NCERT

SMART Scan

OBJECTIVE

CHEMISTRY

Chapterwise Solved Papers

Chief Editor
A.K. Mahajan

Compiled and Edited by
Subject Expert Group

Computer Graphics by
Balkrishna, Charan Singh, Bhupendra Mishra

Editorial Office
12, Church Lane Prayagraj-211002
9415650134
Email : yctap12@gmail.com
website : www.yctbooks.com/www.yctfastbook.com/www.yctbooksprime.com

Publisher Declaration

Edited and Published by A.K. Mahajan for YCT Publications Pvt. Ltd.
and E:Book by APP Youth Prime BOOKS In order to Publish the book,
full care has been taken by the Editor and the Publisher,
still your suggestions and queries are welcomed.
In the event of any dispute, the judicial area will be Prayagraj.

INDEX

SYLLABUS

PHYSICAL CHEMISTRY

UNIT-1
SOME BASIC CONCEPTS IN CHEMISTRY

Matter and its nature.
Dalton's atomic theory: Concept of atom, molecule, element and compound,
Laws of chemical combination.
Atomic and molecular masses.
Mole concept, molar mass, percentage composition, empirical and molecular formulae.
Chemical equations and stoichiometry.

UNIT 2
ATOMIC STRUCTURE

Nature of electromagnetic radiation,
Photoelectric effect;
Spectrum of the hydrogen atom.
Bohr model of a hydrogen atom and its postulates.
Derivation of the relations for the energy of the electron and radii of the different orbits for Bohr's model.
Limitations of Bohr's model.
Dual nature of matter.
De-de Broglie's relationship.
Heisenberg uncertainty principle.
Elementary ideas of quantum mechanics and Quantum mechanics.
The quantum mechanical model of the atom its and important features.
Concept of atomic orbitals as one-electron wave functions.
Variation of Ψ and Ψ^2 with r for ls and 2s orbitals.
Various quantum numbers (principal, angular momentum, and magnetic quantum numbers) and their significance.
Shapes of s, p, and d – orbitals.
Electron spin and spin quantum number:
Rules for filling electrons in orbitals - Aufbau principle, Pauli's exclusion principle and Hund's rule.
Electronic configuration of elements, extra stability of half-filled and completely filled orbitals.

UNIT-3
CHEMICAL BONDING AND MOLECULAR STRUCTURE

Kossel-Lewis approach to chemical bond formation.
The concept of ionic and covalent bonds.
Ionic Bonding: Formation of ionic bonds and factors affecting its formation.
Calculation of lattice enthalpy.
Covalent Bonding: concept of electronegativity.
Fajan's rule.
Dipole moment.
VSEPR theory and shapes of simple molecules.
Quantum mechanical approach to covalent bonding.
Valence bond theory and its important features.
The concept of hybridization involving s, p, and d orbitals.
Resonance.

Molecular orbital Theory

Its important features.
LCAOs, types of molecular orbitals (bonding, antibonding),
Sigma and pi-bonds,
Molecular orbital electronic configurations of homonuclear diatomic molecules,
The concept of bond order, Bond length and bond energy.
Elementary idea of metallic bonding.
Hydrogen bonding and is applications.

UNIT-4
CHEMICAL THERMODYNAMICS

Fundamentals of thermodynamics: system and surroundings, Extensive and intensive properties.
State functions.
Types of processes.

The first law of thermodynamics

Concept of work.
Heat internal energy and enthalpy.
Heat capacity and Molar heat capacity.
Hess's law of constant heat summation:
Enthalpies of bond dissociation, Combustion, Formation, Atomization. Sublimation.
Phase transition, Hydration, Ionization and solution.

The second law of thermodynamics

Spontaneity of processes; ΔS of the universe and ΔG of the system as criteria for spontaneity.
ΔG^o (Standard Gibbs energy change).
Equilibrium constant.

Unit-5
SOLUTIONS

Expressing the concentration of solution: Molality, molarity, mole fraction, percentage (by volume and mass both),
The vapour pressure of solutions.
Raoult's Law–Ideal and non-ideal solutions.
Vapour pressure composition and Plots for ideal and non-ideal solutions.
Colligative properties of dilute solutions :
A relative lowering of vapour pressure.
Depression of freezing point.

The elevation of boiling point and osmotic pressure.
Determination of molecular mass using colligative properties.
Abnormal value of molar mass and Van't Hoff factor and its significance.

UNIT-6
EQUILIBRIUM

Equilibrium and the concept of dynamic equilibrium.

Equilibria involving physical processes :

Solid-liquid, Liquid - gas and solid-gas equilibria,
Henry's law.
General characteristics of equilibrium involving physical processes.

Equilibrium involving chemical processes :

Law of chemical equilibrium,
Equilibrium constants (K_p and K_c) and their significance,
The significance of ΔG and ΔG^o in chemical equilibrium,
Factors affecting equilibrium concentration: Pressure, temperature and catalyst.
Le Chatelier's principle.

Ionic equilibrium :

Weak and strong electrolytes.
Ionization of electrolytes.
Various concepts of acids and bases (Arrhenius. Bronsted - Lowry and Lewis) and their ionization.
Acid-base equilibria (including multistage ionization) and ionization constants.
Ionization of water, pH scale, common ion effect.
Hydrolysis of salts and pH of their solutions.
The solubility of sparingly soluble salts and solubility products.
Buffer solutions.

UNIT-7
REDOX REACTIONS AND ELECTROCHEMISTRY

Electronic concepts of oxidation and reduction.
Redox reactions.
Oxidation number and Rules for assigning oxidation number.
Balancing of redox reactions.
Electrolytic and metallic conduction.
Conductance in electrolytic solutions.
Molar conductivities and their variation with concentration : Kohlrausch's law and its applications.
Electrochemical cells - Electrolytic and Galvanic cells.
Different types of electrodes.
Electrode potentials including standard electrode potential.
Half - cell and cell reactions.
Emf of a Galvanic cell and its measurement.
Nernst equation and its applications.
Relationship between cell potential and Gibbs' energy change.
Dry cell and lead accumulator. Fuel cells.

UNIT-8
CHEMICAL KINETICS

Rate of a chemical reaction.
Factors affecting the rate of reactions: concentration, Temperature, pressure and catalyst.
Elementary and complex reactions.
Order and molecularity of reactions.
Rate law, rate constant and its units.
Differential and integral forms of zero and first-order reactions.
Characteristics and half-lives of zero and first-order reactions.
The effect of temperature on the rate of reactions.
Arrhenius theory, Activation energy and its calculation.
Collision theory of bimolecular gaseous reactions (no derivation).

INORGANIC CHEMISTRY

UNIT-9
CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES

Modern periodic law and present form of the periodic table.
s,p,d and f block elements.
Periodic trends in properties of elements atomic and ionic radii, Ionization enthalpy, Electron gain enthalpy.
Valency, Oxidation states and chemical reactivity.

UNIT-10
P-BLOCK ELEMENTS

Group-13 to Group 18 Elements

General Introduction :

Electronic configuration
General trends in physical and chemical properties of elements.
Unique behaviour of the first element in each group.

UNIT-11
D-AND F-BLOCK ELEMENTS

Transition Elements
General introduction and Electronic configuration.
Occurrence and characteristics,
General trends in properties of the first-row transition elements - physical properties, Ionization enthalpy, Oxidation states, Atomic radii, Colour, catalytic behaviour, Magnetic properties.

Complex formation.
Interstitial compounds.
Alloy formation.
Preparation, properties, and uses of $K_2Cr_2O_7$, and $KMnO_4$.

Inner Transition Elements

Lanthanoids - Electronic configuration, oxidation states, and lanthanoid contraction.

Actinoids - Electronic configuration and oxidation states.

UNIT-12

CO-ORDINATION COMPOUNDS

Introduction to coordination compounds.
Werner's theory; ligands, coordination number, denticity, chelation.
IUPAC nomenclature of mononuclear co-ordination compounds,
Isomerism.
Bonding-Valence bond approach.
Basic ideas of Crystal field theory and Colour and magnetic properties.
Importance of co-ordination compounds (in qualitative analysis, extraction of metals and in biological systems).

ORGANIC CHEMISTRY

UNIT-13

PURIFICATION AND CHARACTERISATION OF ORGANIC COMPOUNDS

Purification -

Crystallization,
Sublimation,
Distillation,
Differential Extraction
Chromatography - principles and their applications.

Qualitative analysis -

Detection of nitrogen.
Detection of Sulphur.
Detection of Phosphorus.
Detection of Halogens.

Quantiative analysis (basic principles only) -

Estimation of carbon.
Estimation of Hydrogen.
Estimation of Nitrogen.
Estimation of Halogens.
Estimation of Sulphur.
Estimation of Phosphorus.
Calculations of empirical formulae and molecular formulae : Numerical problems in organic quantitative analysis.

UNIT-14

SOME BASIC PRINCIPLES OF ORGANIC CHEMISTRY

Tetravalency of carbon : Shapes of simple molecules and hybridization (s and p) .
Classification of organic compounds based on functional groups containing X (Halogen) O, N and S.
Homologous series.
Isomerism - structural and stereoisomerism.

Nomenclature (Trivial and IUPAC)

Covalent bond fission - Homolytic and heterolytic.
Free radicals, carbocations, and carbanions.
Stability of carbocations and free radicals.
Electrophiles and nucleophiles.

Electronic displacement in a covalent bond-

Inductive effect.
Electromeric effect.
Resonance and hyperconjugation.

Common types of organic reactions–

Substitution reaction.
Addition reaction.
Elimination and rearrangement.

UNITS-15

HYDROCARBONS

Classification.
Isomerism.
IUPAC nomenclature.
General methods of preparation and Properties, and reactions.

Alkanes -

Conformations : Sawhorse and newman projections (of ethane) :
Mechanism of halogenation of alkanes.

Alkenes -

Geometrical isomerism : Mechanism of electrophilic addition :
Addition of hydrogen, halogens,
Water, hydrogen halides (Markownikoffs and peroxide effect) :
Ozonolysis and polymerization).

Alkynes -

Acidic character :
Addition of hydrogen, halogens, water, and hydrogen halides :
Polymerization.

Aromatic hydrocarbons –

Nomenclature.
Benzene - structure and aromaticity.
Mechanism of electrophilic substitution: Halogenation, nitration.
Friedel - Craft's alkylation and acylation.
Directive influence of the functional group in mono-substituted benezene.

UNIT-16

ORGANIC COMPOUNDS CONTAINING HALOGENS

General methods of preparation,

Properties and reactions;

Nature of C-X bond;

Mechanisms of substitution reactions.

Environmental effects of chloroform, Iodoform freons, and DDT.

UNIT-17

ORGANIC COMPOUNDS CONTAINING OXYGEN

General methods of preparation.

Properties, Reactions and uses.

ALCOHOLS, PHENOLS, AND ETHERS

Alcohols :

Identification of primary, secondary, and tertiary alcohols.

Mechanism of dehydration.

Phenols :

Acidic nature.

Electrophilic substitution reactions : Halogenation, nitration and sulphonation.

Reimer - Tiemann reaction.

Ethers : Structure.

Aldehyde and Ketones :

Nature of carbonyl group.

Nucleophilic addition to >C = O group.

Relative reactivities of aldehydes and ketones.

Important reactions: Nucleophilic addition reactions (addition of HCN, NH_3, and its derivatives), Grignard Reagent, Oxidation, Reduction (Wolf Kishner and Clemmensen).

The acidity of α-hydrogen:

Aldol condensation.

Cannizzaro reaction.

Haloform reaction.

Chemical tests to distinguish between aldehydes and Ketones.

Carboxylic Acids

Acidic strength and factors affecting it.

UNIT-18

ORGANIC COMPOUNDS CONTAINING NITROGEN

Amines :

Nomenclature.

Classification structure.

Basic character and identification of primary, secondary, and tertiary amines and their basicity.

Diazonium Salts : Importance in synthetic organic chemistry.

UNIT-19

BIOMOLECULES

General introduction and importance of biomolecules.

CARBOHYDRATES -

Classification; aldoses and ketoses.

Monosaccharides (glucose and fructose) and constituent monosaccharides of oligosaccharides (sucrose, lactose, and maltose).

PROTEINS –

Elementary idea of α-amino acids, Peptide bond and polypeptides.

Proteins: Primary, secondary, tertiary, and quaternary structure (qualitative idea only).

Denaturationof proteins.

Enzymes.

VITAMINS – Classification and functions.

NUCLEIC ACIDS – Chemical constitution of DNA and RNA.

Biological functions of nucleic acids.

Hormones (General introduction)

UNIT-20

PRINCIPLES RELATED TO PRACTICAL CHEMISTRY

Detection of extra elements (N, S and X) in organic compounds.

Detection of the following functional groups- Hydroxyl (alcoholic and phenolic).

Carbonyl (aldehyde and ketones), carboxyl and amino groups in organic compounds.

- The chemistry involved in the preparation of the following :

  Inorganic compounds: Mohr's salt, potash alum.

  Organic compounds : Acetanilide, p-nitro acetanilide, Aniline yellow, Iodoform.

- The chemistry involved in the titrimetric exercises:

  Acids, bases and the use of indicators,

  Oxalic-acid vs $KMNO_4$,

  Mohr's salt vs $KMnO_4$.

- Chemical principles involved in the qualitative salt analysis :

  Cations – Pb^{2+}, Cu^{2+}, Al^{3+}, Fe^{3+}, Zn^{2+}, Ni^{2+}, Ca^{2+}, Ba^{2+}, Mg^{2+}, NH_5^+

  Anions - S^{2-}, SO_4^{2-}, NO^{3-}, NO^{2-}, CO_3^{2-}, Cl^-,

  Br^-, I^- (Insoluble salts excluded).

  Chemical principles involved in the following experiments :

1. Enthalpy of solution of $CuSO_4$
2. Enthalpy of neutralization of strong acid and strong base.
3. Preparation of lyophilic and lyophobic sols.
4. Kinetic study of the reaction of iodide ions with hydrogen peroxide at room temperature.

All India Medical Entrance Exam Chemistry Previous Years Exam Papers Analysis Chart

S. No	Exam	Proposed Year	Question Paper	Total Question
National Eligibility Cum Entrance Test /All India Pre Medical Test (NEET/AIPMT)				
1.	RE-NEET (UG)-	23.06.2024		50
2.	NEET (UG)-	05.05.2024		50
3.	RE NEET -Manipur	06.06.2023		50
4.	NEET	07.05.2023		50
5.	NEET	17.07.2022		50
6.	NEET	12.09.2021		50
7.	NEET	13.09.2020		50
8.	NEET	05.06.2019		50
9.	NEET	06.05.2018		50
10.	NEET	07.05.2017		50
11.	NEET	01.05.2016	Phase-I	50
12.	NEET	24.06.2016	Phase-II	50
13.	NEET/AIPMT	25.07.2015		50
14.	NEET	04.05.2014		50
15.	NEET	05.05.2013		50
16.	AIPMT	2012		50
17.	AIPMT	2011		50
18.	AIPMT	2010		50
19.	AIPMT	2009		50
20.	AIPMT	2008		50
21.	AIPMT	2007		50
22.	AIPMT	2006		50
23.	AIPMT	2005		50
24.	AIPMT	2004		50
25.	AIPMT	2003		50
26.	AIPMT	2002		50
27.	AIPMT	2001		50
28.	AIPMT	2000		50
29.	AIPMT	1999-1988		600
Telangana State Council Higher Education				
30.	Telangna SCHE	08.05.2024	Shift-I	40
31.	Telangana SCHE	07.05.2024	Shift I	40
32.	Telangana SCHE	07.05.2024	Shift II	40

All India Institute of Medical Sciences (AIIMS)				
33.	AIIMS	26.05.2019	Shift-I	60
34.	AIIMS	26.05.2019	Shift-II	60
35.	AIIMS	25.05.2019	Shift-I	60
36.	AIIMS	25.05.2019	Shift-II	60
37.	AIIMS	2018		60
38.	AIIMS	2017		60
39.	AIIMS	2016		60
40.	AIIMS	2015		60
41.	AIIMS	2014		60
42.	AIIMS	2013		60
43.	AIIMS	2012		60
44.	AIIMS	2011		60
45.	AIIMS	2010		60
46.	AIIMS	2009		60
47.	AIIMS	2008		60
48.	AIIMS	2007		60
49.	AIIMS	2006		60
50.	AIIMS	2005		60
51.	AIIMS	2004		60
52.	AIIMS	2003		60
53.	AIIMS	2002		60
54.	AIIMS	2001		60
55.	AIIMS	2000		60
56.	AIIMS	1999-1994		300
Andhra Pradesh Engineering, Agriculture and Medical Common Entrance Test (AP EAMCET)				
57.	AP EAMCET Medical	2013		50
58.	AP EAMCET Medical	2012		50
59.	AP EAMCET Medical	2010		40
60.	AP EAMCET Medical	2009		40
61.	AP EAMCET Medical	2008		40
62.	AP EAMCET Medical	2007		40
63.	AP EAMCET Medical	2006		40
64.	AP EAMCET Medical	2004		40
65.	AP EAMCET Medical	2003		50
66.	AP EAMCET Medical	2002		40
67.	AP EAMCET Medical	2001		40
68.	AP EAMCET Medical	1999		40
69.	AP EAMCET Medical	1998		50
70.	AP EAMCET Medical	1997		50

Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER)				
71.	JIPMER	2019		60
72.	JIPMER	2018		60
73.	JIPMER	2017		60
74.	JIPMER	2016		60
75.	JIPMER	2015		60
76.	JIPMER	2014		60
77.	JIPMER	2013		60
78.	JIPMER	2012		60
79.	JIPMER	2011		60
80.	JIPMER	2010		60
81.	JIPMER	2009		60
82.	JIPMER	2008		60
83.	JIPMER	2007		60
84.	JIPMER	2006		60
85.	JIPMER	2005		60
86.	JIPMER	2004		60
Uttar Pradesh Combined Pre Medical Test (UPCPMT)				
87.	UPCPMT	2014		50
88.	UPCPMT	2013		50
89.	UPCPMT	2012		50
90.	UPCPMT	2011		50
91.	UPCPMT	2010		50
92.	UPCPMT	2009		50
93.	UPCPMT	2008		50
94.	UPCPMT	2007		50
95.	UPCPMT	2006		50
96.	UPCPMT	2005		50
97.	UPCPMT	2004		50
98.	UPCPMT	2003		50
99.	UPCPMT	2002		50
100.	UPCPMT	2001		50
			Total	**6070**

Note : After detailed analysis of above mentioned papers of **NEET** and Other Medical and Engineering Examination Related to **Chemistry** 6070 have been presented chapterwise. Questions of repeated and similar nature have included so that the technique of asking question can benefit the competitors.

01.

Some Basic Concepts in Chemistry

A.1 Dalton's atomic theory: Concept of atom molecule, element and compound, matter and its nature

A1.1 Multiple Choice Question. (MCQS)

1. O_2 and O_3 are

(a) allotropes (b) isotopes
(c) isomorphs (d) polymorphs

UP CPMT-2010

Ans. (a) : Since, in O_2 and O_3 different numbers of same element i.e. oxygen are present, these are allotropes.
Note. Different crystalline structures, different number of atoms and different nuclear spins all result in allotropy.

2. Isotones have

(a) same number of protons
(b) same number of electrons
(c) same number of neutrons
(d) same isotopic mass

UP CPMT-2010

Ans. (c): Species having the same number of neutron but different atomic number as well as atomic mass are called isotones. E.g. ${}^{39}_{18}Ar$, ${}^{40}_{19}K$.

3. ${}_{19}K^{40}$ and ${}_{20}Ca^{40}$ are known as

(a) isotopes (b) isobars
(c) isotones (d) isodiaphers

UP CPMT-2002

Ans.(b): ${}_{19}K^{40}$ and ${}_{20}Ca^{40}$ both have same mass no but different atomic number, are called isobars.

4. Isotopic pair is

(a) ${}_{20}X^{40}$, ${}_{21}Y^{40}$ (b) ${}_{20}X^{40}$, ${}_{20}Y^{41}$
(c) ${}_{40}X^{20}$, ${}_{41}Y^{20}$ (d) None of these

UP CPMT-2005

Ans. (b) : Key Idea: Isotopes are the atoms of same element which have different atomic masses (due to different number of neutrons). They had same atomic numbers.
$\therefore$ choice (b) is the correct answer because both (${}_{20}X^{40}$, ${}_{20}X^{41}$) have same atomic number but different atomic mass.

A.1.2 Statements based question

5. Select the correct statements from the following:

A.	**Atoms of all elements are composed of two fundamental particles.**
B.	**The mass of the electron is 9.10939×10^{-31} kg.**
C.	**All the isotopes of a given element show same chemical properties.**
D.	**Protons and electrons are collectively known as nucleons.**
E.	**Dalton's atomic theory, regarded the atom as an ultimate particle of matter.**

Choose the correct answer from the options given below :

(a) B, C and E only (b) A, B and C only
(c) C, D and E only (d) A and E only

NEET (UG) -07.05.2023

Ans. (a) : (A) Atoms of all elements are composed of two fundamental particles. It is incorrect statement.
(B) The mass of the electron is 9.10939 $\times10^{-31}$kg. It is correct statement.
(C) All the isotopes of a given element show same chemical properties is correct statement.
(D) **Nucleons-**Nucleons are equal to number of proton and neutron in the nucleons.
eg-if the given atom of isotope is He^4_2, He^A_z
z = 2 Number of proton.
A = 4 Number of nucleons
A–z = 4–2=2 Number of Neutrons.
(Hence nucleons = Number of protons + neutrons) So It is incorrect option.
(E) Daltons atomic theory, regared the atom as an altimate particles of matter so It is correct statement.

A1.5 Assertion and Reasons.

6. Assertion: Atoms can neither be created nor destroyed.
Reason: Under similar condition of temperature and pressure, equal volume of gases does not contain equal number of atoms.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2002

Ans. (c): Dalton hypothesized the law of conservation of mass. According to this law atoms can neither be created nor destroyed.
Avogadro's law states that under similar condition of temperature and pressure, equal volume of gases contain equal number of atoms.
Therefore Assertion is correct but Reason is incorrect.

A2. Laws of chemical combination, chemical equation and stoichiometry

A2.1 Multiple Choice Question. (MCQS)

7. **Number of moles of $K_2Cr_2O_7$ reduced by one mole of Sn^{2+}?**
   (a) $\frac{1}{3}$ (b) 3
   (c) $\frac{1}{6}$ (d) 6

UP CPMT-2005

Ans. (a) One mole of Sn^{2+} can reduce 1/3 moles $K_2Cr_2O_7$.

8. **$KMnO_4$ oxidizes oxalic acid in acid medium. The number of CO_2 molecules produced as per the balanced equation is:**
   (a) 10 (b) 8
   (c) 6 (d) 3

AP EAMCET (Medical) -1998

Ans. (a): When potassium permanganate ($KMnO_4$) oxidize the oxalic acid then following reaction take place during the reaction–

$$2KMnO_4 + 3H_2SO_4 + 5H_2C_2O_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 10CO_2 + 8H_2O.$$

In a balanced chemical equation of oxidation of oxalic acid by $KMnO_4$ in acidic medium evolve 10 molecules of CO_2.

9. **In the reaction,**
   $$4NH_{3(g)} + 5O_{2(g)} \longrightarrow 4NO_{(g)} + 6H_2O_{(l)}$$
   when 1 mole of ammonia and 1 mole of O_2 are made to react to completion
   (a) all the oxygen will be consumed
   (b) 1.0 mole of NO will be produced
   (c) 1.0 mole of H_2O is produced
   (d) all the ammonia will be consumed

NEET-1998

Ans. (a) :
$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$
$1\ NH_3 + 1.25O_2 \rightarrow 1NO + 1.5\ H_2O$
When 1 mole of NH_3 reacts with 1.25 moles of O_2 it produces 1 mole of NO and 1.5 moles of H_2O. When one mole of ammonia and one mole of oxygen are made to react to completion, then all the oxygen is consumed.

A2.3 Numerical Answer Types (NATS)

10. **A hydrocarbon has 85.7% of carbon by weight. 56 g (2 moles) of hydrocarbon was completely burnt in oxygen and obtained CO_2 and H_2O. What is the weight (in g) of CO_2 formed? (C = 12 u, H = 1 u, O = 16 u)**
    (a) 179 (b) 88
    (c) 132 (d) 352

Telangna SCHE- 08.05.2024 Shift-I

Ans. (b) : Given- Mass of carbon/Total mass of hydrocarbon = 85.7%
Moles of carbon = 2 moles (Since the moss of the hydrocarbon is 56g)
Moles of hydrogen = y (unknown)

$$\frac{(12x)}{(12x+y)} = 0.857$$

$12x = 0.857\ (12x + y)$
$12x = 10.284\ x + 0.857\ y$
$1.716x = 0.857y = \boxed{n = 0.5y}$

The balanced chemical equation for the complete combustion of the hydrocarbon is -
C (0.5y) Hy + (0.5y + 0.25y) $O_2 \rightarrow$ 0.5y CO_2 + (0.5y) H_2O
The calculating the mass of CO_2 formed.
Mass of CO_2 formed = 0.5y × 44 g/mol = 22yg.
Substituting the value of y = 4 (Since the hydrocarbon has 85.7% carbon by weight.
Mass of CO_2 formed = 22 × 4 = 88g.
Therefore, the mass of CO_2 is formed is "88g".

11. **A crystal is formed by X (cations) and Y (anions). Atoms of Y form ccp and atoms of X occupy half of octahedral voids and half of tetrahedral voids. What is the molecular formula of crystal?**
    (a) X_2Y_3 (b) XY_3
    (c) X_3Y (d) X_3Y_2

Telangana SCHE 08.05.2024 Shift-I

Ans. (d) : Atoms of Y formed ccp structure which is referred to as FCC. As we know that FCC has four atom on unit cell.
No. of atom(N) = 4

Half octahedral voids at X = $\frac{N}{2} = \frac{4}{2} = 2$

Half tetrahedral voids at X = $\frac{2N}{2} = 4$

Thus, total atom on X (Cation) = 6
$\therefore$ Molecular Formula = $X_6\ Y_4 = X_3\ Y_2$

12. **50 mL of each gas A and of gas B takes 150 and 200 seconds respectively for effusing through a pin hole under the similar conditions. If molecular mass of gas B is 36, the molecular mass of gas A will be**
    (a) 96 (b) 128
    (c) 32 (d) 20.2

NEET-2012

Ans. (d) : Graham's law of effusion states that the rate of effusion of a gas is inversely proportional to the square root the molar mass of its particles.

$V_A = V_B = 50mL$

$T_A = 150s$

$T_B = 200s$

$M_B = 36$

$M_A = ?$

From Graham's law of effusion.

$$\frac{r_B}{r_A} = \sqrt{\frac{M_A}{M_B}} = \frac{V_B T_A}{T_B.V_A}$$

$$\sqrt{\frac{M_A}{36}} = \frac{V_A \times 150}{200 \times V_A}$$

$$\text{or } \sqrt{\frac{M_A}{36}} = \frac{15}{20} = 3/4$$

$$\frac{M_A}{36} = \frac{9}{16}$$

$$M_A = \frac{9 \times 36}{16} = \frac{81}{4} = 20.25 \approx 20.2$$

13. A certain gas takes three times as long to effuse out as helium. Its molecular mass will be

(a) 27 u (b) 36 u (c) 64 u (d) 9 u

NEET-2012

Ans. (b) : The rate of effusion is inversely proportional to the molecular mass

$$\frac{r_1}{r_2} = \sqrt{\frac{Mw_2}{Mw_1}}$$

The rate of effusion is the ratio of the volume effused to the time taken

$$\frac{v_1}{t_1} \times \frac{t_2}{v_2} = \sqrt{\frac{Mw_2}{Mw_1}}$$

Here, volume is same.

$$\text{So, } \frac{3}{1} = \sqrt{\frac{Mw_2}{4}}$$

$$9 = \frac{Mw_2}{4}, \quad Mw_2 = 36$$

14. Two gases A and B having the same volume diffuse through a porous partition in 20 and 10 seconds respectively. The molecular mass of A is 49 u. Molecular mass of B will be

(a) 50.00 u (b) 12.25 u
(c) 6.50 u (d) 25.00 u

NEET-2011

Ans. (b) : Graham's law of diffusion states that the rate of diffusion of a gas is inversely proportional to the square root of its molecular weight.

According to the Graham's law

$$\text{Rate of diffusion (r)} \propto \frac{1}{\sqrt{M}}$$

$$\text{Rate of diffusion} = \frac{v}{t}$$

Where v is volume and t is time

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

$$\frac{\frac{v_1}{t_1}}{\frac{v_2}{t_2}} = \sqrt{\frac{M_2}{M_1}} = \frac{t_2}{t_1} = \sqrt{\frac{M_2}{49}}$$

$$\frac{1}{2} = \sqrt{\frac{M_2}{49}}$$

$$M_2 = \frac{49}{4}$$

$M_2 = 12.254$

15. The density of a gas is found to be 1.56g/L at 745 mm pressure and 65°C. What is the molecular mass of the gas?

(a) 44.2 u (b) 4.42 u
(c) 2.24 u (d) 22.4 u

JIPMER-2010

Ans. (a): Pressure is P = 745 mm = 0.98 atm (1 atm = 760 mm Hg)

Temperature is T = 65°C = 65 + 273 = 338K

Density is d = 1.56 g/L

From ideal gas equation,

$PV = nRT$

$$P = \frac{m}{M \times V} \times R \times T \quad \left\{\begin{matrix}\text{Where, m = given mass.} \\ \text{M = molecular mass}\end{matrix}\right\}$$

$$M = \frac{d \times R \times T}{P} \quad \left(d = \text{density} = \frac{m}{v}\right)$$

$$M = \frac{1.56 \times 338 \times 0.0821}{0.98} = 44.2u$$

Hence, the molecular mass of the gas is 44.2u

16. A 0.5 g/L solution of glucose is found to be isotonic with a 2.5 g/L solution of an organic compound. What will be the molecular weight of that organic compound?

(a) 300 (b) 600
(c) 900 (d) 200

JIPMER-2009

Ans. (c) : We know, two solutions are said to be isotonic when pressure are equal.

Osmotic pressure is given by (For glucose)

$$\frac{nRT}{V} = \frac{mRT}{MV} = \frac{0.5RT}{M} = \frac{RT}{360}$$

For other organic compound.

$$\frac{nRT}{V} = \frac{mRT}{MV} = \frac{2.5RT}{M_1}$$

n = Moles of solute.

m = mass of solute.

M = Molecular weight of solute.

V = volume of solution.

T = Temperature

When both the pressures are equal.

$$\frac{RT}{360}=\frac{2.5RT}{M_1}$$

$M_1 = 900$

17. Volume of water needed to mix with 10 mL 10N HNO_3 to get 0.1N HNO_3 is

(a) 1000mL (b) 990mL

(c) 1010mL (d) 10mL

AIIMS-2017

Ans. (b): Given, N_1 = 10 N, V_1 = mL, N_2 = 0.1 N and V_2 = ?

By law of conservation

$N_1V_1 = N_2V_2$

$10 \times 10 = 0.1\ (10 + V)$

$$V=\frac{10\times10}{0.1}-10=1000-10=990\,\text{mL}$$

18. An aqueous solution of 6.3 g of oxalic acid dihydrate is made up to 250 mL. The volume of 0.1 N NaOH required to completely neutralise 10 mL of this solution is

(a) 20 mL (b) 40 mL

(c) 10 mL (d) 4 mL

AIIMS-2013

Ans. (b): As we know,

n- factor for $H_2C_2O_4.2H_2O = 2$

$$\text{Normality}=\frac{\text{weight}\times2\times1000}{\text{molecular weight}\times250}=\frac{6.3\times2000}{126\times250}=0.4$$

$N_1V_2 = N_2V_2$

$0.4 \times 10 = V_2 \times 0.1 \Rightarrow$ Volume (V_2) = 40 mL.

19. Liquid benzene burns according to $2C_6H_6(l)$ + $15O_2(g) \rightarrow 12O0_2(g)$ +$6H_2O$ (g) How many litres of oxygen are required for complete combustion of 39g of liquid C_6H_6 (atomic wt. of C=12, O = 16)?

(a) 11.2 (b) 22.4

(c) 42 (d) 84

A.P.EAMCET-1998, 1996

Ans. (d) :

$$2C_6H_6(l)+15O_2(g)\rightarrow12CO_2(g)+6H_2O(g)$$

2×78gm 15×22.4L

For combustion of 2×78gm of C_6H_6

Volume of O_2 required = 15 ×22.4L

$\because$ For combustion of 39 gm of C_6H_6

Volume of O_2 required = $\frac{15\times22.4\times39}{2\times78}$ = 84 L

20. The mass of carbon anode consumed (giving only carbon dioxide) in the production of 270 kg of aluminium metal from bauxite by the Hall process is

(a) 270 kg (b) 540 kg

(c) 90 kg (d) 180 kg

NEET-2005

Ans. (c): $\underset{3\times12=36}{2Al_2O_3+3C} \longrightarrow \underset{4\times27=108}{4Al+3CO_2}$

$\therefore$ For 108 g of Al, 36 g of C is required in above reaction

$\therefore$ For 270 kg of Al require amount of C

$$=\frac{36}{108}\times270=90\text{ kg}$$

21. The number of moles of oxygen obtained by the electrolytic decomposition of 108 g water is

(a) 2.5 (b) 3

(c) 5 (d) 7.5

JIPMER-2008

Ans. (b): $2H_2O \xrightarrow{\text{Electrolysis}} 2H_2+O_2$

2 mole 1 mole

$2\times18=36$

$\because$ 36 g of H_2O produce 1 mole of oxygen

$\therefore$ 108 g of water will produce oxygen

$$=\frac{108}{36}=3\,\text{mole}$$

22. $KMnO_4$ reacts with ferrous sulphate according to the following equation.

$$MnO_4^-+5Fe^{2+}+8H^-\rightarrow Mn^{2+}+2Fe^{3+}+4H_2O$$

Here, 10 mL of 0.1 M $KMnO_4$ is equivalent to

(a) 50 mL of 0.1 M $FeSO_4$

(b) 20 mL of 0.1 M $FeSO_4$

(c) 40 mL of 0.1 M $FeSO_4$

(d) 30 mL of 0.1 M $FeSO_4$

JIPMER-2015

Ans. (a) : $KMnO_4$ reacts with ferrous sulphate according to the following equation,

$$2KMnO_4+10FeSO_4+8H_2SO_4\rightarrow K_2SO_4+2MnSO_4+5Fe_2(SO_4)_3+8H_2O$$

2 moles of $KMnO_4$ reacts with 10 moles of $FeSO_4$

The number of moles of $KMnO_4$ in 10 ml of 0.1

M = 0.1 × 0.01 = 10^{-3} moles

No. of moles $FeSO_4$ = 5 × 10^{-3}

Volume having 5×10^{-3} mol in 0.1 $MFeSO_4$

$$0.1=\frac{5\times10^{-3}\times1000}{V_{m\ell}}$$

$$V_{m\ell}=\frac{5\times10^{-3}\times1000}{0.1}$$

$V_{m\ell}=50\,\text{ml}$

23. An element, X has the following isotopic composition :

$^{200}X:90\%$ $^{199}X:8.0\%$ $^{202}X:2.0\%$

The weighted average atomic mass of the naturally occurring element X is closed to

(a) 201 amu (b) 202 amu

(c) 199 amu (d) 200 amu

NEET-2007

Ans. (d) : weight of $^{200}X = 0.90 \times 200 = 180.00$ u

Weight of $^{199}X = 0.08 \times 199 = 15.92$ u

Weight of $^{202}X = 0.02 \times 202 = 4.04$ u

Total weight = 199.96 $\approx$ 200 amu.

24. Two grams of sulphur is completely burnt in oxygen to form SO_2. In this reaction, what is the volume (in litres) of oxygen consumed at STP?
(Atomic weight of sulphur and oxygen are 32 and 16 respectively).

(a) $\frac{16}{22.4}$ (b) $\frac{22.4}{16}$

(c) $\frac{22.4}{32}$ (d) $\frac{32}{22.4}$

AP-EAMCET (Medical), 2002

Ans. (b) : The following reaction occur which is given below –

$$S + O_2 \rightarrow SO_2$$

Molecular weight of SO_2 = $32 + 2 \times 16 = 64$g

Volume of oxygen (1 mole), at STP = 22.4L

At STP,

$\because$ 32g of sulphur requires O_2 = 22.4 L

$\therefore$ 2g of sulphur requires $O_2 = \frac{22.4\times 2}{32} = \frac{22.4}{16}$ L

25. How many moles of lead (II) chloride will be formed from a reaction between 6.5 g of PbO and 3.2 g HCl? (atomic weight of Pb = 207)

(a) 0.011 (b) 0.029

(c) 0.044 (d) 0.333

NEET-2008

Ans. (b) :

$$\underset{223g/mol}{PbO} + \underset{2(35.59+1)g/mole}{2HCl} \longrightarrow \underset{277g/mol}{PbCl_2} + \underset{18g/mol}{H_2O}$$

223g/mol of PbO need $\rightarrow$ 70g of HCl

$6.5 \rightarrow x \quad \Rightarrow x = \frac{6.5\times 70}{223}$

$\Rightarrow$ x = 2.04 g of HCl is needed.

223g of PbO$\rightarrow$277g of $PbCl_2$

$6.5 \rightarrow y \quad \Rightarrow y = \frac{6.5\times 277}{223} \Rightarrow y = 8.07g$

1 mol $\rightarrow$ 277g

x mol $\rightarrow$ 8.07

$\Rightarrow$ $x = \frac{8.07}{277} = 0.029$ moles

26. 1 mole of H_2 and 2 moles of I_2 are taken initially in a two liter vessel. The number of moles of H_2 at equilibrium is 0.2. Then, the number of moles of I_2 and HI at equilibrium are–

(a) 1.2, 1.6 (b) 1.8, 1.0

(c) 0.4, 2.4 (d) 0.8, 2.0

BCECE-2008, UP CPMT-2006

Ans. (a) :

	H_2 +	I_2 $\rightleftharpoons$	2HI
Intial	1mol	2mol	
At, equlibrium	0.2	$2-0.8$	2×0.8
		1.2 mol	1.6 mol

The numbers of moles of I_2 and HI at equilibrium are 1.2 moles and 1.6 moles respectively.

27. $KMnO_4$ reacts with oxalic acid according to the equation:

$$\mathbf{2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O}$$

Here 20 mL of 0.1 M $KMnO_4$ is equivalent to:

(a) 20mL of 0.5M $H_2C_2O_4$

(b) 50mL of 0.5M $H_2C_2O_4$

(c) 50mL of 0.1M $H_2C_2O_4$

(d) 20mL of 0.1M $H_2C_2O_4$

AIIMS-2013

Ans. (c):

$$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$$

At NTP

$\because$ 2 × 22.4 L reacts with 5×22.4 L of oxalic acid.

$\therefore$ 20 ml of 0.1 $KMnO_4$ reacts with oxalic acid,

$= \frac{5\times 22.4\times 20}{2\times 22.4} = 50$ ml

So, the correct option is 50 ml of 0.1 M oxalic acid.

A3. Mole concept. Atomic and molecular mass, molar mass, percentage composition, empirical and formulae.

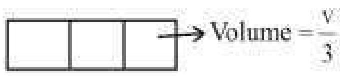
A3.1 Multiple Choice Question (MCQS)

28. At T (K), vessel contains V litres of an ideal gas. The vessel was partitioned into three equal parts. The volume (in L) and temperature (in K) each part are respectively

(a) $\frac{V}{3}, \frac{T}{3}$ (b) $\frac{V}{3}$, T (c) 3V, T (d) $\mathbf{\frac{V}{3}, 3T}$

Telangana SCHE 07.05.2024 Shift II

Ans. (b) : Given that, the volume of vessel contain V liters of an ideal gas and ideal gas is T (k).



Total volume of vessel = V liter.

Volume of cach part = $\frac{V}{3}$

Total volume of vessel = V liter.

Volume of each part = $\frac{V}{3}$

Temperature of each part = T (k).

29. **The number of products formed by thermal decomposition of lithium nitrate, sodium nitrate, sodium nitrate respectively are**

(a) 2,3 (b) 2,2
(c) 3, 3 (d) 3, 2

Telangana SCHE 07.05.2024 Shift II

Ans. (d) : The thermal decomposition of lithium nitrate ($Li\ NO_3$)

$$2\ Li\ NO_3 \xrightarrow{\Delta} Li_2O + 2NO_2 + \frac{1}{2}O_2$$

The no. of product is three.
And thermal decomposition of sodium nitrate ($NaNO_3$)

$$2NaNO_3 + \underline{\Delta}\ 2\ NaNO_2 + O_2$$

The no. of product is two.

30. **What is the correct equation that relates kinetic energy (E_{ke}) and pressure (P) of one mole of an ideal gas?**
(V = Volume)

(a) $P = \frac{2E_{ke}}{3V}$ (b) $P = \frac{3V}{2E_{ke}}$

(c) $P = \frac{3V^2}{2E_{ke}}$ (d) $P = \frac{2(E_{ke})^2}{3V}$

Telangna SCHE- 08.05.2024 Shift-I

Ans. (a) : Pressure exerted by the gas,

$$P = \frac{1}{3}\rho v^2 \quad ...(i)$$

Where, P = Total pressure
ρ = Density of gas
v = Velocity of gas molecule

Kinetic energy for unit mole of the gas -

$$E_R = \frac{1}{2}mv^2 \quad ...(ii)$$

Dividing equation (ii) from (i), we get -

$$\frac{P}{E_{K.e}} = \frac{\frac{1}{3}\rho v^2}{\frac{1}{2}mv^2}$$

or

$$P = \frac{2}{3}\frac{m}{m.v}E_{K.e}$$

$$P = \frac{2}{3}\frac{E_{K.e}}{V}$$

31. **The correct option in which the density of argon (Atomic mass = 40) is highest**

(a) 0°C,4 atm (b) 273^0C, 4 atm
(c) STP (d) 0^0C, 2 atm

RE-NEET (UG) 06.06.2023 (Manipur)

Ans. (a) : From the ideal Gas equation

$$PV = nRT$$

$$n = \frac{w}{M} \quad \text{where, } w = \text{weight}$$
$$M = \text{Molar mass}$$

$$PV = \frac{w}{M}RT$$

$$PM = \frac{w}{V}RT$$

as you know $\frac{w}{V}$ is density

$$PM = dRT$$

$$d = \frac{PM}{RT}$$

Density is directly proportional to pressure and inversely proportional to temperature.
from this equation

$$\Rightarrow d = \frac{PM}{RT}$$

for higher density, pressure will be high and temperature should be low.

32. **The molecular mass of a volatile substance may be measured by**

(a) Liebig's method
(b) Hofmann's method
(c) Victor Meyer's method
(d) none of these

AIIMS-1994

Ans. (c): The molecular mass of volatile substances can be determined by Victor Meyar. In this method primary, secondary and tertiary alcohols are subjected to a series of chemical analysis and the colour of resulting solution observed. A known mass of the compound is vaporized in an instrument called Victor Meyar tube.

33. **How many neutrons are present in tritium nucleus?**

(a) 2 (b) 3
(c) 1 (d) 0

UP CPMT-2003

Ans. (a) : Tritium (^3_1H) is an isotope of hydrogen
∴ atomic number = 1
∴ protons = electrons = 1
No. of neutrons = Atomic mass–No. of protons
= 3–1= 2

34. **Carbon atom consists of electrons, protons and neutrons. If the mass attributed to neutron were halved and that attributed to the electron were doubled, the atomic mass of $_6C^{12}$ would be approximately**

(a) same (b) doubled
(c) halved (d) reduced by 25%

UP CPMT-2013

Ans. (d) : (i) There is no change by doubling mass on electrons, because there are only 6-electrons in carbon atom which have negligible mass (6/1837 of the mass of a proton).
(ii) However, by reducing mass of neutron half, total atomic mass becomes 6 (protons) +3 (neutrons) instead 6 (protons) +6 (neutrons).
Thus, the new atomic mass of ${}_6C^{12}$ would be

$$\frac{3}{12}\times100 = 25\%$$

Thus, the atomic mass of ${}_6C^{12}$ is reduced by 25%.

35. The number of moles of $KMnO_4$ reduced by one mole of KI in alkaline medium is
(a) one fifth (b) five
(c) one (d) two
JCECE-2012
JIPMER-2007

Ans. (d) : In alkaline solution, $KMnO_4$ is reduced to MnO_2 (colourless).

$$2KMnO_4 + 2H_2O \longrightarrow MnO_2 + 2KOH + 3[O]$$
$$KI + 3[O] \longrightarrow KIO_3$$
$$2KMnO_4 + 2H_2O + KI \longrightarrow 2MnO_2 + 2KOH + KIO_3$$

Hence, two moles of $KMnO_4$ are reduced by one mole of KI.

36. For preparing 0.1 N solution of a compound from its impure sample of which the percentage purity is known, the weight of the substance required will be
(a) less than the theoretical weight
(b) more than the theoretical weight
(c) same as the theoretical weight
(d) none of these
AIIMS-2012

Ans. (b): The sample contains impurity. The impurity won't contribute to the normality of the solution. So, we need to take more amount of sample than the theoretical weight so that the theoretical weight of compound equals weight of compound in the sample.

37. One mole of fluorine reacted with two moles of hot concentrated KOH. The products formed are KF, H_2O and O_2. The molar ratio of KF, H_2O and O_2 respectively, is?
(a) 1 :1 : 2 (b) 2 :1 : 0.5
(c) 1 :2 : 1 (d) 2 :1 :2
AP EAMCET- 2002

Ans. (b) : $F_2 + 2KOH \rightarrow 2KF + H_2O + 1/2O_2$
The molar ratios of KF, H_2O and O_2 is 2: 1: 0.5 respectively.

38. One mole of CH_4 contains
(a) 4 g atoms of hydrogen
(b) 3.0 g atoms of carbon
(c) 6.02×10^{23} atoms of hydrogen
(d) 1.81×10^{23} molecules of CH_4
UP CPMT-2002

Ans. (a): 1 mole of CH_4 contains 1 gm of carbon and 4gm of mole of hydrogen. Methane (CH_4) is a colorless, odorless, flammable gas that is the simplest hydrocarbon and is the major constituent of natural gas.

39. Temperature does not affect:
(a) Molality (b) Formality
(c) Molarity (d) Normality
AIIMS-1997-2001

Ans. (a): Since molality is defined in terms of the solvent's mass not its volume, the temperature does not change the molality of a solution.
Where as in case of formality molarity and normality the concentration of solution is expressed in terms of volume which change with the change of temperature.

40. The amount of zinc required to produce 224 ml. of H_2 at STP on treatment with dilute H_2SO_4 will be
(a) 65 g (b) 0.065 g
(c) 0.65 g (d) 6.5 g
NEET-1996

Ans. (c) : When Zinc react with H_2SO_4
$$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$$
1 mole of Zinc will react to give 1 moles of hydrogen
Volume of 1 mole of hydrogen at STP = 22400 ml
1 mole of Zn = 65 grams = $\frac{65\times224}{22400} = 0.65g$
0.65 grams of Zinc can react to give 224 ml of hydrogen.

41. Avogadro's number of oxygen atom weighs
(a) 32 g (b) 8 g
(c) 56 g (d) 16 g
AIIMS-1996

Ans. (d): Avogadro's number, number of units is one mole of any substance (defined as its molecular weight is grams), equal to 6.023×10^{23}.
Weight of 6.023×10^{23} molecular of oxygen (O_2) = 32g
Since the oxygen is diatomic, therefore weight of Avogadro's number of oxygen atom = $\frac{32}{2}$ = 16 g

42. The number of moles of water present in 180 gm of water is
(a) 18 (b) 5
(c) 100 (d) 10
AIIMS-1996

Ans. (d): Given that, Molecular weight of water = 18

$$\therefore \text{ No of moles of water} = \frac{\text{Mass}}{\text{Molecular mass}}$$
$$= \frac{180}{18} = 10 \text{ moles}$$

43. 0.833 mol of a carbohydrate with empirical formula CH_2O, has 10g of hydrogen. Molecular formula of carbohydrate is
(a) $C_3H_5O_3$ (b) $C_6H_{12}O_6$
(c) $C_3H_{10}O_5$ (d) $C_3H_4O_3$
UP CPMT-2012

Ans. (b): Given that,

Weight of hydrogen = 10g

Moles of carbohydrate = 0.833

weight of hydrogen = 10g

0.833 moles of carbohydrate has hydrogen = 10g

1 mole of carbohydrate has hydrogen

$$=\frac{10\times1}{0.833}=12g$$

Given, empirical formula of carbohydrate = CH_2O

CH_2O contains hydrogen = 2 g/mole

$\therefore$ Molecular formula should contain hydrogen

$$=\frac{12\times2}{2}=12$$

Molecular formula = $C_6H_{12}O_6$

44. Two oxides of an non-metal X contain 50% and 40% of non-metal respectively. If the formula of the first oxide is XO_2, Then the formula of second oxide is

(a) X_2O_3 (b) X_2O_5
(c) XO_3 (d) X_2O

AP EAMCET-2017

Ans. (c) : Given that, the formula of first oxide is XO_2

For, second oxide 40% of (X) we have 60% of oxygen.

$\therefore$ For 100% of (X) (i.e. one mole) we get

$\therefore$ Moles of oxygen = $\frac{2\times60}{40}=3$

Hence the formula of second oxide is XO_3.

45. In an experiment it showed that 10 ml of 0.05 M solution of chloride required 10 mL of 0.1 M solution of $AgNO_3$, which of the following will be the formula of the chloride (X stands for the symbol of the element other than chlorine)?

(a) X_2CL_2 (b) XCL_2
(c) XCL_4 (d) X_2CL

Karnataka NEET-2013

Ans. (b): Given that,

Molarity of $AgNO_3$ = 0.1

Molarity = 0.05M

Volume of chloride = 10 ml

So, no. of moles of chloride

$$=\frac{10}{100}\times0.05=\frac{0.5}{1000}$$

& no. of moles of $AgNO_3$

$$=0.1\times\frac{10}{100}=\frac{1}{1000}$$

Gram of chloride = gram equivalent of $AgNO_3$

$$\Rightarrow \frac{0.5n}{1000}=\frac{1}{1000}$$

$$\begin{pmatrix}\text{Where}\\ \text{n = no.of chlorides}\end{pmatrix}$$

$\therefore$ n = 2

So, formula in XCl_2

A3.2 Statements based question

46. The incorrect statement for 14g of CO is

(a) It occupies 2.24L at NTP
(b) It corresponds to 1/2 mole of CO
(c) It corresponds to same mole of CO and N_2
(d) It corresponds to 3.01×10^{23} molecules of CO

UP CPMT-2002

Ans. (a) : For 14 gm of CO –

No. of mole CO = $\frac{14}{28}=\frac{1}{2}$ mole.

for 14 gm of N_2 –

No. of mole N_2 = $\frac{14}{28}=\frac{1}{2}$ mole

$\because$ One mole of any gas occupies 2.24 litre.

$\therefore$ $\frac{1}{2}$ mole of CO gas occupies only 11.2 litre volume.

One mole of molecule contain = N_A molecule

= 6.02×10^{23} molecule

$\therefore$ $\frac{1}{2}$ mole of CO contain = 3.01×10^{23} molecule of CO.

47. Arrange the following in the order increasing mass (atomic mass O = 16, Cu = 63, N = 14)

I. One molecule of oxygen

II. One atom of nitrogen

III. 1×10^{-10} gram molecule of oxygen

IV. 1×10^{-10} g of copper

(a) II < I < IV < III (b) I < II < III < IV
(c) III < II < IV < I (d) IV < II < III < I
(e) II < IV < I < III

AIIMS-2016

Ans. (a) : Comparing the masses, we get correct order of increasing mass is (II) < (I) < (IV) < (III)

(I) 1 molecule of oxygen = O_2

$\therefore$ Mass of O_2

$$=\frac{16\times2}{N_A}=\frac{32g}{N_A}=\frac{32}{6.22\times10^{23}}=5.3\times10^{-23}g$$

(II) Mass of 1 atom of Nitrogen = $1.66\times10^{-24}\times14$

$= 23.2\times10^{-24}g$

(III) 1×10^{-24} gm molecule of oxygen = 1×10^{-10} moles of O_2

Mass of 1×10^{-10} gm molecule of oxygen $1\times10^{-10}\times32$

$= 3.2\times10^{-9}g$

(IV) Mass of copper = $1\times10^{-10}g$

Comparing the masses in (I), (II), (III) and (IV)

We get, (II), < (I), < (IV), < (III)

Therefore, answer is (II) < (I) < (IV) < (III)

A3.3 Numerical Answer Types (NATS)

48. 1.0g of H_2 has same number of molecules as in

(a) 14g of N_2 (b) 18 g of H_2O
(c) 16 g of CO (d) 28 g of N_2

RE-NEET (UG)-23.06.2024

Ans. (a) : Given that, weight of H_2 = 1gm and molecular weight of H_2 = 2

$\therefore$ No. of moles $= \frac{\text{Weight}}{\text{Molecular weight}}$

$= \frac{1}{2} = 0.5$ moles

For 14 g of N_2 -

So, No. of moles $= \frac{14}{28} = \frac{1}{2} = 0.5$ moles

Hence, 1.0 g of H_2 has same number of molecules as in 14g of N_2.

49. The amount of glucose required to prepare 250 ml. of $\frac{M}{20}$ aqueous solution is:
(Molar mass of glucose : 180 g mol^{-1})

(a) 2.25g (b) 4.5g
(c) 0.44g (d) 1.125g

RE-NEET (UG)-23.06.2024

Ans. (a) : Molarity $M = \frac{w_2 \times 1000}{M_2(v)}$

Given, $(M) \Rightarrow \frac{M}{20}$

$\frac{1}{20} = \frac{w_2 \times 1000}{180 \times 250}$

$w_2 = \frac{180 \times 250}{20 \times 1000}$

$w_2 = 2.25g$

50. A compound X contains 32% of A 20% of B and remaining percentage of C. Then, the empirical formula of X is :
(Given atomic masses of A = 64; B = 40; C = 32 u)

(a) ABC_3 (b) AB_2C_2
(c) ABC_4 (d) A_2BC_2

NEET (UG) 05.05.2024

Ans.(a) :

Element	Mass percentage	No. of moles	No. of moles in smallest number	Simplification whole number
A	32%	$\frac{32}{64} = \frac{1}{2}$	$\frac{1}{2} \times 2$	1
B	20%	$\frac{20}{40} = \frac{1}{2}$	$\frac{1}{2} \times 2$	1
C	48%	$\frac{48}{32} = \frac{3}{2}$	$\frac{3}{2} \times 2$	3

So, impirical formula of
2 = A:B:C
1:1:3
The correct impirical formula of compounds ABC_3

51. Mass in gram of copper deposited by passing 9.6487 A current through a voltmeter containing copper sulphate solution for 100 seconds is: (Given: Molar mass of Cu:63 g mol^{-1}, If = 96487C)

(a) 3.15 g (b) 0.315g
(c) 31.5g (d) 0.0315g

NEET (UG) 05.05.2024

Ans. (b) : Given,
Current (I) = 9.6487 A
Time (t) = 100s
Molar mass of Cu = 63 g mol^{-1}
According to the first law of electrolysis-

$w = Z \times q$

$w = \frac{E}{96487} \times I \times t$

(Equivalent weight for Cu, $E = \frac{63}{2} = 31.5$)

$w = \frac{31.5}{96487} \times 9.6487 \times 100$

$w = 0.315$ g

52. The highest number of helium atoms is in

(a) 4 u of helium
(b) 4 g of helium
(c) 2.271098 L of helium at STP
(d) 4 mol of helium

NEET (UG) 05.05.2024

Ans. (d) : (i) 4 mole of helium = 4 N_A He atoms

(ii) 4 u of helium = $\frac{4}{4}$ = 1 He atom $\left(\because n = \frac{W}{mW}\right)$

(iii) 4 g of helium $= \frac{4}{4}$ mole = 1 N_A He atom

(iv) 2.271098 L of helium at STP = $\frac{2.271098}{22.4}$ mole
= 0.1 NA He atom

Hence, the highest number of helium atoms is in 4 mole of helium.

53. 0.1435 g of silver chloride was obtained from 0.0945 g of an organic compound by Carius method The percentage of chlorine by weight in the compound is
(molar mass of Ag Cl = 143.5 g mol^{-1-})

(a) 18.9 (b) 37.6
(c) 24.9 (d) 56.7

Telangana SCHE 07.05.2024 Shift II

Ans. (b) : Given that, 0.0945 gm of organic compound give 0.1435 gm of AgCl.

$\therefore$ 143.32 gm of AgCl contains 35.5 gm of Cl

0.1535 gm of AgCl contain $= \frac{35.5 \times 0.1435}{143.32}$
= 0.03554 gm of chlorine

So, the percentage of chlorine in the organic chloro compound $= \frac{0.03554 \times 100}{0.0945}$ = 37.6%

54. A hydrocarbon containing C and H has 92.3% of C. When 52 g of hydrocarbon is completely burnt in oxygen, X moles of water and y moles of CO_2 were formed. The liberated water is sufficient to liberate one mole of H_2 when reacted with sodium metal. What is the weight (in g) of O_2 consumed? (C=12u; H = lu; O=16u)

(a) 80 (b) 160
(c) 240 (d) 320

Telangana SCHE 07.05.2024 Shift II

Ans. (b) : Determine the empirical formula of the hydrocarbon-

- Given that the hydrocarbon has 92.3% C, the rest is hydrogen.
- Percentage of hydrogen : 100% – 92.3% for 100g of hydro carbon
- Mass of carbon – 92.3g
- Mass of hydrogen = 7.7g

Moles of carbon $\frac{92.3\text{g}}{12\text{g}/\text{mol}} = 7.692$ mol.

Moles of hydrogen $\frac{7.7\text{g}}{1\text{g}/\text{mol}} = 7.7\text{mol}$

Simplifying the ratio of moles-

- Ratio of C is approximately 1:1
- Moles of hydrocarbon (CH) = $\frac{25\text{g}}{139/\text{mol}} = 4\text{mol}$.

$2CH + 20_2 \rightarrow 2CO_2 + H_2O$

According to balanced equation

moles of O_2 = 4 moles

mass of O_2 consumed

4 mol × 32g/mol = 128

Thus the 160g correct balancing mass O_2 consumes.

55. Weight (g) of two moles of the organic compound, which is obtained by heating sodium ethanoate with sodium hydroxide in presence of calcium oxide is :

(a) 18 (b) 16
(c) 32 (d) 30

NEET (UG) -07.05.2023

Ans. (c) :

$$\underset{\text{Sodium enolate}}{CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-O^-Na^+} \xrightarrow[CaO/\Delta]{NaOH} \underset{\text{(Methane)}}{CH_4}$$

1 mole of CH_4 = 16

2 mole of CH_4 = 2×16

= 32

56. The right option for the mass of CO_2 produced by heating 20 g of 20% pure limestone is (Atomic mass of Ca =40)

$$\left[CaCO_3 \xrightarrow{1200K} CaO + CO_2\right]$$

(a) 1.32 g (b) 1.12 g
(c) 1.76 g (d) 2.64 g

NEET (UG) -07.05.2023

Ans. (c) : Sample of $CaCO_3$ = 20%

$$= 20 \times \frac{20}{100} = 4 \text{ gram}$$

$$CaCO_3 \xrightarrow{1200k} CaO + CO_2$$

1 mole $CaCO_3$ gives 1 mole CO_2.

$$100\text{gram } CaCO_3 \longrightarrow 44\text{gram } CO_2$$

$$4\text{gram } CaCO_3 \longrightarrow \frac{44}{100} \times 4 = \frac{176}{100} = 1.76\text{gram}$$

57. The density of 1 M solution of a compound 'X' is 1.25 g mL^{-1}. The correct option for the molality of solution is (Molar mass of compound X= 85 g).

(a) 1.165m (b) 0.858 m
(c) 0.705m (d) 1.208m

RE-NEET (UG) 06.06.2023 (Manipur)

Ans. (b) :

$$d = \frac{m}{V}$$

Volume of solution = 1000 cm^3

Density = 1.25gcm^{-3}

m = d×V

Mass of solution = 1000×1.25=1250g

Given Molar mass of compound X = 85g

mass of solvent = 1250 – 85 = 1165g

molality of solution :

$$m = \frac{1000M}{1000\rho - M \times M_{solute}}$$

ρ = density

M = Molarity = 1M

$$m = \frac{1000 \times 1}{1000 \times 1.25 - (1 \times 85)} = \frac{1000}{1165}$$

m = 0.858m

58. Calculate the millimoles of SeO_3^{2-} in solution on the basis of following data: 70 mL of $\frac{M}{60}$ solution of $KBrO_3$ was added to SeO_3^{2-} solution. The bromine evolved was removed by boiling and excess of $KBrO_3$ was back titrated with 12.5 mL of $\frac{M}{25}$ solution of $NaAsO_2$.

The reactions are given below.

I. $SeO_3^{2-} + BrO_3^- + H^+ \rightarrow SeO_4^{2-} + Br_2^+ + H_2O$

II. $BrO_3^- + AsO_2^- + H_2O \rightarrow Br^- AsO_4^{3-} + H^+$

(a) 1.6×10^{-3} (b) 1.25
(c) 2.5×10^{-3} (d) None of these

AIIMS-2009

Ans. (c): Given that,

$$\mathbf{SeO_3^{2-} + BrO_3^- + H^+ \rightarrow SeO_4^{2-} + Br_2^+ + H_2O}$$

$$\mathbf{BrO_3^- + AsO_2^- + H_2O \rightarrow Br^- AsO_4^{3-} + H^+}$$

In reaction (i)

Moles of BrO_3^- Consumed = $\frac{70}{1000} \times \frac{1}{60} - \frac{10^{-3}}{6} = 10^{-3}$

gm. eq. of SeO_3^{2-} = gm. eq. of BrO_3^-

$n_{SeO_3^{2-}} \times 2 = 10^{-3} \times 5$

$n_{SeO_3^{2-}} = 2.5 \times 10^{-3}$

In reaction (ii)

Gm. Eq. of BrO_3^- = gm. Eq. of AsO_2^-

$n_{BrO_3^-} \times 6 = n_{AsO_2^-} \times 2 = \frac{12.5}{1000} \times \frac{1}{25} \times 2 = 10^{-3}$

$n_{BrO_3^-} = \frac{10^{-3}}{6}$

59. Suppose the elements X and Y combine to form two compounds XY_2 and X_3Y_2. When 0.1 mole of XY_2 weight 10 g and 0.05 mole of X_3Y_2 weights 9 g, the atomic weights of X and Y are

(a) 40, 30 (b) 60, 40
(c) 20, 30 (d) 30, 20

NEET-2015

Ans. (a) : $M_1 \rightarrow$ Molecular mass of xy_2

$M_2 \rightarrow$ Molecular mass of x_3y_2

$a_1 \rightarrow$ Atomic weight of x

$a_2 \rightarrow$ Atomic weight of y

$\frac{10}{M_1} = 0.1$

$m_1 = 100$

$a_1 + 2a_2 = 100$ … (i)

Similarly

$\frac{9}{m_2} = 0.05$

$n_2 = \frac{900}{5}$

$3a_1 + 2a_2 = \frac{900}{5} = 180$ … (ii)

Solving (i) & (ii) simultaneously

$$\begin{array}{rl} 3a_1 + 2a_2 & = 180 \\ -\,a_1 + 2a_2 & = 100 \\ \hline 2a_1 & = 80 \\ a_1 & = 40 \\ a_2 & = 30 \end{array}$$

Atomic weight of x & y are
40 & 30 respectively

60. Specific volume of cylindrical virus particle is 6.02×10^{-2} cc/g whose radius and length are 7 Å and 10 Å respectively. If $N_A = 6.02 \times 10^{23}$, find molecular weight of virus.

(a) 15.4 kg/mol
(b) 1.54×10^4 kg/mol
(c) 3.08×10^4 kg/mol
(d) 3.08×10^4 kg/mol

NEET-2001

Ans. (a) : Given,

Radius (r) = 7Å = 7×10^{-8}

Length (L) = 10Å = 10×10^{-8}cm

Specific volume (volume of 1g of cylindrical virus) = 6.02×10^{-2} cc/gm

Volume of virus $\pi r^2 L = \frac{22}{7} \times (7 \times 10^{-8})^2 \times 10 \times 10^{-8}$

$= 154 \times 10^{-23}$ cc

Wt. of one virus particle $= \frac{\text{Volume}}{\text{Specific volume}}$

$\therefore$ Molecular wt. of virus = wt. of N_A particle

$= \frac{154 \times 10^{-23}}{6.02 \times 10^{-2}} \times 6.02 \times 10^{23}$

= 15400g/mol = 15.4 kg/mol

61. The weight of a single atom of oxygen is:

(a) 1.057×10^{23} g (b) 3.556×10^{23} g
(c) 2.656×10^{-23} g (d) 4.538×10^{-23} g

AIIMS-1998

Ans. (c): Molar mass of oxygen atoms = 16 g mol^{-1}

Number of atom in 1 mole = 6.022×10^{23}

Therefore, 1 atom of oxygen weight $= \frac{16}{6.022 \times 10^{23}}$

$= 2.657 \times 10^{-23}$ g

62. Haemoglobin contains 0.334% of iron by weight. The molecular weight of haemoglobin is approximately 67200. The number of iron atoms (Atomic weight of Fe is 56) present in one molecules of haemoglobin is

(a) 4 (b) 6
(c) 3 (d) 2

NEET-1998

Ans. (a) : Given that,

Molecular weight of haemoglobin = 67200

It contains 0.334% of iron by weight.

Weight of iron = $\frac{0.334}{100} \times 67200 = 224.448$

No. of atoms = $\frac{\text{weight of iron in haemoglobin}}{\text{Atomic weight}}$

$= \frac{224.448}{56}$

= 4.008

63. If active mass of a 6% solution of a compound is 2, its molecular weight will be

(a) 30 (b) 15
(c) 60 (d) 22

AIIMS-1996

Ans. (a): Given, 6% of solution contains 6g of Compound in 100 ml of solution.
Then, mass of Compound present in 1 liter of Solution = 60 g

$\Rightarrow$ No. of moles = $\frac{\text{given mass}}{\text{molar mass}} = \frac{60g}{M}$

$\Rightarrow$ Active mass is defined as number of moles per litre.

So, Active mass = $\frac{60g}{M}$/ litre

$$2 = \frac{60}{M} \times \frac{1}{1L}$$

Then, M (molar mass) = 30

64. A bivalent metal has the equivalent weight of 12. The molecular weight of its oxide will be

(a) 36 (b) 24
(c) 40 (d) 32

AIIMS-1994

Ans. (c): Molecular weight = equivalent weight × n-factor
(Where , n-factor of the metal ion = 2.)
So molecular weight = 12 × 2 = 24
Since it is bivalent ion it requires only one oxygen combine to form oxide.
Therefore, the molecular wt. of the oxide is molecular wt. = molecular wt. of metal + molecular wt. of oxygen
i.e. molecular wt. = 24 + 16 = 40

65. Boron has two stable isotopes, ^{10}B(19%) and ^{11}B(81%). Calculate average at. wt. of boron in the periodic table.

(a) 10.8 (b) 10.2
(c) 11.2 (d) 10.2

NEET-1990

Ans. (a) : Average atomic weight

$$= \frac{\sum \% \text{abundant} \times \text{atomic mass}}{100}$$

$$= \frac{19 \times 10 + 81 \times 11}{100} = 10.81$$

66. The equivalent weight of $KMnO_4$ in acidic medium is

(a) 158 (b) 52.67
(c) 31.6 (d) 49

UP CPMT-2002

Ans. (c) : Equivalent weight of $KMnO_4$ = 158
$KMnO_4$ as an oxidizer in acidic media

$$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{+2} + 4H_2O$$

In Acidic medium

$$= \frac{\text{Molecular weight}}{\text{No.of electron lost or gained}} = \frac{158}{5} = 31.6$$

In Basic Medium = $\frac{\text{Molecular weight}}{3} = \frac{158}{3} = 52.67$

In Neutral Medium = $\frac{\text{Molecular weight}}{1} = 158$

67. Sulphur forms the chlorides S_2Cl_2 and SCl_2. The equivalent mass of sulphur in SCl_2 is

(a) 8 g/ mol (b) 16 g/mol
(c) 64.8 g/mol (d) 32 g/mol

AIIMS-2015

Ans. (b): Equivalent mass of sulphur

$$\Rightarrow \frac{\text{atomic mass of sulphur}}{\text{valency}}$$

$$\overset{x\,(-1)}{SCl_2} = x + 2(-1) = 0$$

$$x = 2$$

$$\Rightarrow \frac{32}{2} = 16$$

68. In acidic medium, dichromatic ion oxidizes ferrous ion to 'ferric ion'. If the gram molecular weight of potassium dichromate is 294g, its gram equivalent weight (in grams) is

(a) 24.5 (b) 49
(c) 125 (d) 250

JIPMER-2015

Ans. (b) : In acidic medium $K_2Cr_2O_7$ acts as a strong oxidising agent and itself gets reduced to Cr^{3+}.

$$Cr_2O_7^{-2} + 6e^- \rightarrow 2Cr^{3+}$$

The oxidation state of $K_2Cr_2O_7$

$$2(+1) + 2x + 2(-7) = 0$$
$$2x = +12$$
$$x = +6$$

Equivalent weight of

$$K_2Cr_2O_7 = \frac{\text{Molecular weight}}{\text{Valency}} = \frac{294}{6} = 49$$

69. Which of the following is correctly arranged in order of increasing weight?

(a) 0.0105 equivalent of $H_2C_2O_4$. $2H_2O$ < 0.625 g of Fe < 0.006 g atom of Ag < 6.0×10^{21} atoms of Zn
(b) 0.625 g of Fe < 0.0105 equivalent of $H_2C_2O_4$. $2H_2O$ < 6.0×10^{21} atoms of Zn < 0.006 g atom of Ag
(c) 0.625 g of Fe < 6.0×10^{21} atoms of Zn < 0.006 g atom of Ag < 0.0105 equivalent of $H_2C_2O_4$. .$2H_2O$
(d) 0.0105 equivalent of $H_2C_2O_4$. $2H_2O$ < 0.006 g atom of Ag < 6.0×10^{21} atoms of Zn < 0.625 g of Fe

JIPMER-2015

Ans. (c) : Here, the correct order of increasing weight, - 0.625 g of Fe < 6.0 × 10^{21} atoms of Zn < 0.006 g atom of Ag < 0.0105 equivalent of $H_2C_2O_4$. $2H_2O$.
6.0 × 10^{21} atoms of Zn (atomic weight 65.4 g/mol)

Corresponds to $\frac{6.0\times10^{21}}{6.0\times10^{23}} \times 65.4 = 0.654$ g

0.006 g atom of Ag (atomic mass 108 g/mol)
Corresponds to 0.006 × 108 = 0.648 g
0.0105 equivalent of $H_2C_2O_4.2H_2O$ (equivalent mass 63 g/eq)
Corresponds to 0.0105 × 63 = 0.662 g

70. What is the mass of the precipitate formed when 50 mL of 16.9% solution of $AgNO_3$ is mixed with 50mL of 5.8% NaCl Solution? (Ag = 107.8, N = 14, O = 16 Na = 23, Cl = 35.5)

(a) 3.5 g (b) 7 g
(c) 14 g (d) 28 g

NEET-2015

Ans. (b) : 16.9 g $AgNO_3$ is present in 100 mL solution.
$\therefore$ 8.45 g $AgNO_3$ is present in 50 mL solution.
5.8 g NaCl is present in 100 mL solution.
2.9 g NaCl is present in 50 mL solution.
Initial mole

$$AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$$

$$\frac{8.45}{169.5} = 0.049 \quad \frac{2.9}{58.5} = 0.049 \quad 0 \quad 0$$

After reaction 0 0 0.049 0.049

Therefore, mass of AgCl precipitated
= 0.049 × 143.5 = 7 g

71. Which has the maximum number of molecules among the following?

(a) 44g CO_2 (b) 48 g O_3
(c) 8 g H_2 (d) 64 g SO_2

AIIMS-2014

Ans. (c): 8g H_2 has the maximum number of molecules.

$$\text{No. of moles} = \frac{\text{weight of the substance}}{\text{Molecular weight of the substance}}$$

Moles of CO_2 = $\frac{44}{44} = 1\text{mol.}$

Moles of O_3 = $\frac{48}{48} = 1\text{mol.}$

Moles of H_2 = $\frac{8}{2} = 4\text{mol}$

Moles of SO_2 = $\frac{64}{64} = 1\text{mol.}$

Maximum no. of moles will corresponds to maximum number of molecules.
4 moles of H_2 i.e. 4 × 6.023 × 10^{23} molecules.

72. Equivalent weight of $(NH_4)_2Cr_2O_7$ in the change is
$(NH_4)_2Cr_2O_7 \rightarrow N_2 + Cr_2O_3 + 4H_2O$

(a) Mol. wt./6 (b) Mol. wt./3
(c) Mol. wt./4 (d) Mol. wt./2

UP CPMT-2013

Ans. (a) : 1 mole $(NH_4)_2Cr_2O_7 \equiv$ 1 mole of Cr_2O_3
$\equiv$ 1 × 6 eq. of Cr_2O_3
$\therefore$ Reduction of $Cr_2O_7^{2-}$ to Cr^{3+} is a $6e^-$ change.
$\left[(Cr^{6+})_2 + 6e^- \rightarrow (Cr^{3+})_2\right]$
Therefore, equivalent weight of $(NH_4)_2Cr_2O_7 = M/6$

73. 0.126 g of an acid is titrated with 0.1 N 20 mL of an base. The equivalent weight of the acid is

(a) 63 (b) 50
(c) 53 (d) 23

UP CPMT-2009

Ans. (a): We know that,

$$w = \frac{E \times NV}{1000}$$

$$\therefore \text{Eq. wt. of acid} = \frac{w \times 1000}{NV}$$

$$= \frac{0.126 \times 1000}{0.1 \times 20}$$

$$= 63$$

74. 1.520 g of hydroxide a metal on ignition gave 0.995 g of oxide. The equivalent weight of metal is

(a) 1.52 (b) 0.995
(c) 190 (d) 9

UP CPMT-2006

Ans. (d) : Since hydroxide and oxide both are involving in same reaction, the ratio of their molecular weight is equal to the ratio of their equivalent weight.

$$\frac{E_{Hydroxide}}{E_{metal} + E_{OH^-}} = \frac{E_{oxide}}{E_{metal} + E_O}$$

$$\frac{1.520}{E + 17} = \frac{0.995}{E + 8}$$

$$E = 9$$

75. The oxygen obtained from 72 kg water is

(a) 72 kg (b) 46 kg
(c) 50 kg (d) 64 kg

UP CPMT-2002

Ans. (d) : Molecular weight of H_2O = 18
Atomic weight of oxygen = 16
$\because$ 18 gm H_2O contain = 16 gm Oxygen
$\therefore$ 72 kg H_2O contain = $\frac{72 \times 16}{18}$
= 64000 gm or 64 kg.

76. The oxide of an element contains 67.67% oxygen and the vapour density of its volatile chloride is 79. Equivalent weight of the element is

(a) 2.46 (b) 3.82
(c) 4.36 (d) 4.96

AIIMS-1998

Ans. (b): Equivalent weight of an element is its weight which reacts with 8 gm of oxygen to form oxide.
67.67 g of oxygen combines with 32.33 g of the element to form oxide.
1 g of oxygen will combine with $\frac{32.33}{67.67}$ g of element to form oxide.
8 g of oxygen will combine with $8 \times \frac{32.33}{67.67}$ = 3.82 g of element to form oxide.
Hence, the equivalent weight of the element is 3.82 g.

77. The weight to a metal of equivalent weight 12, which will give 0.475 g of its chloride, is

(a) 0.18 g (b) 0. 12 g
(c) 0. 24 g (d) 0. 16 g

AIIMS-1994

Ans. (b) : Equivalent weight of metal chloride = Equivalent weight of Metal + Equivalent wt. of Cl = 12 +35.5 = 47.5

47.5 g of metal chloride will give 12g of metal

Then, 0.475g of metal chloride will give -

$$\equiv \frac{12\times0.475}{47.5}$$

$= 0.12g$

78. What is the weight of oxygen required for the complete combustion of 2.8 kg of ethylene?

(a) 2.8 kg (b) 6.4 kg
(c) 9.6 kg (d) 96 kg

NEET-1989

Ans. (c) : $C_2H_4(\text{ethylene})+3O_2 \longrightarrow 2CO_2+2H_2O$

To oxidise 1mol of ethylene we required 3 moles of oxygen.

Then,

For oxidising 28g of C_2H_4,

We need 3×32 = 96g of oxygen.

For 2.8kg of C_2H_4,

We need $= \frac{96}{28}\times 2.8$ =9.6kg of oxygen.

79. The maximum number of molecules is present in

(a) 15 L of H_2 gas at STP
(b) 5 L of N_2 gas at STP
(c) 0.5 g of H_2 gas
(d) 10 g of H_2 gas

NEET-2004

Ans. (a)

1 mole of gas at STP occupies a volume of 22.4 L

Option (a)- 15 L of gas corresponds to

$$\frac{15L}{22.4L} = 0.67\,\text{moles}$$

Option (b)- 5L of N_2 gas at STP:

5L of gas corresponds to $\frac{5L}{22.4L} = 0.22$ moles

Option (c)- 0.5g of H_2 gas (molecular weight 2g/mole) corresponds to $\frac{0.5g}{2g/mol} = 0.25\,\text{moles}$

Option (d)- 10g of O_2 gas (molecular weight 3g/ mol) corresponds to $\frac{10g}{32g/mol} = 0.3125\,\text{moles}$

Higher is the number of moles of a gas, higher will be its number of molecules.

80. 10 gm of hydrogen and 64 g of oxygen were kept in a steel vessel and exploded. Amount of water produced in this reaction will be

(a) 2 mol (b) 4 mol
(c) 8 mol (d) 10 mol

UP CPMT-2012
NEET-2009

Ans. (b) : $2H_2 + O_2 \rightarrow 2H_2O$

10g of hydrogen (molar mass 2g /mol) = $\frac{10g}{2g/mol}$

= 5 mol

64g of oxygen (molar mass 32g/mol) = $\frac{64}{32g/mol}$

= 2 mol

2 moles of oxygen will react with 2 × 2 = 4 moles of hydrogen to form 4 moles of water.

81. The mass of one mole of electron is

(a) 9.1×10^{-28}g (b) 0.55 mg
(c) 9.1×10^{-24}g (d) $6\ 10^{-12}$g

UP CPMT-2010
UPTU/UPSEE-2006

Ans. (b): As we know that,

Mass of one electron = 9.1×10^{-31} kg

$= 9.1\times 10^{-28}$ g

1 mole = 6.023×10^{23} electron

So, 1 mole of electron has mass of

$= 9.1 \times 10^{-28} \times 6.023 \times 10^{23}$

$= 5.48\times10^{-4}$

= 0.55mg

82. Which one of the following has maximum number of atoms?

(a) 1 g of $Ag_{(s)}$ [Atomic mass of Ag = 108]
(b) 1 g of $Mg_{(s)}$ [Atomic mass of Mg = 24]
(c) 1 g of $O_{2(s)}$ [Atomic mass of O = 16]
(d) 1 g of $Li_{(s)}$ [Atomic mass of Li = 7]

NEET-2020

Ans. (d):

Number of atoms in 1g of Li $= \frac{1}{7}\times N_A$

$= \frac{1}{7}\times 6.023\times10^{23}$

$= 0.86\times10^{23}$

Number of atoms in 1g of Ag $= \frac{1}{108}\times N_A$

$= 0.056\times10^{23}$

Number of atoms in 1g of Mg $= \frac{1}{24}\times N_A$

$= 0.25\times10^{23}$

Number of atoms in 1g of O_2 $= \frac{1}{32}\times N_A \times 2$

$= \frac{N_A}{16} = 0.37\times10^{23}$

Max. number of atoms are present in 1g of Li.

83. $2KHCO_3 \rightarrow ... + CO_2 + H_2O$ find amount of gases formed (in lit).
When amount of $KHCO_3$ is 33 gm.

(a) 5.6 (b) 11.2
(c) 7.39 (d) 22.4

JIPMER-2019

Ans. (c) :

$$2KHCO_3(s) \longrightarrow K_2CO_3(s) + CO_2(g) + H_2O$$

$n = \frac{33}{100}$ 0.165 0.166

Total moles of gas (0.165 + 0.165) mol
Total volume of gas = 0.33 × 22.4 L
= 7.39 L

84. Which one of the following is the lightest?

(a) 0.2 mole of hydrogen gas
(b) 6.023×10^{22} molecules of nitrogen
(c) 0.1 g of silver
(d) 0.1 mole of oxygen gas

AIIMS 25 May 2019 (Evening)

Ans. (c):

(a) Moles $= \frac{\text{Weight}}{\text{Molecular weight}}$

Weight of H_2 = mole × molecular wt.
= 0.2 × 2 = 0.4 g

(b) 6.023×10^{23} represents 1 mole

Thus 6.023×10^{22} will represent 0.1 mole

Weight of N_2 = 0.1 × 28 = 2.8 g
(c) Weight of Silver = 0.1 g
(d) Weight of oxygen = 32 × 0.1 = 3.2 g
Thus from the above, silver is lightest.

85. Calculate molarity of a 63% w/w HNO_3 solution if density is 1.4g/mL:

(a) 14 M (b) 12 M
(c) 10 M (d) 8 M

AIIMS 26 May 2019 (Evening)

Ans. (a):

HNO_3 solution = 63 % w/w
Density = 1.4 g / mL

$$\text{Molarity} = \frac{\%\ w/w \times d \times 10}{M_{\text{Solute}}}$$

$$M = \frac{63 \times 1.4 \times 10}{63} = 14M$$

86. Haemoglobin contains 0.33% of iron by weight. The molecular weight of haemoglobin is approximately 67200. The number of iron atoms (at. Wt. of Fe= 56) present in one molecule of haemoglobin is

(a) 6 (b) 1 (c) 2 (d) 4

AIIMS-27 May, 2018 (E)

Ans. (d) : Given,
% of Iron = 0.334 %
Molecular weight of the haemoglobin = 67200 g / mol
Weight of the Iron = 56 g
The number of iron atoms =

$$\frac{\text{Molecular Weight of haemoglobin} \times \%\text{ of iron}}{100 \times \text{Atomic weight of Iron}}$$

$$= \frac{67200 \times 0.334}{100 \times 56} = 4$$

87. A mixture of 2.3 g formic acid and 4.5 g oxalic acid is treated with conc. H_2SO_4. The evolved gaseous mixture is passed through KOH pellets. Weight (in) g of the remaining product at STP will be

(a) 1.4 (b) 3.0
(c) 2.8 (d) 4.4

NEET-2018

Ans. (c)

$$HCOOH \xrightarrow{H_2SO_4} CO + H_2O \quad ....(i)$$

$$(COOH)_2 \xrightarrow{H_2SO_4} CO + CO_2 + H_2O \quad ....(ii)$$

Conc. H_2SO_4 is a strong dehydrating agent

Moles of HCOOH = $\frac{2.3}{46} = 0.05$ mole

Moles of $(COOH)_2$ = $\frac{2.3}{46} = 0.05$ mole

From reaction (i),
Number of CO formed = 0.05 mole
From reaction (ii),
Number of CO formed = 0.05 mole
Number of CO_2 formed = 0.05 mole
Hence, Total CO formed = 0.05 + 0.05 = 0.1 mole
KOH pellets absorbs all CO_2, H_2O absorbed by H_2SO_4 thus CO is remaining product.
Thus the weight of the remaining product = 0.1 × 28
= 2.8g

88. In which case is number of molecules of water maximum?

(a) 18 mL of water
(b) 0.18 g of water
(c) 0.00224 L of water vapours at 1 atm and 273 K
(d) 10^{-3} mol of water

NEET-2018

Ans. (a) : 1 moles of water contain = 6.023×10^{23} atom

(i) Mass of water = 18×1 = 18g (H_2O = 18)
Molecules of water

$$= \text{mole} \times N_A = \frac{18}{18} \times 6.023 \times 10^{23} = 6.023 \times 10^{23}$$

(ii) Molecules of water = mole × N_A

$$= \frac{18}{18} \times 6.023 \times 10^{23}$$

$= 6.023 \times 10^{21}$

(iii) Molecules of water = mole × 6.023×10^{23}
$= 10^{-4} \times 6.023 \times 10^{23}$
$= 6.023 \times 10^{-19}$

(iv) Molecules of water = mole × N_A = $6.023 \times 10^{23} \times 10^{-3}$
$= 6.023 \times 10^{20}$

From above, It is clear that 18 mL of water has maximum molecules.

89. Solid $NaHCO_3$ will be neutralized by 40.0mL of 0.1M H_2SO_4 solution. What would be the weight of solid $NaHCO_3$ in gram?

(a) 0.672g (b) 6.07g
(c) 17g (d) 20g

JIPMER-2016

Ans. (a) :

$$\underset{\substack{\text{Mole ratio} \; 2\text{mole} \\ =168\text{g}}}{2NaHCO_3} + \underset{\substack{1\text{mole} \\ =98\text{g}}}{H_2SO_4} \longrightarrow Na_2SO_4 + 2H_2O + 2CO_2$$

m- moles of $H_2SO_4 = M \times V_{mL} = 40.0\times0.01$
$= 4$ m – mole

Moles of H_2SO_4 = M × VmL = 40.0×0.1 = 4m mol

Also, it can written as m-moles of $NaHCO_3$ when neutralised = 4×2 = 8m-moles.

But m-mole $= \frac{w}{m}\times1000$

$8=\frac{w}{84}\times1000 \Rightarrow w = \frac{84\times8}{1000} \Rightarrow w = 0.672\,g.$

90. In order to prepare one liter 1N solution of $KMnO_4$, how many grams of $KMnO_4$ are required, if the solution to be used in acid medium for oxidation?

(a) 128 g (b) 41.75 g
(c) 31.60 g (d) 62.34 g

JIPMER-2015

Ans. (c) : Given,

Normality = 1 N, volume = 1L

Normality $= \frac{\text{No.of gram equivalence}}{\text{Volume of solution in (L)}}$

No. of gram equivalence = N × V in (L) = 1 × 1 = 1

No. of gram equivalence $= \frac{\text{wt}}{\text{eq wt}}$

Where, eq. wt $= \frac{\text{molecular wt}}{\text{n} - \text{factor}}$.m.w = 158g

$$\overset{+7}{KMnO_4} \xrightarrow{5} \overset{+2}{Mn} \quad \Rightarrow \text{n factor} = 5$$

equal $= \frac{158}{5} = 31.6$

Let of $KMnO_4$ = eq. wt × No. of gram equivalence
= 31.6 × 1 == 31.6 g

91. 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?

(a) 16 : 1 (b) 2 : 1
(c) 1 : 4 (d) 4 : 1

NEET-2015, cancelled

Ans. (d) Number of moles (n) $= \frac{\text{given mass (m)}}{\text{Molar mass (M)}}$

As the ratio by weight of Hydrogen and Oxygen is 1: 4

Molar ratio will be $\frac{n_{H_2}}{n_{o_2}} = \frac{32}{8} = 4:1$

The molar ratio of hydrogen and Oxygen is 4 :1

92. 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)

(a) Mg, 0.16 g (b) O_2, 0.16 g
(c) Mg, 0.44 g (d) O_2, 0.28 g

NEET-2014

Ans. (a):

$2Mg + O_2 \rightarrow 2MgO$

2 moles of Mg require 1 mole of O_2 to produce 2 moles of MgO.

Mole of Mg $= \frac{\text{given mass}}{\text{molar mass}}$

$= \frac{1}{24} = 0.041667$

moles of $O_2 = \frac{\text{gives mass}}{\text{molar mass}}$

$= \frac{0.56}{32} = 0.0175$

$\Rightarrow$ 0.0175 moles O_2 require 0.0175 × 2 = 0.035 moles of Mg.

Mass of Magnesium (Mg) that reacts:-

Mass = moles × molar mass
= 0.035 × 24
= 0.84 g

That means only 0.84 g magnesium is used.

Therefore magnesium is in excess by 0.16 g

93. Calculate the normality of 10 volume H_2O_2?

(a) 1.7 N (b) 12 N
(c) 30.3 N (d) 0.0303 N

AIIMS-2013

Ans. (a): Normality $= \frac{\text{Gram equivlent}}{\text{volume}}$

Gram equivalent $= \frac{\text{Molar mass}}{\text{Normality factor}}$

Molar mass of H_2O_2 is = 1 × 2 + 2 × 16 = 34 g

N. factor of H_2O_2 is 2.

Gram equivalent $= \frac{34}{2} = 17$

Normality $= \frac{17}{10} = 1.7$

94. The vapour density of a mixture containing NO_2 and N_2O_4 is 27.6 Mole fraction of NO_2 in the mixture is

(a) 0.8 (b) 0.6
(c) 0.4 (d) 0.2

AIIMS-2012

Ans. (a): Let the moles of NO_2 be x.

Moles of N_2O_4 will be 1 – x

Molar mass = 2 × Vapour density

So, Molar mass = 2 × 27.6 = 55.2 g

Molar mass of NO_2 = 46 g and N_2O_4 = 92 g

$$\frac{x\times 46+(1-x)\times 92}{1}=55.2$$

46x + 92 – 92x = 55.2

$$x = \frac{36.8}{46}=0.8$$

Here, mole fraction of NO_2 in the mixture is 0.8

95. How many grams of sulphuric acid is to be dissolved to prepare 200 mL aqueous solution having concentration of $[H_3O^+]$ ions 1 M at 25^0 C temperatures? [H= 1, O= 16, S= 32g mol^{-1}]

(a) 4.9g (b) 19.6g
(c) 9.8g (d) 0.98g

UP CPMT-2012

Ans. (c) $\therefore$ 2 M $[H_3O^+]$ ions are obtained from 1M H_2SO_4
$\therefore$ 1 M $[H_3O^+]$ ions are obtained from 0.5 M H_2SO_4
Molarity

$$M=\frac{m(H_2SO_4)\times 1000}{M(\text{molar mass } H_2SO_4)}\times \text{Volume of solution(mL)}$$

$$0.5=\frac{m\times 1000}{98\times 200}=\frac{0.5\times 98\times 200}{1000}=9.8g$$

96. Which has the maximum number of molecules among the following ?

(a) 44 g CO_2 (b) 48 g O_3
(c) 8 g H_2 (d) 64 g SO_2

NEET Mains-2011

Ans. (c) : No. of moles$(n)=\dfrac{\text{weight in gram}}{\text{molecualr weight}}$

$$(i)\ 44\,\text{gram}\,CO_2=\frac{44}{44}\quad \left\{\begin{array}{l}\text{Molecular weight of } CO_2\\ =12+2\times 16\\ =12+32\\ =44\end{array}\right.$$

= 1 mol

= N_A i.e. 6.022×10^{23} atoms

$$(ii)\ 48\,\text{gram}\,O_3=\frac{48}{48}=1\,\text{mol}$$

$$(iii)\ 8\,\text{gram}\,H_2=\frac{8}{2}=4\text{ mol}$$

$$(iv)\ 64\,\text{gram}\,SO_2=\frac{64}{(32+2\times 16)}$$

$$=\frac{64}{64}=1\text{ mol}$$

So, maximum no. of moles present in H_2.

97. How many moles of magnesium phosphate, $Mg_3(PO_4)_2$ will contain 0.25 mole of oxygen atoms.

(a) 0.02 (b) 3.125×10^{-2}
(c) 1.25×10^{-2} (d) 2.5×10^{-2}

UP CPMT-2011

Ans. (b): 8 mol O-atoms are contained by 1 mole $Mg_3(PO_4)_2$.
$\therefore$ 0.25 mole of O-atoms are present in

$$Mg_3(PO_4)=\frac{1}{8}\times 0.25\text{ mol}$$

$= 3.125 \times 10^{-2}$ mol

98. 0.1 mol HCl is equal to

(a) 3.65 g (b) 36.5 g
(c) 18 g (d) 1.8 g

JIPMER-2011

Ans. (a) : Given,
The number of moles of HCl = 0.1
The number of particles in one mole = 6.023×10^{23}
The molar mass of a substance is defined as the mass of 1 mole of that substance, expressed in gram per mole, and is equal to the mass of 6.022×10^{23} atoms, molecules, or formula units of that substance.
So the mass of one mole of HCl = 1 + 35.5 = 36.5 g
• So, the mass of 0.1 mole = $\dfrac{36.5}{10}=3.65g$

99. A solution is prepared by dissolving 24.5 g of sodium hydroxide in distilled water to give 1 L solution. The molarity of NaOH in the solution is (Given that molar mass of NaOH = 40.0 g mol^{-1})

(a) 0.2450 M (b) 0.6125 M
(c) 0.9800 M (d) 1.6326 M

AIIMS-2010

Ans. (b): Given, $W_{NaOH}=24.5$ g
Molar mass of NaOH = 23 + 16 + 1 = 40
No. of moles of NaOH = $\dfrac{24.5}{40}$ moles
= 0.6125
$\therefore$ Molarity of solution = $\dfrac{0.6125\,\text{moles}}{1L}$
= 0.6125 M

100. The number of water molecules is maximum in

(a) 1.8 gram of water
(b) 18 gram of water
(c) 18 moles of water
(d) 18 molecules of water

NEET-2013

Ans. (c) : No of moles of water in 1.8 g = 0.1 moles
in 18 g = 1 moles.
$\because$ 1 mole water = 6.02×10^{23} molecules
$\therefore$ 18 mole water = $18 \times 6.02 \times 10^{23}$ molecules
Here, 18 mole water has maximum number of molecules.

101. 25.3 g of sodium carbonate, Na_2CO_3 is dissolved in enough water to make 250 ml. of solution. If sodium carbonate dissociates completely, molar concentration of sodium ion, Na^+ and carbonate ions, CO_3^{2-} are respectively (Molar mass of Na_2SO_3 = 106 g mol^{-1})

(a) 0.955 M and 1.910 M
(b) 1.910 M and 0.955 M
(c) 1.90 M and 1.910 M
(d) 0.477 M and 0.477 M

NEET-2010

Ans. (b) : Given that, weight of sodium carbonate = 25.3 gm

Moles of $Na_2CO_3 = \frac{\text{Moles of solute}}{\text{litre of solution}}$

$= \frac{25.3}{106} = 0.239 \text{ moles}$

Molarity of solution $= \frac{0.239}{0.25} = 0.956$ mol/litre

$Na_2CO_3 \rightarrow 2Na^+ + CO_3^{2-}$

$\therefore$ Concentration of CO_3^{2-} = 0.956 M

Concentration of Na^+ = 2×0.956
= 1.912 M.

102. The number of atoms in 0.1 mol of triatomic gas is (N_A=6.02 ×10^{23} mol^{-1})
(a) 6.026 ×10^{22}
(b) 1.806 ×10^{23}
(c) 3.600 ×10^{23}
(d) 1.800 ×10^{22}

NEET-2010

Ans. (b) : 1 mole of triatomic gas has 3 × 6.02×10^{23} atoms

Therefore, no. of atoms 0.1 mol = 0.1 × 3×6.02 × 10^{23}
= 1.806 × 10^{23}

103. Which has maximum molecules?
(a) 7 g N_2
(b) 2 g H_2
(c) 16 g NO_2
(d) 16 g O_2

NEET-2002

Ans. (b): 1 mole of any element contain 6.022 × 10^{23} number of molecules so

(a) 28 g N_2 = 1 mole of N_2

7g N_2 = $\frac{7}{28}$ = 0.25 mole

(d) 32 g O_2 = 1 mole of O_2

16 g O_2 = $\frac{16}{32}$ = 0.5 mole

(b) 2g H_2 = 1 mole of H_2

(c) 46 g NO_2 = 1 mole of NO_2

16 g NO_2 = $\frac{16}{46}$ = 0.35 mole

Maximum number of moles will corresponds to maximum number of molecules.

So, 2g H_2 contain maximum molecules

104. Number of atoms of He in 100 amu of He (atomic wt. of He is 4) are
(a) 25
(b) 100
(c) 50
(d) 100

UP CPMT-2006

Ans. (a) : Number of atom of a substance = Number of gram molecular weight × 6.05 × 10^{23} × atomicity

$= \frac{\text{wt. of substance}}{\text{Number of g.molecules}} \times 6.02 \times 10^{23} \times \text{atomicity}$

$= 1 \text{ amu} = 1.6 \times 10^{-24} \text{ g}$

$= 100 \text{ amu} = 1.6 \times 100 \times 10^{-24} \text{ g}$

$= \frac{100 \times 1.6 \times 10^{-24}}{4} \times 6.023 \times 10^{23} \times 1$

$= 25 \times 1.6 \times 10^{-24} \times 6.023 \times 10^{23} = 25$

105. The total number of protons in 10g of calcium carbonate is (N_0=6.023×10^{23})
(a) 3.01×10^{24}
(b) 4.06×10^{24}
(c) 2.01×10^{24}
(d) 3.01×10^{24}

UP CPMT-2003

Ans. (a) : Number of protons = Atomic number

$\therefore$ Protons in 1 mole $CaCO_3$

= Atomic No. of Ca + atomic. No. of C + 3 × atomic No. of O

= 20 + 6 + 3 × 8

= 50

Atomic mass of $CaCO_3$

= 40 + 12 + 3 × 16

=100

$\because$ 100 g of $CaCO_3$ has protons= 50

$\therefore$ 10 g of $CaCO_3$ has protons

$= \frac{50}{100} \times 10 \times 6.02 \times 10^{23}$

$= \frac{50}{100} \times 10 \times 6.02 \times 10^{23}$

= 3.01×10^{24}

106. 10^{21} molecules are removed from 200 mg of CO_2. The moles of CO_2 left are:
(a) 2.84×10^{-3}
(b) 28.4×10^{-3}
(c) 284×10^{-3}
(d) 28.4×10^{3}

AIIMS-2001

Ans. (a): Given mass = 200 mg = 0.2 g

Molar mass of CO_2 = 44 g

Number of moles $= \frac{\text{Weight}}{\text{Mole weight}} = \frac{0.2}{44} = \frac{1}{220}$

No. of molecules = 6.022 × 10^{23} × 1/220
= 2.73 × 10^{21}

As 10^{21} molecules are removed,

Hence, No. of Molecules left = 2.73 × 10^{21} – 10^{21}
= 1.73 ×10^{21}

No. of moles = No. of molecules /Avogadro's number

$= \frac{1.73 \times 10^{21}}{6.23 \times 10^{23}} = 2.88 \times 10^{-3}$

107. The weight of NaCl decomposed by 4.9 g of H_2SO_4, if 6g of sodium hydrogen sulphate and 1.825 g of HCl, were produced in the reaction is:
(a) 6.921g
(b) 4.65g
(c) 2.925g
(d) 1.4 g

AIIMS-2001

Ans. (c): $NaCl(xg) + H_2SO_4(4.9g) \rightarrow NaHSO_4(6g) + HCl\ (1.825g)$

The law of conservation of mass states that in a chemical reaction mass is neither created nor destroyed.

$\therefore$ Mass of the reactants = Mass of Products

$x + 4.9 = 6 + 1.825$ g

$x = 2.925$ g

108. The molarity of 98% by weight H_2SO_4 solution, which has a density 1.84 g/cc at 35° C is:

(a) 1.84 M (b) 18.4 M
(c) 20.6 M (d) 24.5 M

AIIMS-2001

Ans. (b): The solution contains 98% H_2SO_4 by weight/mass that means 100 gram of solutions 98 grams of H_2SO_4.

Density is 1.84 gm/ml (cc = ml)

So, volume of the solution = $\frac{\text{mass of the solution}}{\text{density of solution}}$

$= \frac{100\,\text{gram}}{1.84} = 54.34$ ml

No. of moles of $H_2SO_4 = \frac{\text{weight of } H_2SO_4}{\text{molar mass of } H_2SO_4}$

$= \frac{98}{98} = 1$ moles

Molarity = $\frac{1\,\text{mole}}{54.3\,\text{ml} \times 1000} = 18.41$ M

109. The normality of orthophosphoric acid having purity of 70% by weight and specific gravity 1.54 is:

(a) 11 N (b) 22 N
(c) 33 N (d) 44 N

AIIMS-2001

Ans. (c): Density of orthophosphoric acid (H_3PO_4) = specific gravity × density of water.

Density of orthophosphoric acid = 1.54 × 0.998
= 1.54 g/ml

Mass in 1000 ml = 1.54 × 1000 = 1540 g

Gram equivalent weight of orthophosphoric acid =

$\frac{\text{Molar mass}}{\text{N} - \text{factor}} = \frac{98}{3} = 32.66$ g eq.

orthophosphoric acid is only 70% pure so the weight of orthophosphoric acid = $1540 \times \frac{70}{100} = 1078\,\text{g}$

Number of gram equivalents of orthophosphoric acid

$= \frac{1078}{32.66} = 33$

Normality = $\frac{(\text{number of gram equivalents})}{(\text{volume of solution in L})}$

Normality = 33 N.

110. 0.4 moles of HCl and 0.2 moles of $CaCl_2$ were dissolved in water to have 500ml of solution, the morality of Cl^- ion is:

(a) 0.8 M (b) 1.6 M
(c) 1.2 M (d) 10.0 M

AIIMS-2000

Ans. (b): $HCl \rightleftharpoons H^+ + Cl^-$

$CaCl_2 \rightleftharpoons Ca^{2+} + \underset{2\times0.2=0.4\,\text{moles}}{2Cl^-}$

Total moles of Cl^- = 0.4 + 0.4 = 0.8 moles

Volume of solution of 500ml = 0.5 L

Molarity of Cl^- = moles Cl^- /volume of solution

Molarity of $Cl^- = \frac{0.8}{0.5} = 1.6\,\text{M}$

111. Volume of CO_2 obtained by the complete decomposition of 9.85 g of $BaCO_3$ is

(a) 2.24 L (b) 1.12 L
(c) 0.84 L (d) 0.56 L

NEET-2000

Ans. (b) :

$BaCO_3 \longrightarrow BaO + CO_2 \uparrow$

1mole 1 mole mole

Moles = $\frac{\text{Given weight}}{\text{molecular weight}} = \frac{9.85}{197\,\text{g/mol.}}$

=0.05 mole

At STP. 1 mole = 22.4 L

0.05 mole = 22.4 × 0.05 L = 1.12 L

112. The number of atoms in 4.25 g of NH_3 is approximately

(a) 4×10^{23} (b) 2×10^{23}
(c) 1×10^{23} (d) 6×10^{23}

NEET-1999

Ans. (d) : Given that,

Weight of NH_3 =4.25g

Number of moles of NH_3 = $\frac{\text{Weight}}{\text{Molecular Weight}}$

$= \frac{4.25}{17} = 0.25\,\text{mole}$

Number of molecules in 0.25 moles of NH_3

$= 0.25 \times 6.023 \times 10^{23}$

So, number of atoms = $4 \times 0.25 \times 6.023 \times 10^{23}$

$= 6.023 \times 10^{23}$

$\approx 6 \times 10^{23}$

113. The normality of a solution obtained by mixing 10 mL of N/5 HCI and 30mL of N/10HCI is:

(a) $\frac{N}{15}$ (b) $\frac{N}{5}$
(c) $\frac{N}{7.5}$ (d) $\frac{N}{8}$

AIIMS-1999

Ans. (d): N = M × n – factor

$NV = N_1V_1 + N_2V_2 \quad \begin{cases} \text{where N} = \text{Normality of mixture} \\ \text{V} = \text{Volume of mixture} \end{cases}$

$NV = \frac{1}{5}\times 10 + \frac{1}{10}\times 30$

N × 40 = 2 + 3

$N = \frac{5}{40}$

$N = \frac{1}{8}$

114. The molar concentration of 20g of NaOH present in 5 litre of solution is:

(a) 0.1 mols/litre (b) 0.2 mols/litre
(c) 1.0 mols/litre (d) 2.0 mols/litre

AIIMS-1998

Ans. (a) : Molar mass of NaOH : 39.997 g/mol

$20g\ NaOH\ \frac{1\,mol\,NaOH}{39.997\,g\,NaOH} = 0.5\ mol\ NaOH$

Convert liters of H_2O to kg

Density of H_2O – 1g/ml → 1 kg/L

$SL\ H_2O — \frac{1kg\,H_2O}{1L\,H_2O} = 5kgH_2O$

Molarity of NaOH = $\frac{.5\,mol}{5\,kg}$

m = 0.1 mols/liter

115. Volume of a gas at NTP is 1.12×10^{-7} cc. The number of molecule in it is:

(a) 3.01×10^{12} (b) 3.01×10^{18}
(c) 3.01×10^{24} (d) 3.01×10^{30}

AIIMS-1998

Ans. (a): Given that,

∴22400 cm^3 of the gas at STP has molecules
= 6.02×10^{23}

∴ 1.12×10^{-7} cm^3 of the gas at STP will have molecules.

$= \frac{6.02\times10^{23}}{22400}\times1.12\times10^{-7}$

= 3.01×10^{12} molecules

116. When 6 volumes of oxygen undergoes complete reaction to ozone, the number of moles of ozone formed are

(a) 6 (b) 3
(c) 4 (d) 2

AP EAMCET- 1995

Ans. (c) : $3O_2 \rightarrow 2O_3$

No. of moles of O_3 produced by 3 moles of O_2 = 2

No. of moles of O_3 produced by 6 moles of

$O_2 = \frac{2}{3}\times6 = 4\,mol.$

117. The number of molecules in 4.25 g of ammonia is approximately

(a) 3.5×10^{23} (b) 0.5×10^{23}
(c) 2.5×10^{23} (d) 1.5×10^{23}

AIIMS-1996

Ans. (d): We know that 17 g of ammonia (NH_3) Contains 6.02×10^{23} molecules.

Therefore number of molecules in 4.25 of

$NH_3 = \frac{6.02\times10^{23}\times4.25}{17}$

$NH_3 = 1.50\times10^{23}$

$NH_3 = 1.5\times10^{23}$

118. The mole fraction of solute in 20% aqueous H_2O_2 solution is

(a) 0.588 (b) 0.444
(c) 0.1168 (d) 4.44

AP EAMCET- 1992

Ans. (c) : Given that,

20% aqueous H_2O_2

No. of moles of H_2O_2 = $\frac{20}{34}$ =0.588

No. of moles of H_2O = $\frac{80}{18}$ = 4.44

∴ Mole fraction of $H_2O_2 = \frac{0.588}{0.588+4.44}$ = 0.1168

119. The number of moles of oxygen in one litre of air containing 21% oxygen by volume, under standard conditions, is

(a) 0.0093 mol (b) 2.10 mol
(c) 0.186 mol (d) 0.21 mol

NEET-1995

Ans. (a) : Volume of oxygen in 1L of air

$\frac{21}{100}\times1000 = 210mL$

∴ 22400 mL volume at STP is occupied by oxygen = 1 mole

number of moles occupied by 210 mL

$\frac{210}{22400} = 0.0093\,mol.$

120. The number of gram molecules of oxygen is 6.02×10^{24} CO molecules is

(a) 10 g molecules (b) 5 g molecules
(c) 1 g molecules (d) 0.5 g molecules

NEET-1990

Ans. (b) : No. of CO molecules = 6.022×10^{24}

Number of oxygen atoms = Number of CO molecules = 6.022×10^{24}

Number of Oxygen molecule = $\frac{1}{2}$ × number of oxy

= 3.011×10^{24}

Number of molecules of O_2 molecules

$= \frac{No.of\ molecules}{Avogadro's\ No.} = \frac{3.011\times10^{24}}{6.022\times10^{23}}$ = 5g molecule

(Note: mole also called gram-molecule)

121. The number of oxygen atoms in 4.4 g of CO_2 is

(a) 1.2×10^{23} (b) 6×10^{22}
(c) 6×10^{23} (d) 0.12×10^{23}

NEET-1989

Ans. (a) : Moles of CO_2 = $\frac{4.4}{44} = 0.1 \text{moles}$

$\therefore$ Number of molecules of $CO_2 = 0.1 \times 6.022 \times 10^{23}$

$= 6.022 \times 10^{22}$ molucules

1 molecule of CO_2 contains 2 oxygen atoms.

$\therefore$ Number of oxygen atoms = $2 \times 6.022 \times 10^{22}$

$= 12.044 \times 10^{22}$

$= 1.2 \times 10^{23}$ atoms

122. 1 cc N_2O at NTP contains

(a) $\frac{1.8}{224} \times 10^{22}$ atoms

(b) $\frac{6.02}{22400} \times 10^{23}$ molecules

(c) $\frac{1.32}{224} \times 10^{23}$ electrons

(d) All of the above

NEET-1988

Ans. (d) : At NTP 22400 cc of N_2O contains = 6.02×10^{23} molecules

$\therefore$ 1 cc N_2O will contain = $\frac{6.02 \times 10^{23}}{22400}$ molecules

In N_2O molecule, number of atoms = 2 + 1 = 3

Thus, the number of atoms = $\frac{3 \times 6.02 \times 10^{23}}{22400}$ atoms

$= \frac{1.8 \times 10^{22}}{224}$ atoms

In an N_2O molecule, the number of electrons = 7 + 7 + 8 = 22

Hence, the number of electrons, $= \frac{6.02 \times 10^{23}}{22400} \times 22$

$= \frac{1.32 \times 10^{23}}{224}$ electrons.

123. At STP the density of CCl_4 vapour of g/L will be nearest to

(a) 6.87 (b) 3.42
(c) 10.26 (d) 4.57

NEET-1988

Ans. (a) : We know that, mass of C = 12g, Cl = 35.5 g

1 mole CCl_4 vapours = $12 + 4 \times 35.5$

= 154g

At STP, volume of 1 mole of gas = 22.4 L

Thus, 154g = 22.4 L

$\therefore$ Density of CCl_4 vapours = $\frac{154}{22.4} gL^{-1}$

$= 6.87 \text{ g L}^{-1}$

124. If Avogadro number N_A, is changed from 6.022×10^{23} mol^{-1} to 6.022×10^{20} mol^{-1}, this would change

(a) the mass of one mole of carbon
(b) the ratio of chemical species to each other in a balanced equation.
(c) the ratio of elements to each other in a compound
(d) the definition of mass in units of grams.

NEET-2012

Ans. (a) :

Mass of 1 mole (6.022×10^{23}) atoms of carbon = 12 g

If Avogadro Number (N_A) is changed than mass of 1 mol (6.022×10^{20} atom) of carbon

$= \frac{12 \times 6.022 \times 10^{20}}{6.022 \times 10^{23}} = 12 \times 10^{-3} g$

Therefore, Mass of 1 mol of carbon is changed.

125. The volume in litres of CO_2 liberated at STP when 10 g of 90% pure lime stone is heated completely is:

(a) 2.016 (b) 20.16
(c) 2.24 (d) 22.4

AP EAMCET (Medical) -1998

Ans. (a): $CaCO_3 \xrightarrow{\Delta} CaO + \underset{\substack{22.4 L at STP \\ (1 mole)}}{CO_2}$

$\therefore$ Molecular weight of $CaCO_3$ = 100g/mole

Weight of 10gm of 90% pure limestone $= \frac{10 \times 90}{100}$

= 9 gm pure $CaCO_3$

$\therefore$ 9 gm pure $CaCO_3$

$CO_2 = \frac{22.4 \times 9}{100} = 2.016 L$.

126. The total number of valence electrons in 4.2 g of N_3^- ion is (N_A is the Avogadro's number)

(a) 2.1 N_A (b) 4.2 N_A
(c) 1.6 N_A (d) 3.2 N_A

NEET-1994

Ans. (c) : Molecular wt of $N_3^- = 3 \times 14 = 42g$

Moles of N_3^- ion $= \frac{4.2}{42} = 0.1$

Each nitrogen atom has 5 valence electrons, total number of electrons in

N_3^- ion = 16

Total number of electrons in 0.1 mole,

4.2g of N_3^- ion = $0.1 \times 16 \times N_A = 1.6 N_A$

127. An organic compound contains 78% (by wt) carbon and remaining percentage of hydrogen. The right option for the empirical formula of this compound is [Atomic wt. of C is 12, h is 1]

(a) CH_4 (b) CH
(c) CH_2 (d) CH_3

NEET-2021

Ans. (d) : Element Mass % At. weight $\frac{\%}{\text{At.Weight}}$ Simplest ratio.

C	78	12	78/12 = 6.5	65/6.5 = 1
H	22	1	22/1 = 22	22/6.5 = 3

Empirical formula of this compound is CH_3.

128. The empirical formula of the compound if M = 68% (atomic mass = 34) and remaining 32% oxygen is?

(a) MO (b) M_2O
(c) MO_2 (d) M_2O_3

AIIMS 25 May 2019 (Morning)

Ans. (a): We know that,

$$\text{No. of moles} = \frac{\text{Percentage of element}}{\text{At. mass}}$$

$$\text{No. of moles of element (M)} = \frac{68}{34} = 2$$

$$\text{No. of moles of oxygen} = \frac{100-68}{16} = 2$$

$$\text{Empirical formula of compound} = M_2O_2 = MO$$

129. A binary mixture of bivalent metals having mass 2 g, molecular mass of A and B are 15 and 30 respectively, is dissolved in HCl, it evolves 2.24L H_2 at STP, what is the mass of A present in mixture? (Atomic mass of A = 15μ, B = 30μ)

(a) 1 g (b) 1.5 g
(c) 0.5 g (d) 0.75 g

AIIMS-26 May, 2018 (E)

Ans. (a): For metal A let the mass of metal is x

No. of moles = x/15

$$A + 2HCl \rightarrow ACl_2 + H_2$$

one mole of metal gives one mole of H_2 gas

Mole : $\frac{x}{15}$ $\qquad$ $\frac{x}{15}$

$$B + 2HCl \rightarrow BCl_2 + H_2$$

Mole $\frac{2-x}{30}$ $\qquad$ $\frac{2-x}{30}$

Total moles of $H_2 = \frac{x}{15} + \frac{2-x}{30} = \frac{2.24}{22.4} = \frac{1}{10}$

$$\frac{2+x}{30} = \frac{1}{10}$$

$$20 + 10x = 30$$

$$10 = 10x$$

$$x = 1g$$

130. In a hydrocarbon, mass ratio of hydrogen and carbon is 1:3, the empirical formula of hydrocarbon is

(a) CH_4 (b) CH_2
(c) C_2H (d) CH_3

AIIMS-2012

Ans. (a): Given, $\frac{C}{H} = \frac{1}{3}$

Atomic mass of H = 1

Atomic mass of C = 12

According to the option

In,

$$CH_2 \rightarrow \frac{C}{H} = \frac{2}{12} = 1:6$$

$$C_2H \rightarrow \frac{C}{H} = \frac{1}{24} = 1:24$$

$$CH_3 \rightarrow \frac{C}{H} = \frac{3}{12} = 1:4$$

$$CH_4 \rightarrow \frac{C}{H} = \frac{4}{12} = 1:3$$

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

(a) CHO (b) CH_4O
(c) CH_3O (d) CH_2O

NEET-2008

Ans. (c): For calculating Empeirical formula,

Element	%	At. Wt.	Relative No. of atoms	Simplest ratio of atoms
C	38.71	12	3.23	3.23/3.23=1
H	9.67	1	9.67	9.67/3.23=3
O	51.62	16	3.23	3.23/3.23=1

Hence, empirical formula is CH_3O.

132. In an organic compound, C =68.5% and H = 4.91%. Which empirical formula is correct for it?

(a) C_6H_{10} (b) $C_7H_6O_2$
(c) C_5H_8O (d) C_9H_3O

UP CPMT-2009

Ans. (b): For calculating Empirical formula,

Element	At.wt.	Percent composition	No.of moles	Simple molar ratio
C	12	68.5	$\frac{68.5}{12} = 5.708$	$\frac{5.708}{1.67} = 3.41 \times 2 = 7$
H	1	4.91	$\frac{4.91}{1} = 4.91$	$\frac{4.91}{1.67} = 2.95 \times 2 = 6$
O	16	$(100-68.5-4.91) = 26.59$	$\frac{26.59}{16} = 1.67$	$\frac{1.67}{1.67} = 1 \times 2 = 2$

Hence, the empirical formula of the compound is $C_7H_6O_2$.

133. In a compound C, H and N are present in 9 : 1 : 3.5 by weight. If molecular weight of the compound is 108, then the molecular formula of the compound is

(a) $C_2H_6N_2$ (b) C_3H_4N
(c) $C_6H_8N_2$ (d) $C_9H_{12}N_3$

UP CPMT-2006

Ans. (c) : Molecular weight of compound = 108

C	H	N
9	1	3.5
$\frac{9}{12} = 0.75$	$\frac{1}{1} = 1$	$\frac{3.5}{14} = 0.25$
$\frac{0.75}{0.25} = 3$	$\frac{1}{0.25} = 4$	$\frac{0.25}{0.25} = 1$

So, empirical formula = C_3H_4N

Molecular weight of C_3H_4N = 54

$\Rightarrow \quad n = \frac{108}{54} = 2$

$\therefore$ Molecular formula = $(C_3H_4N)_2$

= $C_6H_8N_2$

134. A compound is 60g on analysis produce carbon, hydrogen and oxygen 24g, 4g and 32g respectively. The empirical formula is

(a) $C_2H_2O_2$ (b) $C_2H_4O_2$

(c) CH_2O (d) $C_2H_4O_6$

UP CPMT-2002

Ans. (c) :

Element	**Analysis produce**	**% of element**	**Relative number**
C	24	$\frac{24}{60} \times 100 = 40\%$	$\frac{40}{12} = 3.33 = 1$
H	4	$\frac{4}{60} \times 100 = 6.66\%$	$\frac{6.66}{1} = 6.66 = 2$
N	32	$\frac{32}{60} \times 100 = 53.33\%$	$\frac{53.33}{14} = 3.33 = 1$

Hence, the empirical formula is CH_2O.

135. 4g of a hydrocarbon on complete combustion gave 12,571 g of CO_2 and 5.143 g of water. What is the empirical formula of the hydrocarbon?

(a) CH (b) CH_2

(c) CH_3 (d) C_2H_3

A.P.EAMCET-2002

Ans. (b) : % of carbon

$= \frac{12}{44} \times \frac{\text{weight of } CO_2 \times 100}{\text{weight of organic compound}}$

$= \frac{12}{44} \times \frac{12.571}{4} \times 100 = 85.7\%$

% of Hydrogen $= \frac{2}{18} \times \frac{\text{weight of water}}{\text{weight of compound}} \times 100$

$= \frac{2}{18} \times \frac{5143 \times 100}{4} = 143\%$

Element	% atomic weight	Simple ratio
C	$\frac{85.7}{12} = 7.15$	$\frac{7.15}{7.15} = 1$
H	$\frac{14.3}{1} = 14.3$	$\frac{14.3}{7.15} = 2$

Hence the empirical formula = CH_2

136. An organic compound containing C and H has 92.3% of carbon, Its empirical formula is

(a) CH (b) CH_3

(c) CH_2 (d) CH_4

A.P.EAMCET-2004

Ans. (a) : Given that, C = 92.3% and H is 7.7%

Element	Percentage atomic weight	Simple ratio
C	$\frac{92.3}{12} = 7.69$	$\frac{7.69}{7.69} = 1$
H	$\frac{7.7}{1} = 7.7$	$\frac{7.70}{7.69} \simeq 1$

Hence the empirical formula = CH

137. How many litres of oxygen (at STP) are required for complete combustion of 39 g of liquid benzene?
(atomic weights : C =12, O =16, H=1)

(a) 84 (b) 22.4

(c) 42 (d) 11.2

A.P.EAMCET-2001

Ans. (a)

$C_6H_6(l) + \frac{15}{2}O_2(g) \rightarrow 6CO_2(g)) + 3H_2O(g)$

Molar mass of C_6H_6 = 78 g/mol

39 gms of $C_6H_6(l) = \frac{39}{78}$ moles = 0.5 moles

For 2 moles, we require 15 moles of O_2, for 0.5 moles we will require–

$\Rightarrow \quad \frac{0.5}{2} \times 15 = \frac{15}{4} \text{moles of } O_2$

$= \frac{15}{4} \times 22.4 \text{ litres} = 84 \text{ litres}$

A3.5 Assertion and Reasons

138. Assertion: Molecular weight of a compound is 180, if its vapour density is 90.

Reason: Molecular Weight = $\frac{\text{Vapour density}}{2}$

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) If Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

AIIMS 25 May 2019 (Morning)

Ans. (c): Relation between molecular weight and vapour density is,

Molecular weight of compound = 2 × vapour density

= 2 × 90

= 180

Hence, assertion is correct but reason is incorrect.

139. Assertion : The normality of 0.3 M aqueous solution of H_3PO_3 is equal to 0.6N.

Reason: Equivalent weight of H_3PO_3

$$= \frac{\textbf{Molecular weight of } H_3PO_3}{3}$$

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-2018, 2013, 2011

Ans. (c): H_3PO_3 is a divalent. This is because it has two ionizable hydrogen atoms bonded to two oxygen atom and one non-ionizable hydrogen atom bonded directly to phosphorus.

$$\therefore \text{ Equivalent weight} = \frac{\text{Molecular weight}}{\text{Valency factor}}$$

(Where, valency factor = no. of replaceable H^+ ions)

equivalent weight = $\frac{M}{q}$, since, no. of replaceable H^+ ions in $H_3PO_3 = 2$

140. Assertion : Equal moles of different substances contain same number of constituent particles.

Reason: Equal weights of different substance contain the same number of constituent particles.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-2017

Ans. (c): Equal moles of different substances contain same number of constituent particles. But equal weights of different substances do not contain the same number of constituent particles. Hence, Assertion is correct but reason is incorrect.

$$\text{Number of moles} = \frac{\text{Weight}}{\text{Molecular weight}}$$

$$\text{Number of moles} = \frac{\text{Number of particle}}{N_A}$$

Where, N_A = Avogadro's number

141. Assertion : Equivalent weight of a base

$$= \frac{\textbf{Molecular weight}}{\textbf{Acidity}}$$

Reason : Acidity is the number of replaceable hydrogen atoms in one molecule of the base.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-2008

Ans. (c):

$$\text{Equivalent weight of base} = \frac{\text{Molecular weight}}{\text{Acidity}}$$

Acidity of base is defined as the number of ionizable hydroxyl group present in base.
So, reason is incorrect.

142. Assertion: One molal aqueous solution of glucose contains 180 g of glucose in 1 kg water.

Reason: The solution containing one mole of solute in 1000 g of solvent is called one molal solution.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-2008

Ans. (a): Molality = No. of moles of solute /wt. of solvent in kg
If no. of moles of solute = 1
weight of solvent = 1 kg
then,
molality = 1
Glucose ($C_6H_{12}O_6$)
molecular weight = 180

$$\text{Here, No. of mole} = \frac{\text{Molecular mass}}{\text{wt. of solvent}} = \frac{180}{180} = 1$$

$$\text{Molality} = \frac{1}{1}$$

Hence, assertion and reason, both are Correct and reason is the correct explanation of assertion.

02.

Atomic Structure

B1. Nature of Electromagnetic Radiation, Photoelectric Effect

B1.1 Multiple Choice Question (MCQs)

1. The wavelength of visible light is:

(a) 2000Å–3700Å (b) 7800Å–8900Å
(c) 3800Å–7600Å (d) None of these

AIIMS-1998

Ans. (c): The visible spectrum is the portion of the electromagnetic spectrum that is visible to the human eye. Electromagnetic radiation in this range of wavelengths is called visible light or simple light. A typical human eye will respond to wavelengths from about.

380 to 700 nm or 3800Å – 7600Å

The visible spectrum is VIBGYOR. Violet has the shortest wavelength, at around 380 nanometers, and red has the longest wavelength, at around 700 nanometers in this spectrum.

B1.2 Statement Based question

2. Given below are two statements:

Statement I: The Balmer spectral line for H atom with lowest energy is located at $\frac{5}{36}R_H Cm^{-1}$

(R_H = Rydberg constant)

Statement II: When the temperature of blackbody increases, the maxima of the curve (intensity vs wavelength) shifts to shorter wavelength.

In the light of the above statements, choose the correct answer from the options given below:

(a) Statement I is true but Statement II is false
(b) Statement I is false but Statement II is true
(c) Both Statement I and Statement II are true
(d) Both Statement I and Statement II are false

RE-NEET (UG)-23.06.2024

Ans. (c) : For Balmer spectral line for H atom

$n_1 = 2$, $n_2 = 3$

$$\therefore E = R_H\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$$

$$= R_H\left(\frac{1}{2^2}-\frac{1}{3^2}\right)$$

$$= R_H\left(\frac{9-4}{36}\right)$$

$$= \frac{5}{36}R_H cm^{-1}$$

• When the temperature of blackbody increases, the maxima of the curve shifts to shorter wavelength.

B1.3 Numerical Answer Types (NATs)

3. What is the energy (in J) required to transfer the electron from n = 1 to n=2 state in Li^{2+}? (K = constant = 2.18×10^{-18}J)

(a) $\frac{4K}{27}$ (b) 9K
(c) 8K (d) $\frac{27K}{4}$

Telangana SCHE 07.05.2024 Shift II

Ans. (d) : To find the energy required to transfer the electron from n = 1 to n = 2 state in Li^{2+}

1. According to the formula for the energy levels of a hydrogen-like ion -

$$En = \frac{-z^2k}{n^2}$$

Where z = 3 and k = 2.18×10^{-18}

2. Calculate the energies -

• For n = 1

$$E_1 = \frac{3^2k}{1^2} = -9k$$

For n = 2

$$E_2 = -\frac{3^2k}{2^2} = -\frac{9k}{4}$$

3. Find the energy difference

$$\Delta E = E_2 - E_1 = \left(\frac{-9k}{4}\right) - (-9k)$$

$$\Delta E = -\frac{9k}{4} + 9k$$

$$\Delta E = -\frac{9k+36k}{4}$$

$$\Delta E = \frac{27k}{4}$$

so, the required energy is $\frac{27k}{4}$

4. The momentum of an electron is 6.625×10^{-28}kg ms^{-1}. What its wavelength in nm?

($h = 6.625\times10^{-34}$ Js)

(a) 100 (b) 1000
(c) 500 (d) 6625

Ans. (b) : Given, momentum of electron (P) = 6.625×10^{-28} kgms^{-1}

wavelength (λ) = ?

From de- Broglie equation -

$$\lambda = \frac{h}{p}$$

where, λ = Wavelength of light

h = Planck's constant

p = Momentum of electron.

$$\therefore \quad \lambda = \frac{6.62\times10^{-34}\,Js}{6.62\times10^{-28}\,kgms^{-1}}$$

$\lambda = 1 \times 10^{-6}$ m

or

λ = 1000nm

5. The value of Planck's contant is 6.63×10^{-34} Js. Speed of light is 3×10^{17} nm s^{-1}. Which a value is closed to the wavelength in nanomter of a quantum of light with frequency of 6×10^{15} s^{-1}?

(a) 50 (b) 75

(c) 10 (d) 25

NEET-2013

Ans. (a) : We know that –

$c = \nu\lambda$

$$\lambda = \frac{c}{\nu}$$

$$\lambda = \frac{3\times10^{17}}{6\times10^{15}} = 50nm$$

6. The value of Planck's constant is 6.63×10^{-34} Js. The velocity of light is 3.0×10^{8} ms^{-1}. Which value is closest to the wavelength in nanometers of a quantum of light with frequency of $8\times10^{15}s^{-1}$?

(a) 2×10^{-25} (b) 5×10^{-18}

(c) 4×10^{1} (d) 3×10^{7}

NEET-2003

Ans. (c): Given that –

$c = 3 \times 10^{8}$ m/s

$\lambda = 8 \times 10^{15}$ s^{-1}

We know that,

$$\lambda = \frac{c}{\upsilon}$$

$$\lambda = \frac{3\times10^{8}}{8\times10^{15}} = 0.375\times10^{-7}\,m$$

$= 0.375\times10^{-7}\times10^{9}$ nm

$= 0.375\times10^{2}$ nm

= 37.5 nm

$\approx 4\times10^{1}$ nm

7. A particular station of All India Radio, New Delhi, broadcasts ona frequency of 1,368 kHz (kilohertz). The wavelength of the electro-magnetic radiation emitted by the transmitter is [speed of light, c = 3.0×10^{8} m s^{-1}]

(a) 21.92 cm (b) 219.3 m

(c) 219.2 m (d) 2192 m

NEET-2021

Ans. (b) : We know that –

$$\text{Wave length } (\lambda) = \frac{c}{v}$$

$$\lambda = \frac{3\times10^{8}}{1368\times10^{3}} = 219.298m = 219.3\,m$$

8. The energy required to overcome the attractive forces on the electrons, w, of some metals is listed below. The number of metals showing photoelectric effect when light of 300 nm wavelength falls on it is

(1eV = 1.6×10^{-19} J)

Metal	Li	Na	K	Mg	Cu	Ag	Fe	Pt	W
w(eV)	2.4	2.3	2.2	3.7	4.8	4.3	4.7	6.3	4.75

(a) 6 (b) 8

(c) 5 (d) 4

AP EAMCET (Medical) - 2013

Ans. (d) : Given:

wavelength (λ) = 300 nm = 300×10^{-9} m

1 eV = 1.6×10^{-19} J

$\therefore$ Energy of a photon of radiation of wavelength 300nm will be -

E = hν

$$\text{or} \quad E = \frac{hc}{\lambda}$$

$$\text{or} \quad E = \frac{6.6\times10^{-34}\,(JS)\times3\times10^{8}\,(ms^{-1})}{300\times10^{-9}\,m}$$

or E = 6.6×10^{-19}J

$$E = \frac{6.6\times10^{-19}}{1.6\times10^{-19}}\,eV$$

or E = 4.14 eV

There are 4 metals for which the energy required to overcome the attractive forces on the electrons, w, is less than 4.14eV, the energy of light of wavelength 300 nm. Thus the number of metals showing a photoelectric effect is 4.

9. The work functions of Ag, Mg, K and Na respectively in eV are 4.3, 3.7, 2.25, 2.30, When an electromagnetic radiation of wavelength of 300 nm is allowed to fall on these metal surface, the number of metals from which the electrons are ejected is (1ev = 1.6022×10^{-19}J)

(a) 4 (b) 3

(c) 2 (d) 5

AP EAMCET-2017

Ans. (b) : Given that,

λ = 300 nm = 300×10^{-9} m

$$E = \frac{hc}{\lambda}$$

$$E = \frac{6.6\times10^{-34}\times3\times10^{8}}{300\times10^{-9}}$$

$$E = \frac{19.8\times10^{-26}}{300\times10^{-9}}$$

E = 6.6×10^{-19} Joule

And work function for Ag, Mg, K and Na in Joules are –
$Ag = 4.3 \times 1.6022 \times 10^{-19} = 6.89 \times 10^{-19}$ Joule
$Mg = 3.7 \times 1.6022 \times 10^{-19} = 5.93 \times 10^{-19}$ joule
$K = 2.25 \times 1.6022 \times 10^{-19} = 3.60 \times 10^{-19}$ joule
$Na = 2.30 \times 1.6022 \times 10^{-19} = 3.68 \times 10^{-19}$ Joule
Thus Mg, K and Na metal will eject electron only when $W \le E_{(300)}$.
Hence the option (b) is correct

10. A bulb emitted electromagnetic radiation of 660 nm wavelength. The total energy of radiation is 3×10^{-18} J. The number of emitted photon will be:
($h = 6.6 \times 10^{-34}$ Js, $c = 3 \times 10^8$ m/s)

(a) 1 (b) 10
(c) 100 (d) 1000

AIIMS 26 May 2019 (Morning)

Ans. (b): Given that, total energy of radiation = 3×10^{-18}J

$h = 6.6\times10^{-34}$Js, $c = 3\times10^8$, $\lambda = 660\times10^{-9}$

Number of photons emitted = n
We know that,

$$E = \frac{nhc}{\lambda}$$

Where, h = the plank's constant
c = the speed of light
and λ = wavelength
Now, by substituting the value of these, we get–

$$3\times10^{-18} = \frac{6.6\times10^{-34}\times3\times10^8\times n}{660\times10^{-9}}$$

$$n = \frac{30}{3} = 10$$

11. Find the frequency of light that corresponds to photons of energy 5.0×10^{-5} erg?

(a) $7.5\times10^{-21}\,\text{sec}^{-1}$ (b) 7.5×10^{-21} sec
(c) $7.5\times10^{21}\,\text{sec}^{-1}$ (d) 7.5×10^{21} sec

AIIMS-2010

Ans. (c): We know that, E= hv.

$$v = \frac{E}{h} = \frac{5.0\times10^{-5}\,\text{erg}}{6.63\times10^{-34}\,\text{Js}}$$

$$v = \frac{5.0\times10^{-5}\,\text{erg}}{6.63\times10^{-34}\times10^{7}\,\text{erg sec}}$$

$\therefore$ [1J= 10^7 erg]
$v = 7.54\times10^{21}\,\text{sec}^{-1}$

12. Ratio of energy of photon of wavelength 3000Å and 6000Å is

(a) 3 : 1 (b) 2 : 1
(c) 1 : 2 (d) 1 : 3

AIIMS-2012

Ans. (b): Given that, ratio of energy of photon of wavelength 3000Å and 6000Å

$$E = \frac{hc}{\lambda}$$

$$\frac{E_1}{E_2} = \frac{\lambda_2}{\lambda_1} = \frac{6000}{3000} = 2:1$$

13. According to law of photochemical equivalence the energy absorbed (in ergs/mole) is given as ($h = 6.62 \times 10^{-27}$ ergs, $c = 3 \times 10^{10}$ cm s^{-1}, $N_A = 6.02 \times 10^{23}$ mol^{-1})

(a) $\frac{1.196\times10^8}{\lambda}$ (b) $\frac{2.859\times10^5}{\lambda}$
(c) $\frac{2.859\times10^{16}}{\lambda}$ (d) $\frac{1.196\times10^{16}}{\lambda}$

Karnataka NEET-2013

Ans. (a) : Given data,
$h = 6.62 \times 10^{-27}$ ergs
$c = 3 \times 10^{10}$ cm s^{-1}
$N_A = 6.02 \times 10^{23}$ mol^{-1}

$$E = \frac{hcN_A}{\lambda}$$

$$= \frac{6.62\times10^{-27}\times3\times10^{10}\times6.02\times10^{23}}{\lambda}$$

$$= \frac{1.196\times10^8}{\lambda}\,\text{ergs mol}^{-1}.$$

14. The energies E_1 and E_2 of two radiations are 25 eV and 50 eV respectively. The relation between their wavelengths i.e. λ_1 and λ_2 will be

(a) $\lambda_1 = \lambda_2$ (b) $\lambda_1 = 2\lambda_2$
(c) $\lambda_1 = 4\lambda_2$ (d) $\lambda_1 = \frac{1}{2}\lambda_2$

NEET-2011

Ans. (b) : Given, E_1= 25ev and E_2= 50 ev

$$E_1 = \frac{hc}{\lambda_1}, E_2 = \frac{hc}{\lambda_2}$$

By dividing E_1 and E_2

$$\Rightarrow \frac{25}{50} = \frac{\lambda_2}{\lambda_1}$$

$$\Rightarrow \frac{\lambda_2}{\lambda_1} = \frac{1}{2}$$

$$\Rightarrow \lambda_1 = 2\lambda_2$$

15. For given energy, $E = 3.03 \times 10^{-19}$ Joules corresponding wavelength is
($h = 6.626 \times 10^{-34}$) J sec, $c = 3 \times 10^8$ m/sec

(a) 65.6 nm (b) 6.36 nm
(c) 3.4 nm (d) 656 nm

NEET-2000

Ans. (d) : We know that–

$$E = \frac{hc}{\lambda}$$

Given that –
$E = 3.03 \times 10^{-19}$J
$h = 6.626 \times 10^{-34}$ Js
$c = 3 \times 10^8$ m/s

$$\lambda = \frac{6.6\times10^{-34}\times3\times10^8}{3.03\times10^{-19}}$$

$$= 6.56\times10^{-7}\,\text{m} = 656\times10^{-9}\,\text{m} = 656\,\text{nm}$$

B1.5 Assertion and Reasons

16. Assertion: Threshold frequency is the maximum frequency required for the ejection of electron from the metal surface.
Reason: Threshold frequency is characteristic of a metal.
(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-26 May, 2018

Ans. (d): Threshold frequency is a minimum frequency required for the emission of electron from the metal surface.

17. Assertion: All photons possess the same amount of energy.
Reason: Energy of photon does not depend upon wavelength of light used.
(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason, are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-1998

Ans. (d): Energy of a photon $= h\nu$

$\because \nu = \dfrac{c}{\lambda}$

Hence, $E = \dfrac{hc}{\lambda}$

So, energy depends on wavelength.

B.2 Bohr model of a hydrogen atom, spectrum of the hydrogen atom and its postulates for the energy of the electron and radii'

B2.1 Multiple Choice Question (MCQs)

18. Which of the following gives proof of quantized electronic levels in hydrogen atom?
(a) Atomic spectrum
(b) Photoelectric effect
(c) Emission of blackbody radiation
(d) Davisson – Germer experiment

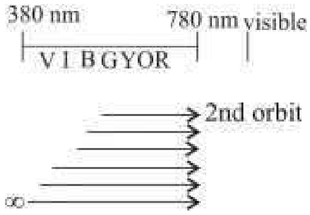
Telangana SCHE 07.05.2024 Shift II

Ans. (a) : The atomic spectrum of hydrogen, specifically its emission spectrum. Provides direct evidence of quantized electronic levels. When an electron in hydrogen atom transitions between energy levels, it emits or absorbs light of specific wavelength, these wavelengths form a series of discrete spectral lines, known as the Balmer, Lyman series etc. Depending on the energy levels involved in the transition.

19. In Bohr series of lines of hydrogen spectrum, the third line from the red end corresponds to which one of the following inter- orbit jumps of the electron for Bohr orbits in an atom of hydrogen
(a) $5 \rightarrow 2$ (b) $4 \rightarrow 1$
(c) $2 \rightarrow 5$ (d) $3 \rightarrow 2$

AIIMS-2017

Ans. (a): In hydrogen spectrum coloured radiaton means visible radiation corresponds to Balmer series.
(n_1=2, n_2=3, 4…….)



2nd line from the red end, it means $5 \rightarrow 2$

20. If radius of second Bohr orbit of the He^+ ion is 333. The spectrum of Helium is expected to be similar to that of——
(a) Li^+ (b) H
(c) Na (d) He^+

NEET-1998

Ans. (a) : The spectrum of any element depends upon the no. of electron in outer shell.
Electronic configuration of He = $_1s^2$
Reason:- Li^+ has the same electronic configuration like as He atom i.e.
$Li^+ = 1s^2, 2s^1$ (Removing of one electron form outer shell)
$Li^+ = 1s^2$
i.e $Li^+ = 2$

21. In hydrogen atomic spectrum, a series limit is found at 12186.3 cm^{-1}. Then, it belongs to
(a) Lyman Series (b) Balmer series
(c) Paschen series (d) Brackett series

AIIMS-2014

Ans. (c): Series limit is the last line of the series
i.e. $n_2 = \infty$

$$\therefore \quad \bar{\nu} = \frac{1}{\lambda} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] = R\left[\frac{1}{n_1^2} - \frac{1}{\infty^2}\right]$$

$$\bar{\nu} = \frac{R}{n_1^2}$$

$$12186.3 = \frac{109677.76}{n_1^2}$$

$$n_1^2 = \frac{109677.76}{12186.3} = 9,\ n_1 = 3$$

The line belongs to Paschen series.

22. If r is the radius of the first orbit, the radius of nth orbit of H-atom is given by

(a) rn^2 (b) rn
(c) r/n (d) r^2n^2

NEET-1988

Ans. (a) : Radius of nth orbit= r_1n^2 (for H–atom).

23. What are the values of n_1 and n_2 respectively for H_β line in the Lyman series of hydrogen atomic spectrum?

(a) 3 and 5 (b) 2 and 3
(c) 1 and 3 (d) 2 and 3

UP CPMT-2008

Ans. (c): H_β line is formed when electron jumps from 3rd orbit in Lyman series.

$n_1 = 1,\ n_2 = 3$

24. What are the values of n_1 and n_2 respectively for H_β line in the Lyman series of hydrogen atomic spectrum 44?

(a) 3 and 5 (b) 2 and 3
(c) 1 and 3 (d) 2 and 4

JIPMER-2009

Ans. (c) : H_B line is formed when electron jumps from 3rd orbit to 1st orbit in Lyman Series

$\therefore n_1 = 1,\ n_2 = 3$

25. Based on equation, $E = -2.178\times10^{-18} J\left(\frac{Z^2}{n^2}\right)$, certain conclusions are written. Which of them is not correct?

(a) Larger the value of n, the larger is the orbit radius.
(b) Equation can be used to calculate the change in energy when the electron changes orbit.
(c) For n=1, the electron has a more negative energy than it does for n=6 which means that the electron is more loosely bound in the smallest allowed orbit.
(d) The negative sign in equation simply means that the energy of electron bound to the nucleus is lower than it would be if the electrons were at the infinite distance from the nucleus.

AIIMS-2015

Ans. (c): For n=1, the electron has a more negative energy than it does for n=6 which means that the electron is more loosely bound in the smallest allowed orbit.

26. In the Bohr hydrogen atom, the electronic transition emitting light of longest wave length is:

(a) n = 2 to n =3 (b) n = 4 to n = 3
(c) n = 3 to n =2 (d) n = 2 to n = 1

AP – EAMCET - (Medical)-1997

Ans. (b) : The spectrum of hydrogen atom obey the following formula–

$$\bar{v} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

Where R_H = Rydberg constant

In the Paschen series of hydrogen atom spectrum, the minimum energy difference found in n =4 to n = 3 due to which they have longest wavelength.

27. For which of the following species, Bohr theory does not apply?

(a) H (b) He^+
(c) H^+ (d) Li^{2+}

AIIMS-2000

Ans. (c) : One of the limitations of Bohr's atomic model is that it does not explain the spectra of multi-electron atoms all these species like H, He^+ and Li^{2+} are iso electronic and have only one electron. Their electronic configurations are same and so their spectra is explained by Bohr's atomic model But H^- has 2 electron.

28. Ratio of radii of second and first Bohr orbits of H atom is

(a) 2 (b) 4
(c) 3 (d) 5

JIPMER-2005

Ans. (b) : According to Bohr's rule, $r \propto n^2$

Where r is radii and n is the number of orbit

So, $\frac{r_1}{r_2} = \frac{(2)^2}{(1)^2} = 4$

Hence, ratio of radii is 4.

29. What will be the number of waves formed by a Bohr electron in one complete revolution in its second orbit?

(a) Three (b) Two
(c) One (d) Zero

JIPMER-2016

Ans. (b) :

$$\text{Number of waves} = \frac{\text{circumference of orbit}}{\text{de} - \text{Broglie wavelength of electron}}$$

$$\lambda = \frac{h}{mv}$$

$$\mu = \frac{2\pi r}{\frac{h}{mv}} = \frac{2\pi}{h}\times mvr$$

$$mvr = \frac{nh}{2\pi},\ \mu = \frac{2\pi}{h}\times\frac{nh}{2\pi}$$

$$\mu = n$$

For second orbit, n =2

$\therefore$ number of waves, $\mu = 2$

30. **Which of the following statement do not form a part of Bohr's model of hydrogen atom?**
(a) Energy of the electrons in the orbits are quantized.
(b) The electron in the orbit nearest the nucleus has the lower energy.
(c) Electrons revolve in different orbits around the nucleus
(d) The position and velocity of the electrons in the orbit cannot be determined simultaneously

NEET-1989

Ans. (d) : According is the Heisenberg uncertainty principle, the position and velocity of the electrons in the orbit cannot be determined simultaneously. This statement is not correct according to Bohr's model because according to Bohr's model it was possible to determine both position and velocity simultaneously.

31. **Who modified Bohr's theory by introductin elliptical orbits for electrons path?**
(a) Rutherford (b) Thomson
(c) Hund (d) Sommerfeld

NEET-1999

Ans. (d) : Sommerfeld modified Bohr's theory. According to him electrons move in elliptical orbits in addition to circular orbits.

32. **Based on equation E = -2178 × 10^{-15} J $\left(\frac{Z^2}{n^2}\right)$ certain conclusions are written. What of them is not correct?**
(a) Equation can be used to calculate the change in energy when the electron changes orbit.
(b) For n=1, the electron has a more negative energy than it does for n = 6 which means that the electron is more loosely bound in the smallest allowed orbit.
(c) The negative sign in equation simply means that the energy of electron bound to the nucleus is lower than it would be if the electrons were at the infinite distance from the nucleus.
(d) Larger the value of n, the larger is the orbit radius.

NEET-2013

Ans. (b): For n=1 the electron has more negative energy than it does for n=6 which means that the electron is less loosely bound in the smallest allowed orbit.
We know that,
$$E = -R_H\left(\frac{Z^2}{n^2}\right)$$
If n = 1
$$E = -R_H\left(\frac{Z^2}{1}\right) = -2.178\times10^{-18}\,J$$
If n = 6
$$E = -R_H\left(\frac{Z^2}{6^2}\right) = \frac{-2.178}{36}\times10^{-18}\,J$$
$$= -6.05\times10^{-20}\,J$$
$E_{n=1} > E_{n=6}$

B2.2 Statement Based question

33. **The following orbital energies (E) are compared. Identify the correct sets**
I. $E_{2s}(H) = E_{2p}(H)$
II. $E_{2s}(H) = E_{2s}(He)$
III. $E_{2s}(H) < E_{2s}(He)$
IV. $E_{3s}(He) < E_{3s}(H)$
(a) I, II only (b) I, II, III, IV
(c) III, IV only (d) I, IV only

Telangana SCHE 08.05.2024 Shift-I

Ans. (*) : (ii) $E_{2S}(H) = E_{2S}(He)$ The 2s orbital energy of hydrogen is equal to the 2s orbital energy of helium (He).
(iii) $E_{2S}(H) < E_{2S}(He)$ This statement is also correct. The 2s orbital energy of hydrogen is lower than the 2s orbital energy of helium.

B2.3 Numerical Answer Types (NATs)

34. **The energy of an electron in the ground state (n = 1) for He^+ ion is –x J, then that for an electron in n = 2 state for Be^{3+} ion in J is:**
(a) $-\frac{x}{9}$ (b) –4x
(c) $-\frac{4}{9}x$ (d) – x

NEET (UG) 05.05.2024

Ans. (d) : Given that, energy of an electron in the ground state for He^+ ion is –x joule
$$E_{He^+} = \frac{-13.6z^2}{n^2}$$
$\therefore He^+ = xJ$
$E_{He^+} = -13.6 \times 4J = -2$ Joule $\therefore He^+ = xJ$
$$\text{So, } E_{Be^{3+}} = \frac{-13.6\times(4)^2}{(2)^2}$$
$$= \frac{-13.6\times16}{4}$$
$E_{Be^{3+}} = -13.6\times4$ Joule $(\because -x\,J = 13.6\times4J)$
Or $E_{Be^{3+}} = -x$ Joule

35. **8 pm, what is the radius of third Bohr orbit of Li^{2+} ion?**
(a) 158.7 Å (b) 158.7 pm
(c) 15.87 pm (d) 1.587 pm

NEET-17.07.2022

Ans. (b) : $r = \frac{n^2}{Z} \times a_0$

For He^+, n = 2

Z = 2

$r_{He^+} = 105.8\,pm$

$r_{He^+} = \frac{(2)^2}{2} \times a_0$

$105.8 = \frac{4 \times a_0}{2}$

$a_0 = \frac{105.8 \times 2}{4} = 52.9$

For Li^{2+}, n = 3, Z = 3

$r_{Li^{2+}} = \frac{3^2}{3} \times a_0$

= 3 × 52.9 = 158.7 pm

36. Wavelength of a particular transition for H atom is 400 nm. What can be wavelength of He^+ for same transition?

(a) 400 nm (b) 100 nm
(c) 1600 nm (d) 200 nm

AIIMS-26 May, 2018

Ans. (b): According to the Rhyberg's equation–

$$\frac{1}{\lambda} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) \times Z^2$$

$$\frac{1}{400} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)(1)^2 \quad .....(i)$$

$$\frac{1}{\lambda_{He^+}} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)(2)^2 \quad .....(ii)$$

On dividing equation (i) by (ii), we get

$$\lambda_{He+} = \frac{400}{2^2} = \frac{400}{4} = 100\,nm$$

37. What is maximum wavelength of line of Balmer series of hydrogen spectrum? ($R = 1.09 \times 10^7 m^{-1}$)

(a) 400 nm (b) 654 nm
(c) 486 nm (d) 434 nm

AIIMS-26 May, 2018

Ans. (b): For maximum wavelength in the Balmer series energy difference is lowest.

Thus, $\bar{v} = R \times Z2 \left(\frac{1}{n^2} - \frac{1}{n_2^2}\right), n_2 = 3 \text{ and } n_1 = 2$

$$\therefore \frac{1}{\lambda} = 1.09 \times 10^7 \times 1^2\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$$

$$\Rightarrow \frac{1}{\lambda} = 1.09 \times 10^7 \times 1\left(\frac{1}{4} - \frac{1}{9}\right)$$

$$\Rightarrow 1.09 \times 10^7 \times 1\left(\frac{5}{36}\right)$$

$$\Rightarrow \lambda = \frac{36}{5 \times 1.09 \times 10^{7m}}$$

$\Rightarrow 6.60 \times 10^{-7}$ m $\Rightarrow$ 660 nm

38. Which transition in the hydrogen atomic spectrum will have the same wavelength as the transition, n=4 to n=2 of He^+ spectrum?

(a) n=4 to n= 3 (b) n=3 to n= 2
(c) n=4 to n= 2 (d) n=2 to n= 1

AIIMS-2016

Ans. (d): $\because \frac{1}{\lambda} = z^2.R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

$\therefore$ For He^+ ion, z=2

$$\frac{1}{\lambda} = 2^2 R\left[\frac{1}{2^2} - \frac{1}{4^2}\right]$$

$$\frac{1}{\lambda} = 4 \times R \times \frac{3}{16} = \frac{3}{4}R$$

The same value for H-atom is possible when electron jumps from n=2 to n=1 i.e.

$$\frac{1}{\lambda} = 1 \times R\left[\frac{1}{1} - \frac{1}{4}\right] \Rightarrow \frac{3}{4}R$$

39. Spectrum of Li^{2+} is similar to that of

(a) H (b) Be
(c) He (d) Ne

AIIMS-2002

Ans. (a): Electronic configuration of Li is $1s^2\ 2s^1$ and of Li^{2+} is $1s^1$. That is similar to the electronic configuration of H ($1s^1$) Which has only one electronic in its valance shell, thus it has spectrum similar to that of H.

40. Number of spectral lines of Lyman series of electron when it jumps from 6 to first level (in Lyman series), is

(a) 9 (b) 12
(c) 15 (d) 18

UP CPMT-2009

Ans. (c): Number of spectral lines $= \frac{n(n-1)}{2}$

$$= \frac{6(6-1)}{2}$$

= 15

41. What is the wave number of 4^{th} line in Balmer series of hydrogen spectrum? ($R = 1,09,677\ cm^{-1}$)

(a) 24,630 cm^{-1} (b) 24,360 cm^{-1}
(c) 24,730 cm^{-1} (d) 24,372 cm^{-1}

UP CPMT-2008

JIPMER-2009

Ans. (d): $\bar{v} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

For Balmer series n_1 = 2 and for 4^{th} line in Balmer series n_2 = 6

R = 109677 cm^{-1}

$$\bar{v} = 109677\left(\frac{1}{2^2} - \frac{1}{6^2}\right)$$

$$= 109677\left(\frac{1}{4} - \frac{1}{36}\right)$$

$\bar{v}$ = 24,372 cm^{-1}

42. Which is the shortest wavelength line in the Lyman series of the hydrogen spectrum? ($R=1.097\times10^{-2}nm^{-1}$)

(a) 94.21 nm (b) 91.16 nm
(c) 911.6 nm (d) 933.6 nm

JIPMER-2004

Ans. (b) : : For Lyman Series $\frac{1}{\lambda}=R\left(\frac{1}{(1)^2}-\frac{1}{n^2}\right)$

Hence for λ to be smallest n should be greatest

$$\frac{1}{\lambda_{min}}=1.097\times10^{-2}\left(1-\frac{1}{\infty 2}\right)$$

$\Rightarrow 1.097\times10^{-2}$

or

$$\lambda_{min}=\frac{1}{1.097\times10^{-2}}=91.16\,nm$$

43. What will be the longest wavelength line in Balmer series of spectrum?

(a) 546 nm (b) 656 nm
(c) 566 nm (d) 356 nm

NEET-1996

Ans. (b) : The longest wavelength means that lowest energy. We known that relation for wavelength

$$\frac{1}{\lambda}=R_H\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$$

Here $n_1 = n_2$ $n_2 = 3$

RH is Rydberg constant = 109677 cm^{-1}

$$\frac{1}{\lambda}=109677\left(\frac{1}{(2)^2}-\frac{1}{(3)^2}\right)=15233$$

Or

$$\lambda=\frac{1}{15233}=6.56\times10^{-5}\ cm$$

$\Rightarrow 6.56\times10^{-7}\lambda \Rightarrow 656$ nm

44. The wavelength of a spectral line emitted by hydrogen atom in the Lyman series is $\frac{16}{15R}$ cm. What is the value of n_2? (R = Rydberg constant)

(a) 2 (b) 3 (c) 4 (d) 1

AIIMS-2011

Ans. (c) : For Lyman series.

$$\frac{1}{\lambda}=R\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$$

$$\frac{15R}{16}=R\left[\frac{1}{1^2}-\frac{1}{n_2^2}\right]$$

$$\frac{15R}{16R}=\left[\frac{n_2^2-1}{n_2^2}\right]$$

$$\frac{15}{16}=\left[\frac{n_2^2-1}{n_2^2}\right]$$

$$16n_2^2-15n_2^2-16=0$$

$$n_2^2-16=0$$

$$n_2=4$$

45. Which of the following corresponds to the energy of the possible excited state of hydrogen?

(a) –13.6 eV (b) 13.6 eV
(c) –3.4 eV (d) 3.4 eV

NEET-2002

Ans. (c) : Energy level of an atoms are

$E_n=-13.6Z^2/n^2$ eV

Where Z = atomic number

Energy level (n) = 1, 2, 3, …..

For hydrogen atom, Z = 1

And first excited state, n = 2

$$\therefore E=\frac{-13.6\times1^2}{2^2}$$

E = –3.4 eV

46. What is the energy (kJ/mol) associated with the de-excitation of an electron from n=6 to n=2 in He^+ ion?

(a) 1.36×10^6 (b) 1.36×10^3
(c) 1.16×10^3 (d) 1.78×10^3

AIIMS-27 May, 2018

Ans. (c): Given that,

n = 6 to n = 2

$$E=13.6\times Z_1^2\left(\frac{1}{4}-\frac{1}{36}\right)$$

$$=13.6\times4\left(\frac{9-1}{36}\right)$$

$$=13.6\times4\times\frac{8}{36}$$

= 12.08 eV × 96 kJ/mol

= 1.16×10^3 KJ/mol

47. In Second orbit of H atom the velocity of e^- is:

(a) 2.18×10^6 m/sec (b) 3.27×10^6 m/sec
(c) 10.9×10^5 m/sec (d) 21.8×10^6 m/sec

AIIMS-27 May, 2018

AIIMS-2001

Ans. (c): $V = 2.18\times10^6\times\frac{z}{n}$

$$V=2.18\times10^6\times\frac{1}{2}=10.9\times10^5\,m/sec.$$

Hence, $V=10.9\times10^5$ m/sec

48. The energy of electron in first energy level is -21.79×10^{-12} erg per atom. The energy of electron in second energy level is:

(a) -54.47×10^{-12} erg atom^{-1}
(b) -5.447×10^{-12} erg atom^{-1}
(c) -0.447×10^{-12} erg atom^{-1}
(d) -0.05447×10^{-12} erg atom^{-1}

AIIMS-2000

Ans. (b): Assume that atom to be hydrogen like,
Energy of n^{th} energy level

$$E_n = \frac{-E_1}{x^2}$$, where E_1 is energy of first energy level

$$E_2 = \frac{-E_1}{2^2} = \frac{-E_1}{4} = \frac{-21.79\times10^{-12}}{4}$$

$= -5.447\times10^{-12}$ erg per atom

49. The energy of an electron in second Bohr orbit of hydrogen atom is–

(a) -5.44×10^{-19} eV (b) -5.44×10^{-19} cal
(c) -5.44×10^{-19} kJ (d) -5.44×10^{-19} J

AIIMS 26 May 2019 (Evening)

Ans. (d) : For H atom, $E_X = \frac{-13.6z^2}{n^2}$ eV

For second orbit, n = 2
z = 1 (for hydrogen)

$$\therefore\ E_2 = \frac{-13.6\times(1)^2}{(2)^2} = -\frac{13.6}{4}\text{eV}$$

$$= \frac{-13.6\times1.6\times10^{-19}}{4}\text{ J}$$

$= -5.44\times10^{-19}$ J

50. The ratio of the difference in energy between the first and the second Bohr orbit to that between the second and the third Bohr orbit is

(a) 1/2 (b) 1/3
(c) 4/9 (d) 27/5

JIPMER-2012

Ans. (d) : $\Delta E = E_2 - E_1 = \frac{1312}{1^2} - \frac{1312}{2^2} = 1312\left(\frac{3}{4}\right)$

$$= E_3 - E_2 = \frac{1312}{2^2} - \frac{1312}{3^2} = 1312\left(\frac{5}{36}\right)$$

$$\therefore\ E_2 - E_1 : E_3 - E_2 = \frac{3}{4} : \frac{5}{36} = 27:5$$

51. The Bohr orbit radius for the hydrogen atom (n =1) is approximately 0.530Å. The radius for the first excited state (n=2) orbit is (in Å)

(a) 4.77 (b) 1.06
(c) 0.13 (d) 2.12

NEET-1998

Ans. (d) : Radius of hydrogen atom = 0.53Å
Number of excited state (n) = 2
Atomic number of hydrogen atom (Z)=1
We know that the Bohr radius.

$$r = \frac{n^2}{Z}\times r_n = \frac{(2)^2}{1}\times0.530$$

= 4×0.530
= 2.12Å

52. In a Bohr's model of an atom, when an electron jumps from n = 1 to n = 3, how much energy will be emitted or absorbed?

(a) 2.389×10^{-12} ergs (b) 0.239×10^{-10} ergs
(c) 2.15×10^{-11} ergs (d) 0.1936×10^{-12} ergs

NEET-1996

Ans. (d) : According to Bohr's model of atom

$$\Delta E = 2.18\times10^{-18}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)\text{J}$$

$$= 2.18\times10^{-18}\left(\frac{1}{2} - \frac{1}{9}\right)\text{J}$$

$= 1.9\times10^{-18}$ J
$= 1.9\times10^{-18}\times10^{7}$ erg
$= 0.19\times10^{-10}$ erg

53. According to the Bohr theory, which of the following transitions in the hydrogen stom will give the ratio the least energic photon?

(a) n = 6 to n = 1 (b) n = 5 to n = 4
(c) n = 6 to n = 5 (d) n = 5 to n = 3

NEET-Mains 2011

Ans. (c) : We know that

$$\Delta E \propto \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$, where $n_2 > n_1$

$\therefore$ n=6 to n=5 will give least energetic photon

54. The energy of second Bohr orbit of the hydrogen atom is –328 kJ mol^{-1}. hence the energy of fourth Bohr orbit would be

(a) –41 kj mol^{-1} (b) –82 kj mol^{-1}
(c) –164 kj mol^{-1} (d) –1312 kj mol^{-1}

NEET-2005

Ans. (b) : Energy of electron in n^{th} orbit of hydrogen

$$E_n = -\frac{E}{n^2}$$

Where E is a constant

$$E_2 = \frac{E}{2^2} = -328\text{kJ mol}^{-1}$$

E= 4×328 kJ mol^{-1}

$$E_4 = \frac{-E}{4^2} = \frac{-4\times328}{16}\text{kJ mol}^{-1}$$

= –82 kJ mol^{-1}

55. The radius of which of the following orbit is same as that of the first Bohr's orbit of hydrogen atom

(a) He^+ (n = 2) (b) Li^{2+} (n = 2)
(c) Li^{2+} (n = 3) (d) Be^{4+} (n = 2)

UP CPMT-2013

Ans. (d) : For H-like particles, the radii of the first stationary states are given by the expression

$$r_n = \frac{a_0 n^2}{Z}$$

For H-atom, n = 1 and Z = 1
$\therefore$ $r_n = a_0$ = Bohr radius = 52.9 pm.

(a) For He^+ ion, n = 2 and Z = 2

$$\therefore \quad r_n = \frac{a_0(2)^2}{2} = 2a_0$$

(b) For Li^{2+} ion, n = 2 and Z = 3

$$\therefore \quad r_n = \frac{a_0(2)^2}{3} = \frac{4a_0}{3}$$

(c) For Li^{2+} ion, n = 3 and Z = 3

$$\therefore \quad r_n = \frac{a_0(3)^2}{3} = 3a_0$$

(d) For Be^{4+} ion, n = 2 and Z = 4

$$\therefore r_n = \frac{a_0(2)^2}{4} = a_0 \text{ = Bohr radius = 52.9 pm}$$

56. The energy of second Bohr orbit of the hydrogen atom is – 328 kJ mol^{-1}; hence the energy of fourth Bohr orbit would be

(a) –41kJ mol^{-1} (b) –1312 kJ mol^{-1}
(c) –164kJ mol^{-1} (d) –82 kJ mol^{-1}

UPTU/UPSEE-2007

Ans. (d) : Energy of 2nd orbit= –328 kJ/mol

Now, energy of 4th orbit will be $= -\frac{328}{4} = -82\,\text{kJ mol}^{-1}$

57. The energy of an electron in the nth Bohr orbit of hydrogen atom is

(a) $-\frac{13.6}{n^4}$eV (b) $-\frac{13.6}{n^3}$eV
(c) $-\frac{13.6}{n^2}$eV (d) $-\frac{13.6}{n}$eV

NEET-1992

Ans.(c): Energy of an electron in nth Bohr orbit of hydrogen atom $(E) = -\frac{13.6}{n^2}$eV (Z = 1)

58. The frequency of radiation emitted when the electron falls from n = 4 to n = 1 in a hydrogen atom will be (Given ionization energy of H = 2.18 ×10^{-18} J atom^{-1} and h = 6.626 × 10^{-34}J s)

(a) 1.54 × 10^{15} s^{-1} (b) 1.03 × 10^{15} s^{-1}
(c) 3.08 × 10^{15} s^{-1} (d) 2.00 × 10^{15} s^{-1}

NEET-2004

Ans. (c): Hydrogen like atom–

$$E_n = -\frac{E_1}{n^2} = \frac{-2.18\times10^{-18}}{n^2}\text{J/atom}$$

$$E_1 = \frac{-2.18\times10^{-18}}{(1)^2}\text{J/atom}$$

$$E_4 = -\frac{2.18\times10^{-18}}{(4)^2}\text{J/atom}$$

On applying $\Delta E = E_1 - E_4$

$$= -2.18\times10^{-18} - \left[\frac{-2.18\times10^{-18}}{16}\right]$$

$$= -2.04 \times 10^{-18} \text{ J/atom}$$

On applying $\Delta E = h\nu$

$$-2.04 \times 10^{-18} = 6.626 \times 10^{-34} \times \nu$$

$$\nu = \frac{-2.04\times10^{-18}}{6.626\times10^{-34}}$$

$$\nu = 3.08 \times 10^{15} \text{ s}^{-1}$$

59. The first emission line on hydrogen atomic spectrum in the Balmer series appears at (R = Rydberg constant):

(a) $\frac{5R}{36}$cm^{-1} (b) $\frac{3R}{4}$cm^{-1}
(c) $\frac{7R}{144}$cm^{-1} (d) $\frac{9R}{400}$cm^{-1}

AP EAMCET (Medical) -1998

Ans. (a) : The first emission line on hydrogen atomic spectrum in Balmer series contains the following values-

$n_1 = 2$ and $n_2 = 3$

now, $\bar{\nu} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)\text{Cm}^{-1}$

where – $\bar{\nu}$ = wave number

R = Rydberg constant

$$\therefore \quad \bar{\nu} = R\left(\frac{1}{4} - \frac{1}{9}\right)$$

$$\bar{\nu} = R\left(\frac{9-4}{36}\right)\text{Cm}^{-1}$$

$$\text{or } \bar{\nu} = \frac{5R}{36}\text{Cm}^{-1}$$

60. The radius of hydrogen atom in the ground state is 0.53 Å. The radius of Li^{2+} ion (atomic number = 3) in a similar state is

(a) 0.53 Å (b) 1.06 Å
(c) 0.17 Å (d) 0.236 Å

NEET-1995

Ans. (c) : Radius of Hydrogen atom in the ground state is 0.53 Å

∴ Atomic number of Li is 3

$$\because \text{Radius of } Li^{2+} \text{ ion} = \frac{r\times n^2}{2}$$

$$= \frac{0.53\times1^2}{3} = 0.17\text{Å}$$

B2.4 Match the column

61. Match the type of series given in Column I with the wavelength range given in Column II and choose the correct option.

Column I	Column II
A. Lyman	1. Ultraviolet
B. Paschen	2. Near infrared
C. Balmer	3. Far infrared
D. Pfund	4. Visible

Codes

(a) 1 2 4 3 (b) 4 3 1 2
(c) 3 1 2 4 (d) 4 3 2 1

JIPMER-2017

Ans. (a) : The correct match is
(A) → Lyman → (1) Ultraviolet
(B) → Paschen → (2) Near infrared
(C) → Balmer → (4) Visible
(D) → Pfund → (3) Far infrared

B2.5 Assertion and Reasons

62. **Assertion:** A spectral line will be seen for a $2P_x \rightarrow 2p_y$ transition.
Reason: Energy is released in the form of waves of light when the electron drops from $2p_x$ to $2p_y$ orbital.
(a) If both Assertion and Reason are true and the Reason is a correct explanation of the Assertion
(b) If both Assertion and Reason are true but Reason is not a correct explanation of the Assertion
(c) If Assertion is true but the Reason is false
(d) If both Assertion and Reason are false

AIIMS-1996

Ans. (d): In this case both assertion and reason are false. Both $2p_x$ and $2p_y$ orbitals have equal energy (2p orbitals are degenerate), there is no possibility of electron transition and hence, no energy is released and thus, no spectral line will be observed.

B3. Dual Nature of Matter, De-Broglie's Heisenberg uncertainity Principle, Ψ and Ψ², nodes, quantum numbers.

B3.1 Multiple Choice Question (MCQs)

63. **Electromagnetic radiation has electric and magnetic field components. These two components**
(a) Have same wavelength (λ), same frequency (v), same speed (c) and same amplitude
(b) Have same wavelength (λ), same frequency (v), same speed (c) and different amplitude
(c) Have same wavelength (λ), same frequency (v), same amplitude and different speed
(d) Have same frequency (v), same speed (c), same amplitude and different wavelength (λ)

Telangna SCHE- 07.05.2024 Shift-I

Ans. (a) : Electromagnetic radiation has electric and magnetic field components these components are have same wavelength (λ) same frequency (v) same speed (c) and same amplitude.

64. **Incorrect set of quantum numbers from the following is**
(a) n= 4, l =2, m_l = -2,0,+1,+2, m_s=-1/2
(b) n=5, l=3, m_l =-3,-2,-1,0,+1,+2,+3, m_s = +12
(c) n= 4, l =3, m_l = -3,-2,-1,0,+1,+2,+3, m_s=-1/2
(d) n=5, l =2, m_l =-2,-1,+1, +2, m_s=+1/2

RE-NEET (UG) 06.06.2023 (Manipur)

Ans. (d) : For any set of Quantam number the following 4 representation is used,
n = Principal quantum number.
l = Azimuthal quantum number.
m= Magnetic quantum number.
s= Spin quantum number.
For given value of n, l ranges from 0 to n–1. It means 'l' depends on the value of n.
For given value of l, m ranges from $-l$ to l
spin quantum number is always = $+\frac{1}{2}$ and $-\frac{1}{2}$
⇒n = 5, l = 2, m_l =–2,–1,+1,+2, m_s = $+\frac{1}{2}$
This is incorrect because, value of m_l is not completed.
The correct set is
n = 5, l = 2, m_l =–2,–1, 0,+1,+2, m_s = $+\frac{1}{2}$ or $\frac{-1}{2}$.

65. **Wave nature of electrons was demonstrated by**
(a) Schrodinger (b) de-Broglie
(c) Davisson and Germer (d) Heisenberg

UP CPMT-2004
J & K CET-(1999)

Ans. (c) : (a) Schrodinger He put forward new model of atom by taking into account the de-Broglie concept of dual nature matter and Heisenberg's uncertainly principle. He described the motion of electron in threo dimensional space in the form of mathematical equation known as Schrödinger wave equation.
(b) de-Broglie According to him, all the material particles possess wave character as well as particle character.

$$\lambda = \frac{h}{mv} \text{(de - Broglie equation)}$$

Water, λ = Wavelength
h = Planck's constant
m = mass of particle
v = Velocity of particle

(c) Davisson and Germer They carried out experiment to show the wave character of electrons. They observed when a beam of electrons is allowed to fall on the surface of nickel crystal are received on photographic plate, a diffraction pattern similar to that of X-rays is obtained. Since, X-rays are electromagnetic rays, it means electrons have wave character also.
(d) Heisenberg's uncertainty principle It states that position and momentum of an electron cannot be measured accurately and simultaneously.
∴ Correct answer is (c) because wave nature of electron is demonstrated by Davission and Germer.