d) slightly lower than that of rain water without thunderstorm.
74	(d) If both assertion and reason are false
75	(a) If both assertion and reason are true and reason is the correct explanation of assertion
76	(a) If both assertion and reason are true and reason is the correct explanation of assertion
77	b) If both assertion and reason are true and reason is the not the correct explanation of assertion
78	b) If both assertion and reason are true and reason is the not the correct explanation of assertion

79	(a) If both assertion and reason are true and reaason is the correct explanation of assertion
80	c) If assertion is true but reason is false
81	b) If both assertion and reason are true and reaason is the not the correct explanation of assertion
82	(a) If both assertion and reason are true and reaason is the correct explanation of assertion
83	(d) slightly lower than that of rain water without thunderstorm.

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CHAPTER: s-BLOCK ELEMENTS

MULTIPLE CHOICE QUESTIONS

- The correct order of hydration enthalpies of alkali metal ions is :
(a) $\text{Li}^+ > \text{Na}^+ > \text{K}^+ > \text{Cs}^+ > \text{Rb}^+$ (b) $\text{Na}^+ > \text{Li}^+ > \text{K}^+ > \text{Rb}^+ > \text{Cs}^+$
(c) $\text{Na}^+ > \text{Li}^+ > \text{K}^+ > \text{Cs}^+ > \text{Rb}^+$ (d) $\text{Li}^+ > \text{Na}^+ > \text{K}^+ > \text{Rb}^+ > \text{Cs}^+$
- The incorrect statement is
(a) Lithium is the strongest reducing agent among the alkali metals.
(b) Lithium is least reactive with water among the alkali metals.
(c) LiNO_3 decomposes on heating to give LiNO_2 and O_2 .
(d) LiCl crystallise from aqueous solution as $\text{LiCl} \cdot 2\text{H}_2\text{O}$.
- The compounds of lithium has increased covalent character due to
(a) small atomic size (b) high polarizing power
(c) large atomic size (d) both (a) and (b)
- The reducing power of a metal depends on various factors. Suggest the factor which makes Li, the strongest reducing agent in aqueous solution
(a) Sublimation enthalpy (b) Ionisation enthalpy
(c) Hydration enthalpy (d) Electron gain enthalpy
- When sodium is dissolved in liquid ammonia, a solution of deep blue colour is obtained. The colour of the solution is due to
(a) Ammoniated electron (b) Sodium ion
(c) Sodium amide (d) Ammoniated sodium ion
- Which of the following elements does not form hydride by direct heating with dihydrogen?
(a) Be (b) Mg
(c) Sr (d) Ba
- The alkali metal that reacts with nitrogen directly to form nitride is
(a) Li (b) Na
(c) K (d) Rb
- Which of the following does not illustrate the anomalous properties of lithium?
(a) The melting point of and boiling point of Li are comparatively high.
(b) Li is much softer than the other group I elements.
(c) Li forms a nitride Li_3N unlike group I elements.
(d) The ion of Li and its compounds are more heavily hydrated than those of the rest of the group.
- Based on lattice enthalpy and other considerations which one of the following alkali metal chlorides is expected to have the highest melting point
(a) LiCl (b) NaCl
(c) KCl (d) RbCl
- In certain matters, lithium differs from the other alkali metals. The reason for this is:
(a) Small size of Li atom and Li^+ ion (b) Extremely high electropositivity of Li
(c) Greater hardness of Li (d) Hydration of Li^+ ion

11. When sodium is heated with moist air, then the product obtained is
(a) Na_2O (b) NaOH
(c) Na_2CO_3 (d) Na_2O_2
12. Lithium shows similarities to magnesium in its chemical behaviour because of
(a) Similar size, greater electronegativity and similar polarizing power
(b) Similar size, same electronegativity and lower polarizing power
(c) Similar size, same electronegativity and similar high polarizing power
(d) None of these
13. Photoelectric effect is maximum in
(a) Cs (b) Na
(c) K (d) Li
14. Alkaline earth metals are denser than alkali metals, because metallic bonding in alkaline earth metal is
(a) Stronger (b) Weaker
(c) Volatile (d) Not present
15. Sodium metal cannot be stored under
(a) Benzene (b) Kerosene
(c) Alcohol (d) Toluene
16. The main oxides formed on combustion of Li, Na and K in excess of air are respectively
(a) Li_2O_2 , Na_2O_2 and K_2O (b) Li_2O_2 , Na_2O_2 and KO_2
(c) Li_2O , Na_2O_2 and KO_2 (d) Li_2O , Na_2O and KO_2
17. Which one of the following on hydrolysis gives the corresponding metallic hydroxide, H_2O_2 and O_2
(a) Li_2O (b) NaO_2
(c) Na_2O_2 (d) Na_2O
18. Choose the incorrect statement in the following:
(a) BeO is almost insoluble but BeSO_4 is soluble in water
(b) BaO is soluble but BaSO_4 is insoluble in water
(c) LiI is more soluble than KI in ethanol
(d) Both LiCl and MgCl_2 are deliquescent
19. For alkali metals, which one of the following trends is incorrect?
(a) Hydration enthalpy: $\text{Li} > \text{Na} > \text{K} > \text{Rb}$
(b) Ionisation enthalpy: $\text{Li} > \text{Na} > \text{K} > \text{Rb}$
(c) Density: $\text{Li} < \text{Na} < \text{K} < \text{Rb}$
(d) Atomic Size: $\text{Li} < \text{Na} < \text{K} < \text{Rb}$
20. Which of the following sulphates have the highest solubility in water?
(a) MgSO_4 (b) BaSO_4
(c) CaSO_4 (d) BeSO_4
21. Which of the following can be represented by the configuration $[\text{Kr}] 5s^2$?
(a) Ca (b) Sr
(c) Ba (d) Ra
22. Which gas is released by the treatment of magnesium with very dilute solution of HNO_3 ?
(a) N_2 (b) NO_2
(c) H_2 (d) H_2O

23. Point out the incorrect statement regarding Be.
- (a) It forms ionic carbide (b) Its carbonate decomposes on heating
(c) Its halides are covalent (d) It is easily attacked by water
24. A metal M readily forms its sulphate MSO_4 which is water soluble. It forms its oxide MO which becomes inert on heating. It forms its insoluble hydroxide $\text{M}(\text{OH})_2$ which is soluble in NaOH solution. Then M is
- (a) Mg (b) Ca
(c) Be (d) Ba
25. The ionic compound BaSO_4 is insoluble in water due to
- (a) High lattice enthalpy (b) Low lattice enthalpy
(c) Low hydration enthalpy (d) Both (a) and (c)
26. Which pair of the following chlorides do not impart colour to the flame?
- (a) BeCl_2 and MgCl_2 (b) BeCl_2 and SrCl_2
(c) CaCl_2 and BaCl_2 (d) CaCl_2 and MgCl_2
27. Which of the following on thermal decomposition yields a basic as well an acidic oxide?
- (a) KClO_3 (b) Na_2CO_3
(c) CaCO_3 (d) NaNO_3
28. The second ionization enthalpy of which of the following alkaline earth metals is the highest?
- (a) Be (b) Mg
(c) Ca (d) Sr
29. The decreasing order of basic character of K_2O , BaO , CaO and MgO is:
- (a) $\text{K}_2\text{O} > \text{CaO} > \text{BaO} > \text{MgO}$ (b) $\text{K}_2\text{O} > \text{BaO} > \text{CaO} > \text{MgO}$
(c) $\text{MgO} > \text{BaO} > \text{CaO} > \text{K}_2\text{O}$ (d) $\text{MgO} > \text{CaO} > \text{BaO} > \text{K}_2\text{O}$
30. The solubility of the alkali metal carbonates
- (a) Increase at first and then decreases (b) Does not show regular variation
(c) Increases as we go down the group (d) Decreases as we go down the group
31. The low solubility of LiF and that of CsI in water are respectively due to which of the properties of the alkali metal ions:
- (a) Higher hydration enthalpy of Li^+ , higher lattice enthalpy of Cs^+
(b) Smaller hydration enthalpy of Li^+ , higher lattice enthalpy of Cs^+
(c) Smaller lattice enthalpy of Li^+ , higher hydration enthalpy of Cs^+
(d) Higher lattice enthalpy of Li^+ , smaller hydration enthalpy of Cs^+
32. The hydration with least K_{sp} value at room temperature is:
- (a) $\text{Mg}(\text{OH})_2$ (b) $\text{Ca}(\text{OH})_2$
(c) $\text{Ba}(\text{OH})_2$ (d) $\text{Be}(\text{OH})_2$
33. The decreasing order of $\Delta_i H_2$ values in K, Ca and Ba is:
- (a) $\text{K} > \text{Ca} > \text{Ba}$ (b) $\text{Ca} > \text{Ba} > \text{K}$
(c) $\text{Ba} > \text{K} > \text{Ca}$ (d) $\text{K} > \text{Ba} > \text{Ca}$
34. Alkali metals are generally extracted by
- (a) Reduction methods (b) Double decomposition methods
(c) Displacement methods (d) Electrolytic methods
35. The structures of beryllium chloride in the solid state and vapour phase, respectively are:
- (a) dimeric and dimeric (b) polymeric and dimeric
(c) dimeric and polymeric (d) monomeric and dimeric

ASSERTION REASONING TYPE QUESTIONS

Read the following statements carefully to make the correct option out of the options given below:

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

(b) Both assertion and reason are correct but the 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.

36. Assertion: Be does not impart any characteristic colour to flame.

Reason: Due to its very high ionization enthalpy, beryllium requires a large amount of energy for the excitation of the electrons.

37. Assertion: Na_2SO_4 is soluble while BaSO_4 is insoluble.

Reason: Lattice enthalpy of BaSO_4 exceeds its hydration enthalpy.

38. Assertion: LiCl is predominantly a covalent compound.

Reason: Electronegativity difference between Li and Cl is too small.

39. Assertion: Alkali metals dissolve in liquid ammonia to give blue solutions.

Reason: Alkali metals in liquid ammonia give solvated species of the type $[\text{M}(\text{NH}_3)_n]^+$ (M = alkali metals)

40. Assertion: Li is the strongest reducing agent among all the elements of the periodic table.

Reason: Li has the lowest hydration energy among the alkali metals.

41. Assertion: NaOH is a stronger base than KOH .

Reason: KOH is more soluble in water than NaOH .

42. Assertion: BeCl_2 fumes in moist air.

Reason: BeCl_2 reacts with moisture to form HCl gas.

43. Assertion: Superoxides of alkali metals are paramagnetic.

Reason: Superoxides contain the ion O_2^- which has one unpaired electron.

44. Assertion: BeCl_2 is covalent whereas MgCl_2 and CaCl_2 are ionic.

Reason: Beryllium is the first member of the group.

45. Assertion: The carbonates of group 2 are more covalent than those of group 1.

Reason: Carbonates of group 2 are more covalent than those of group 1.

46. Assertion: Beryllium hydroxide becomes soluble in excess alkali forming beryllate ion $[\text{Be}(\text{OH})_4]^{2-}$.

Reason: Beryllium ion has lesser tendency to form complexes.

47. Assertion: The carbonate of lithium decomposes easily on heating to form lithium oxide and CO_2 .

Reason: Lithium being very small in size polarizes large carbonate ion resulting the formation of more stable Li_2O and CO_2 .

48. Assertion: The alkaline earth metals have much higher melting and boiling points than those of alkali metals.

Reason: The melting and boiling points of alkaline earth metal do not vary in a regular fashion.

CASE STUDY

Read the following passage given below and answer the following questions:

49. A typical characteristic of the representative elements is that the first member of each group gives different characteristics as compared to the rest of the members present in that group. Lithium is no exception. Though it is the first member of the alkali metal family (group 1), it is anomalous in behavior. This may be attributed to the small size of the Li and Li^+ ion, high ionization enthalpy, high ionization enthalpy, high polarizing power and non-availability of d-electrons in its valence shell.

(i) The order of solubility of lithium halides in non-polar solvents is:

- (a) $\text{LiI} > \text{LiBr} > \text{LiCl} > \text{LiF}$ (b) $\text{LiF} > \text{LiI} > \text{LiBr} > \text{LiCl}$
(c) $\text{LiCl} > \text{LiF} > \text{LiI} > \text{LiBr}$ (d) $\text{LiBr} > \text{LiCl} > \text{LiF} > \text{LiI}$

(ii) Which among the following has the least thermal stability?

- (a) K_2CO_3 (b) Na_2CO_3
(c) Li_2CO_3 (d) Rb_2CO_3

(iii) Which is formed with lithium is heated in air?

- (a) Li_2O (b) Li_3N
(c) Both Li_2O and Li_3N (d) Both Li_2O_2 and Li_3N

(iv) The solubility of metal halides depends on their nature, lattice enthalpy and hydration enthalpy of the individual ions. Amongst fluorides of alkali metals, the lowest solubility of LiF in water is due to

- (a) Ionic nature of lithium fluoride
(b) high lattice enthalpy
(c) high hydration enthalpy of lithium ion
(d) low ionisation enthalpy of lithium atom

50. All alkali metals and alkaline earth metals (except Be and Mg) dissolve in liquid ammonia to give deep blue conducting and paramagnetic solutions due to the ammoniated electrons which absorb energy in the red region and therefore impart blue colour. Ammoniated electrons impart strong reducing nature to ammoniacal solutions that they can even reduce an aromatic ring.

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

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

(b) Both assertion and reason are correct but the 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.

(i) Assertion: All alkali metals dissolve in liquid NH_3 to give a deep blue conducting solution.

Reason: Ammoniated metal ions and ammoniated electrons are present in the solution of alkali metals in liquid NH_3 .

(ii) Assertion: Solutions of alkali metals in liquid ammonia are paramagnetic and conducting.

Reason: Solutions of metals in liquid NH_3 act as powerful reducing agents.

(iii) Assertion: Concentrated solutions of metals in liquid NH_3 become paramagnetic.

Reason: Pairing of electrons occurs in concentrated solutions.

(iv) Assertion: In concentrated solution of metals in liquid NH_3 the blue colour changes to bronze colour.

Reason: Formation of metal ion clusters is observed in concentrated solution of metals in liquid ammonia.

ANSWER KEY

1. (d) $\text{Li}^+ > \text{Na}^+ > \text{K}^+ > \text{Rb}^+ > \text{Cs}^+$
2. (c) LiNO_3 decomposes on heating to give LiNO_2 and O_2 .
3. (d) both (a) and (b)
4. (c) Hydration enthalpy
5. (a) Ammoniated electron
6. (a) Be
7. (a) Li
8. (b) Li is much softer than the other group I elements
9. (b) NaCl
10. (a) Small size of Li atom and Li^+ ion
11. (a) Na_2O
12. (c) Similar size, same electronegativity and similar high polarizing power
13. (a) Cs
14. (a) Stronger
15. (c) Alcohol
16. (c) Li_2O , Na_2O_2 and KO_2
17. (b) NaO_2
18. (c) LiI is more soluble than KI in ethanol
19. (c) Density : $\text{Li} < \text{Na} < \text{K} < \text{Rb}$
20. (d) BeSO_4
21. (b) Sr
22. (b) NO_2
23. (d) It is easily attached by water
24. (c) Be
25. (d) Both (a) and (c)
26. (a) BeCl_2 and MgCl_2
27. (c) CaCO_3
28. (a) Be
29. (b) $\text{K}_2\text{O} > \text{BaO} > \text{CaO} > \text{MgO}$
30. (c) Increases as we go down the group
31. (d) Higher lattice enthalpy of Li^+ , smaller hydration enthalpy of Cs^+
32. (d) $\text{Be}(\text{OH})_2$
33. (a) $\text{K} > \text{Ca} > \text{Ba}$
34. (d) Electrolytic methods
35. (b) polymeric and dimeric
36. (a) Both assertion and reason are correct and the reason is the correct explanation of the assertion.
37. (b) Both assertion and reason are correct but the reason is not the correct explanation of the assertion.
38. (c) Assertion is correct but reason is incorrect.
39. (b) Both assertion and reason are correct but the reason is not the correct explanation of the assertion.
40. (c) Assertion is correct but reason is incorrect.

41. (d) Assertion is incorrect but reason is correct.
42. (a) Both assertion and reason are correct and the reason is the correct explanation of the assertion.
43. (a) Both assertion and reason are correct and the reason is the correct explanation of the assertion.
44. (b) Both assertion and reason are correct but the reason is not the correct explanation of the assertion.
45. (d) Assertion is incorrect but reason is correct.
46. (c) Assertion is correct but reason is incorrect.
47. (a) Both assertion and reason are correct and the reason is the correct explanation of the assertion.
48. (b) Both assertion and reason are correct but the reason is not the correct explanation of the assertion.
49. (i) (a) $\text{LiI} > \text{LiBr} > \text{LiCl} > \text{LiF}$
(ii) (c) Li_2CO_3
(iii) (c) Both Li_2O and Li_3N
(iv) (b) high lattice enthalpy
50. (i) (a) Both assertion and reason are correct and the reason is the correct explanation of the assertion.
(ii) (b) Both assertion and reason are correct but the reason is not the correct explanation of the assertion.
(iii) (d) Assertion is incorrect but reason is correct.
(iv) (a) Both assertion and reason are correct and the reason is the correct explanation of the assertion.

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PGT CHEMISTRY

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CHAPTER: THE p-BLOCK ELEMENTS

MULTIPLE CHOICE QUESTIONS

1. The structure of diBorane contains

- (a) Four 2c – 2e bonds and two 3c – 2e bonds
- (b) Two 2c – 2e bonds and two 3c – 2e bonds
- (c) Two 2c – 2e bonds and two 3c – 3e bonds
- (d) Four 2c – 2e bonds and four 3c – 2e bonds

2. Which is not the correct statement for Boron?

- (a) It exhibits Allotropy
- (b) It exists in both crystalline and Amorphous form
- (c) It forms solid chlorides
- (d) It forms volatile hydrides.

3. In general, the Boron Trihalides act as

- (a) Strong reducing agent
- (b) Lewis Acids
- (c) Lewis Bases
- (d) Dehydrating Agents

4. Find the amphoteric oxide

- (a) CaO₂
- (b) CO₂
- (c) SnO₂
- (d) SiO₂

5. Graphite has a structural similarity with

- (a) B₂H₆
- (b) B₄C
- (c) B
- (d) BN

6. Which is the correct order of decreasing acidity of Lewis acids?

- (a) BBr₃ > BCl₃ > BF₃
- (b) BF₃ > BCl₃ > BBr₃
- (c) BCl₃ > BF₃ > BBr₃
- (d) BBr₃ > BF₃ > BCl₃

7. Which of the following oxides is acidic in nature?

- (a) B_2O_3
- (b) Al_2O_3
- (c) Ga_2O_3
- (d) In_2O_3

8. Boric acid is an acid because its molecule

- (a) contains replaceable H^+ ion
- (b) gives up a proton
- (c) accepts OH^- from water releasing proton
- (d) combines with proton from water molecule

9. The tendency of catenation in Group 14 elements follows the order:

- (a) $C > Si > Ge > Sn$
- (b) $C \gg Si > Ge \approx Sn$
- (c) $Si > C > Sn > Ge$
- (d) $Ge > Sn > Si > C$

10. Dry ice is

- (a) Solid NH_3
- (b) Solid SO_2
- (c) Solid CO_2
- (d) Solid N_2

11. The linear shape of CO_2 is due to _____.

- (a) sp^3 hybridisation of carbon
- (b) sp hybridisation of carbon
- (c) $p\pi-p\pi$ bonding between carbon and oxygen
- (d) sp^2 hybridisation of carbon

12. Aluminium oxide is

- (a) Acidic oxide
- (b) basic Oxide
- (c) Amphoteric oxide
- (d) none of these

13. Which element is a typical non-metal,

- (a) Boron
- (b) gallium
- (c) indium
- (d) thallium

14. Which is the important mineral of aluminium.

- a) orthoboric acid
- b) borax
- c) kernite
- d) Bauxite

15. Which of the following properties of aluminium makes it useful for food packaging ?

- (a) Good electrical conductivity
- (b) Good thermal conductivity
- (c) Low density
- (d) Non toxicity

16. The most commonly used reducing agent is

- (a) AlCl_3
- (b) PbCl_2
- (c) SnCl_4
- (d) SnCl_2

17. Which of the following attacks glass

- (a) HCl
- (b) HF
- (c) HI
- (d) HBr

18. Which one of the following statements about the zeolites is false ?

- (a) They are used as cation exchangers
- (b) They have open structure which enables them to take up small molecules
- (c) Zeolites are aluminosilicates having three dimensional network
- (d) None of the above

19. The hybridisation of boron atom in orthoboric acid is

- (a) sp
- (b) sp^2
- (c) sp^3
- (d) $sp^3 d$

20. What is the colour obtained when borax is heated in a Bunsen burner flame with CoO?

- (a) Blue
- (b) Black
- (c) Green
- (d) Violet

21. _____ helps to maintain pH of blood between 7.26 to 7.42

- (a) CO_2
- (b) H_2CO_3
- (c) CO_3^{2-}
- (d) H_2CO_3 / HCO_3^-

22. Crystalline form of silica is called

- (a) crystalline silicon
- (b) quartz
- (c) rock
- (d) talc

23. Which of the following is not the crystalline form of silica?

- (a) Quartz
- (b) Cristobalite
- (c) Tridymite
- (d) All are crystalline form of silica.

24. Which of the following types of forces bind together the carbon atoms in diamond ?

- (a) Ionic
- (b) Covalent
- (c) Dipolar
- (d) van der Waal's

25. The reducing power of divalent species decreases in the order

- (a) $\text{Ge} > \text{Sn} > \text{Pb}$
- (b) $\text{Sn} > \text{Ge} > \text{Pb}$
- (c) $\text{Pb} > \text{Sn} > \text{Ge}$
- (d) None of these

26. Which one of the following has the lowest m.p.?

- (a) B
- (b) Al
- (c) Ga
- (d) Tl

27. Ionisation enthalpy for the elements of Group 13 follows the order.

- (a) $B > Al > Ga > In > Tl$
- (b) $B < Al < Ga < In < Tl$
- (c) $B < Al > Ga < In > Tl$
- (d) $B > Al < Ga > In < Tl$

28. The strongest Lewis acid is

- (a) BF_3
- (b) BCl_3
- (c) BBr_3
- (d) BI_3

29. Which metal is protected by a layer of its own oxide?

- (a) Al
- (b) Ag
- (c) Au
- (d) Fe

30. NH_3 and BF_3 form an adduct readily because they form

- (a) a coordinate bond
- (b) a hydrogen bond
- (c) an ionic bond
- (d) a covalent bond

31. Boric acid is polymeric due to

- (a) its acidic nature
- (b) the presence of hydrogen bonds
- (c) its monobasic nature
- (d) its geometry

32. Producer gas is the mixture of

- (a) $\text{CO} + \text{N}_2$
- (b) $\text{CO} + \text{H}_2$
- (c) $\text{CO} + \text{water vapours}$
- (d) $\text{N}_2 + \text{CH}_4$

33..fibres are used in making bullet-proof vest.

- (a) Aluminium
- (b) Boron
- (c) Indium
- (d) Thallium

34. Which is thermodynamically most stable allotrope of carbon.

- (a) Diamond
- (b) Graphite
- (c) Fullerenes
- (d) Buckminsterfullerene

35. An aqueous solution of borax is

- (a) neutral
- (b) amphoteric
- (c) basic
- (d) acidic

36. Diborane upon hydrolysis gives

- (a) boric anhydride
- (b) metaboric acid
- (c) orthoboric acid
- (d) boron oxide

37. Orthoboric acid when heated to red hot gives

- (a) metaboric acid
- (b) pyroboric acid
- (c) boron and water
- (d) boric anhydride

38. The main reason that SiCl_4 is easily hydrolysed as compared to CCl_4 is that

- (a) Si-Si bond is weaker
- (b) SiCl_4 can form hydrogen bonds
- (c) SiCl_4 is covalent
- (d) Si can extend its coordination number beyond four

39. In silica (SiO_2), each silicon atom is bonded to

- (a) two oxygen atoms
- (b) four oxygen atoms
- (c) one silicon and two oxygen atoms
- (d) one silicon and three oxygen atoms

40. How many six membered and five membered rings are present in fullerene?

- (a) Six membered = 20, five membered = 10
- (b) Six membered = 20, five membered = 12
- (c) Six membered = 25, five membered = 10
- (d) Six membered = 12, five membered = 25

CASE-BASED/PASSAGE-BASED QUESTIONS

Read the following passage and answer the questions that follow:

Group 13 and 14 are p-block elements, consisting of metals, non-metals and metalloids. These elements show variable oxidation states, lower oxidation state becomes more stable, when we go down the group. The combined effect of size and availability of d-orbitals influence their ability to form π -bonds. Lighter elements form $p\pi-p\pi$ bonds where as heavier elements form $d\pi-p\pi$ or $d\pi-d\pi$ bonds. Boron forms electron deficient compounds. Al exhibits +3 oxidation state. Tl^+ is more stable than Tl^{3+} due to inert pair effect. Carbon is typical non-metal of group 14, shows property of catenation and forms large number of compounds. It also shows allotropy, diamond, graphite and fullerene are crystalline allotropes of carbon. Group 14 elements show +4 and +2 oxidation states. Pb^{2+} is more stable than Pb^{4+} . CO and CO_2 are oxides of carbon. CO_2 is acidic and CO has lone pair, therefore, forms metal carbonyls. CO is deadly poisonous. CO_2 is greenhouse gas. Silica, silicates and silicones are important classes of compounds of silicon.

41. carbon is able to show allotropic forms as it

- (a) as it shows the property of catenation
- (b) as it forms $p\pi-p\pi$ bond
- (c) as c-c bond is strong
- (d) all of these

42. The inert pair effect is most prominent in

- (a) C
- (b) Pb
- (c) Ge
- (d) Si

43. Which of the following oxidation states are most characteristic for lead and tin respectively?

- (a) 2, 2
- (b) 4, 2
- (c) 2, 4
- (d) 4, 4

44. Pb^{4+} is a good oxidizing agent as

- (a) Pb^{4+} is more stable oxidation state
- (b) Pb^{4+} do not show inert pair effect
- (c) Pb^{4+} do not show catenation
- (d) Pb^{2+} is more stable oxidation state

45. The correct statement with respect to CO is

- (a) it combines with H_2O to give carbonic acid
- (b) it reacts with haemoglobin in RBC
- (c) it is powerful oxidising agent
- (d) it is used to prepare aerated drinks

ASSERTION-REASON TYPE QUESTIONS

Directions : Each of these questions contain two statements, Assertion and Reason. Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select one of the codes (a), (b), (c) and (d) given below.

- (a) Assertion is correct, reason is correct; reason is a correct explanation for assertion.
- (b) Assertion is correct, reason is correct; reason is not a correct explanation for assertion
- (c) Assertion is correct, reason is incorrect
- (d) Assertion is incorrect, reason is correct.

46. Assertion : Atomic radius of gallium is higher than that of aluminum

Reason : The presence of additional d-electron offer poor screening effect for the outer electrons from increased nuclear charge.

47. Assertion : Silicons are water repelling in nature.

Reason : Silicons are organosilicon polymers, which have $(-R_2SiO-)$ as repeating unit.

48. Assertion : The use of aluminium and its compounds for domestic purposes is now reduced considerably.

Reason : The highly toxic nature of aluminium is the responsible factor.

49. Assertion : Pb^{4+} compounds are stronger oxidizing agents than Sn^{4+} compounds.

Reason : The higher oxidation states for the group 14 elements are more stable for the heavier members of the group due to 'inert pair effect'.

50. Assertion : Boric acid considered as weak Lewis acid.

Reason : It releases its ionizable H^+ ion.

ANSWER KEY :

Q1. a	Q2. c	Q3. b	Q4. c	Q5. d	Q6. a	Q7. a	Q8. c	Q9. b	Q10.c
Q11.b	Q12. c	Q13.a	Q14.d	Q15.c	Q16.d	Q17. b	Q18. d	Q19. b	Q20. a
Q21.d	Q22.b	Q23. d	Q24.b	Q25.a	Q26.c	Q27.d	Q28.d	Q29.a	Q30.a
Q31.b	Q32.a	Q33.b	Q34.b	Q35.c	Q36.c	Q37.b	Q38.d	Q39.b	Q40.b
Q41.d	Q42.b	Q43.c	Q44.d	Q45.b	Q46.d	Q47.b	Q48.a	49.c	Q50.c

Prepared By:-AMIT SHARMA

(PGT-CHEMISTRY)

K.V. HALWARA

CHAPTER : HYDROCARBONS

QUESTIONS BASED ON CASE STUDY

(I) Aldehydes undergo a variety of oxidation reactions. With the cold and neutral or alkaline KMnO_4 , alkenes are oxidised to give vicinal diols. Oxidation with hot KMnO_4 undergoes cleavage of $\text{C} = \text{C}$ bond leading to the formation of carboxylic acids, ketones and carbon dioxide depending on the nature of alkene. Reductive ozonolysis of alkenes gives aldehydes or ketones. When alkynes are treated with hot KMnO_4 solution, the triple bond is completely broken leading to the formation of carboxylic acids and carbon dioxide depending upon the position of triple bond. The cleavage occurs at the site of triple bond. The reactions in which triple bond is completely broken are called degradation or cleavage reactions. This can be used to locate the position of triple bond.

Answer the following questions

1. But-2-ene on treatment with cold alk. KMnO_4 gives
 - (a) Butane-1, 2 diol
 - (b) Butane -2, 3 diol
 - (c) Ethylene glycol
 - (d) Glyoxal
2. An alkene 'X' on treatment with hot alkaline KMnO_4 gives acetic acid. Alkene 'X' is
 - (a) Hex-3-ene
 - (b) But-2-ene
 - (c) But-1-ene
 - (d) Pent-1-ene
3. Reductive ozonolysis of alkene 'A' gives propanone. The alkene 'A' is
 - (a) 2,3,- Dimethylbut-2-ene
 - (b) 1,4,- Dimethylpent-2-ene
 - (c) 1,3,- Dimethylbut-2-ene
 - (d) 2- Methylpropene
4. 2- Methyl propene on treatment with hot alkaline KMnO_4 gives
 - (a) $(\text{CH}_3)_2\text{CO}$, HCOOH
 - (b) $(\text{CH}_3)_2\text{CO}$, CO_2
 - (c) $(\text{CH}_3)_2\text{CO}$, CH_3CHO
 - (d) CH_3CHO , $\text{CH}_3\text{CH}_2\text{CHO}$

(II) Benzene and other aromatic hydrocarbons, though contain π -bonds, yet they behave as saturated hydrocarbons. They are stable because of delocalisation of π – cloud. These undergo electrophilic substitution reaction as:



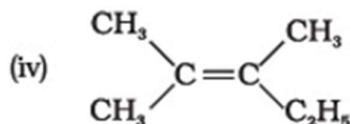
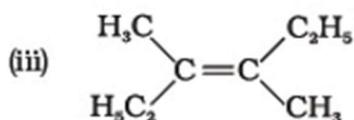
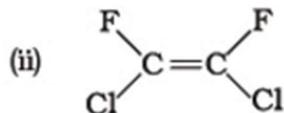
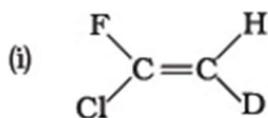
The reactivity of aromatic hydrocarbons towards electrophilic substitution depends upon the electron density in the benzene ring .

Answer the following questions

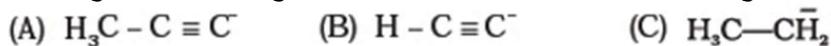
- Which of the following is not compatible with arenes?
 - Greater stability
 - Delocalisation of π - electrons
 - Electrophilic addition
 - Resonance
- In the reaction of $\text{C}_6\text{H}_5\text{Y}$, the major product is m-isomer. The group Y may be
 - COOH
 - Cl
 - OH
 - NH₂
- The electrophile in sulphonation of benzene is
 - SO_3^+
 - HSO_4^-
 - SO_3
 - H_3SO_4^+
- Which reagent cannot be used in Friedel Craft alkylation of benzene ?
 - FeCl_3
 - SnCl_4
 - AlCl_3
 - LiAlH_4
- The correct order of reactivity in electrophilic substitution reaction is
(1) C_6H_6 (2) $\text{C}_6\text{H}_5\text{-CH}_3$ (3) $\text{C}_6\text{H}_5\text{-Cl}$ (4) $\text{C}_6\text{H}_5\text{-NO}_2$
 - 1 >2 >3 >4
 - 3 >4 >2 >1
 - 2 >1 >3 >4
 - 2 >3 >1 >4

MULTIPLE CHOICE QUESTIONS (TYPE-I)

1. Which of the following will not show geometrical isomerism?



2. Arrange the following carbanions in order of their decreasing stability.



(i) $\text{A} > \text{B} > \text{C}$ (ii) $\text{B} > \text{A} > \text{C}$ (iii) $\text{C} > \text{B} > \text{A}$ (iv) $\text{C} > \text{A} > \text{B}$

3. Arrange the following in decreasing order of their boiling points.

(A) n-butane

(B) 2-methylbutane

(C) n-pentane

(D) 2,2-dimethylpropane

(i) $\text{A} > \text{B} > \text{C} > \text{D}$

(ii) $\text{B} > \text{C} > \text{D} > \text{A}$

(iii) $\text{D} > \text{C} > \text{B} > \text{A}$

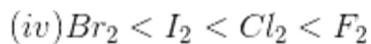
(iv) $\text{C} > \text{B} > \text{D} > \text{A}$

4. Arrange the halogens F_2 , Cl_2 , Br_2 , I_2 , in order of their increasing reactivity with alkanes.

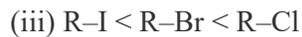
(i) $\text{I}_2 < \text{Br}_2 < \text{Cl}_2 < \text{F}_2$

(ii) $\text{Br}_2 < \text{Cl}_2 < \text{F}_2 < \text{I}_2$

(iii) $\text{F}_2 < \text{Cl}_2 < \text{Br}_2 < \text{I}_2$



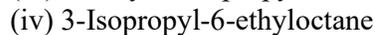
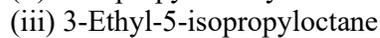
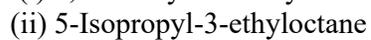
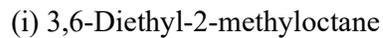
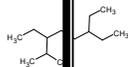
5. The increasing order of reduction of alkyl halides with zinc and dilute HCl is



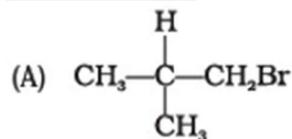
6. Arrange the following hydrogen halides in order of their decreasing reactivity with propene.



7. The correct IUPAC name of the following alkane is



8. Arrange the following alkyl halides in decreasing order of the rate of β – elimination reaction with alcoholic KOH.





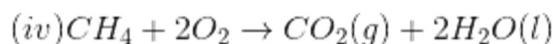
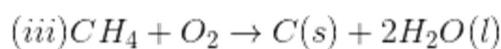
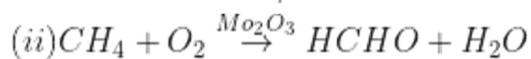
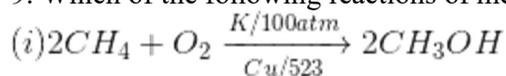
(i) $A > B > C$

(ii) $C > B > A$

(iii) $B > C > A$

(iv) $A > C > B$

9. Which of the following reactions of methane is incomplete combustion:



10. A dibromo derivative of an alkane reacts with sodium metal to form an alicyclic hydrocarbon. The derivative is _____.

(i) 2, 2-dibromobutane

(ii) 1, 1-dibromopropane

(iii) 1, 4-dibromobutane

(iv) 1, 2-dibromoethane

11. The position of double bond in alkenes can be located by :

(i) Hydrogenation of oil

(ii) Ozonolysis

(iii) Photolysis

(iv) Hydration

12. Nitrobenzene on reaction with conc. HNO_3/H_2SO_4 at $80 - 100^\circ C$ forms which one of the following products?

(i) 1, 2-Dinitrobenzene

(ii) 1, 3-Dinitrobenzene

(iii) 1, 4-Dinitrobenzene

(iv) 1, 2, 4-Trinitrobenzene

13. Some meta-directing substituents in aromatic substitution are given. Which one is most deactivating?

(i) $-C \equiv N$

(ii) $-SO_3H$

(iii) $-COOH$

(iv) $-NO_2$

14. Which of the following compounds will exhibit geometrical isomerism?

- (i) 1-Phenyl-2-butene
- (ii) 3-Phenyl-1-butene
- (iii) 2-Phenyl-1-butene
- (iv) 1,1-Diphenyl-propene .

15. The order of decreasing reactivity towards an electrophilic reagent, for the following : (i) Benzene (ii) Toluene (iii) Chlorobenzene (iv) Phenol would be:

- (i) (i) > (ii) > (iii) > (iv)
- (ii) (ii) > (iv) > (i) > (iii)
- (iii) (iv) > (iii) > (ii) > (i)
- (iv) (iv) > (ii) > (i) > (iii)

16. Pure methane can be prepared by

- (i) Soda lime decarboxylation
- (ii) Kolbes electrolytic method
- (iii) Wurtz reaction
- (iv) Reduction with H_2

17. Hydrocarbon containing following bond is most reactive

- (i) $C \equiv C$
- (ii) $C = C$
- (iii) C-C
- (iv) All of these

18. The compound C_3H_4 has a triple bond, which is indicated by its reaction with

- (i) Bromine water
- (ii) Bayers reagent
- (iii) Fehling solution
- (iv) Ammonical silver nitrate

19. Isopropyl bromide on Wurtz reaction gives

- (i) Hexane
- (ii) Propane
- (iii) 2,3-Dimethylbutane
- (iii) Neohexane

20. Nitrobenzene on reaction with conc. HNO_3/H_2SO_4 at $80 - 100^\circ C$ forms which one of the following products?

- (i) 1,2-Dinitrobenzene
- (ii) 1,3-Dinitrobenzene
- (iii) 1,4-Dinitrobenzene
- (iv) 1,2,4-Trinitrobenzene

21. 2-Phenylpropene on acidic hydration gives

- (i) 2-Phenyl-2-propanol
- (ii) 2-Phenyl-1-propanol
- (iii) 3-Phenyl-1-propanol
- (iv) 1-Phenyl-2-propanol

22. Which one of these is not true for benzene?

- (i) There are three carbon-carbon single bonds and three carbon-carbon double bonds.
- (ii) Heat of hydrogenation of benzene is less than the theoretical value
- (iii) It forms only one type of mono substituted product
- (iv) The bond angle between carbon-carbon bonds is 120 Degree

23. The catalyst used in Friedel-Crafts reaction is

- (i) Aluminium Chloride
- (ii) Anhydrous Aluminium Chloride
- (iii) Ferric Chloride
- (iv) Copper.

24. Alkyl halides react with dialkyl copper reagents to give?

- (i) Alkanes
- (ii) Alkenes
- (iii) Hydrogen
- (iv) Carbon

25. The lowest alkene, that is capable of exhibiting geometrical isomerism is

- (i) Ethene
- (ii) But-1-ene
- (iii) But-2-ene
- (iv) Propene.

26. Presence of a nitro group in a benzene ring

- (i) Activates the ring towards electrophilic substitution
- (ii) Renders the ring basic
- (iii) Deactivates the ring towards nucleophilic substitution
- (iv) Deactivates the ring towards electrophilic substitution

27. Which of the following is correct regarding the stability of carbocation?

- (i) $3^\circ > 2^\circ > 1^\circ$
- (ii) $1^\circ < 2^\circ < 3^\circ$
- (iii) $2^\circ > 1^\circ > 3^\circ$
- (iv) $2^\circ > 3^\circ > 1^\circ$

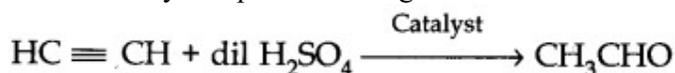
28. A liquid hydrocarbon is converted to a mixture of gaseous hydrocarbon by

- (i) hydrolysis
- (ii) oxidation
- (iii) distillation
- (iv) cracking

29. The peroxide effect in anti-Markovnikov addition involves

- (i) The heterolytic fission of the double bond
- (ii) The homolytic fission of the double bond
- (iii) a free radical mechanism
- (iv) an ionic mechanism

30. The catalyst required for the given reaction is



- (i) HgSO_4 (ii) Pt (iii) AlCl_3 (iv) Pd

31. Which conformation of ethane has the lowest potential energy?

- (i) Eclipsed (ii) Skewed
- (iii) Staggered (iv) All will have equal PE

32. Baeyer's reagent is

- (i) aqueous KMnO_4 (ii) neutral KMnO_4
- (iii) alkaline KMnO_4 (iv) aqueous bromine water

33. Benzene reacts with acetyl chloride in the presence of AlCl_3 to give

- (i) acetophenone (ii) toluene
- (iii) benzophenone (iv) ethyl benzene

34. An aqueous solution of compound A gives ethane on electrolysis, the compound A is

- (i) Ethyl acetate (ii) Sodium acetate
- (iii) Sodium propionate (iv) Sodium ethoxide

35. Toluene reacts with chlorine in the presence of light to give

- (i) benzyl chloride (ii) benzoyl chloride
- (iii) p-chlorotoluene (iv) o-chlorotoluene

36. Which of the following is less reactive than benzene towards electrophilic substitution reactions?

- (i) Nitrobenzene (ii) Aniline
- (iii) Bromobenzene (iv) Chlorobenzene

ASSERTION AND REASON TYPE QUESTIONS

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.

41. 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) : $(4n + 2) \pi$ electrons rule does not hold good and ring is not planar.

- (i) Both A and R are correct and R is the correct explanation of A.
- (ii) Both A and R are correct but R is not the correct explanation of A.
- (iii) Both A and R are not correct.
- (iv) A is not correct but R is correct.

42. 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-position.

- (i) Both A and R are correct and R is the correct explanation of A.
- (ii) Both A and R are correct but R is not the correct explanation of A.
- (iii) Both A and R are not correct.
- (iv) A is not correct but R is correct.

43. Assertion (A) : Nitration of benzene with nitric acid requires the use of concentrated sulphuric acid.

Reason (R) : The mixture of concentrated sulphuric acid and concentrated nitric acid produces the electrophile, NO_2^+ .

- (i) Both A and R are correct and R is the correct explanation of A.
- (ii) Both A and R are correct but R is not the correct explanation of A.
- (iii) Both A and R are not correct.
- (iv) A is not correct but R is correct.

44. Assertion (A) : Among isomeric pentanes, 2, 2-dimethylpentane has highest boiling point.

Reason (R) : Branching does not affect the boiling point.

- (i) Both A and R are correct and R is the correct explanation of A.
- (ii) Both A and R are correct but R is not the correct explanation of A.
- (iii) Both A and R are not correct.
- (iv) A is not correct but R is correct.

ANSWER KEY

CASE STUDY

(I) 1: (b) 2: (b) 3: (a) 4 : (b)

(II) 1. : (c) 2.: (a) 3 : (c) 4: (d) 5 : (c)

MCQ

1 (iv)	2 (ii)	3 (iv)	4 (i)	5 (ii)	6 (iii)	7 (i)	8 (iv)	9 (iii)	10(iii)
11(ii)	12(ii)	13(iv)	14(i)	15(iv)	16(i)	17(i)	18(iv)	19(iii)	20(ii)
21(i)	22(i)	23(ii)	24(i)	25(iii)	26(iv)	27 (i)	28(iv)	29(iii)	30(i)
31(iii)	32(iii)	33(i)	34(ii)	35(i)	36(i)	37(iii) and (iv)	38(i&iv)	39(i & iii)	40(i& iii)
41(i)	42(i)	43(i)	44(iii)						

PREPARED BY; PARVEEN MEHMI

PGT CHEMISTRY

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