QP Code: D112834

FIRST SEMESTER UG DEGREE EXAMINATION, NOVEMBER 2024 (CUFYUGP)

CHEIMN103: BASIC INORGANIC AND GREEN CHEMISTRY

Section A. All Questions can be answered. Each Question carries 3 marks

(Ceiling: 24 Marks)

1) Writing Heisenberg's uncertainty principle- equation ($\Delta x. \Delta p \geq h/4\pi$) **- 1 mark**
   Substituting values **-1 mark**
   Correct answer with unit: **5.52×10^{-25} kg m/s -1 mark**
2) Writing De Broglie equation **($\lambda = h/mv$) -1 mark**
   Substituting values -1 mark
   Correct answer with unit: **7.25×10^{6} m/s- 1 mark**
3) Ionization enthalpy decreases along a group- **1 mark**
   As going down the group a new electron-filled principal shell is added in each step **-1 mark**
   Effective nuclear charge decreases down the group and consequently decreases attraction between the nucleus and the valence electron. **- 1 mark**
4) Valency is the combining capacity of an atom/element. Oxidation state is the number of electrons lost or gained by an atom**.**
   Oxidation state is a measure of electron transfer, in contrast valency is a measure of chemical bonding.
   Oxidation state can be positive, negative or zero but valency is always positive.
   Any two points **-3 mark**
5) They are all electropositive metals.
   They are good conductors of heat and electricity.
   They show metallic lustre.
   They are good reducing agents.
   Any other three relevant points **-3 mark**
6) Writing equation to calculate ppm.(concentration = $(W_{solute}/ W_{sol}) \times 10^{6}$) **- 1 mark**
   Substituting values **- 1 mark**
   Correct answer with unit: 25 ppm **- 1 mark**
7) Writing equation to calculate molarity (M= no: of moles/volume in L) **- 1 mark**
   Substituting values. **- 1 mark**
   Correct answer with unit: 2 mol/ L **- 1 mark**

8) Green chemistry prevents pollution by designing products and processes that minimize the waste and the use of hazardous substances.

Green chemistry uses safer solvents and auxiliaries that are less toxic and more environmental friendly

9) Principle of prevention of waste : It is better to prevent waste than to treat or clean up waste after it has been created – **1 mark**

Eg: Reducing the use of chemicals by using micro-level analysis instead of macro level analysis (use of spot test in the laboratory)

Recycle and reuse materials whenever possible

Any other two relevant strategies for prevention of waste- 2 marks

10) Principle of prevention of waste: It is better to prevent waste than to treat or clean up the waste after than it is created

Principle of atom economy: synthetic methods should be designed to maximize the incorporation of all the materials used in the process to final material

Principle of less hazardous chemical synthesis: whenever practicable, synthetic methods should be designed to use and generate substances that possess less or no toxicity to human health and environment

Any other three principles with explanation. – **3 marks**

<u>Section B.</u> All Questions can be answered. Each Question carries 6 marks
(Ceiling: 36 Marks)

11) Writing equation **(En = -(2.179 x 10 $^{-18}$) Z^2 /n^2) J/atom**

Or E=-13.6/n^2 eV– **2 mark**

Substituting values **-2 marks**

Correct answer with unit: **- 5.4 x 10^{-19} J/atom.** or **-3.4 eV - 2 mark**

12) SO_4^{2-}: Explanation on VSEPR theory with the calculation of valence shell electron pairs (four bond pairs and no lone pairs) – **3 marks**

Shape – tetrahedral – **1 mark**

Structure with bond angle (bonds are arranged symmetrically in a tetrahedral shape, so the bond angle between any two adjacent oxygen atoms is 109°28$'$.) – **2 marks**

CO_3^{2-} -Out of syllabus

13) Explain sp^3 hybridization with correct geometry taking an example - **3 mark**

Explain sp^2 hybridization with correct geometry taking an example - 3 **mark**

14) Writing equation $\mathbf{M_1 V_1 = M_2 V_2}$ – **2 mark**

Substituting values **-2 mark**

Correct answer with unit: 10 mL.- **2 mark**

15) Principle – Double burette titration is a volumetric analysis technique which uses two burettes instead of the conventional burette and pipette setup. In this method, a definite volume of the solution from the first burette is transferred into a conical flask, a suitable indicator is added, and the solution is titrated using the second burette to determine the endpoint. Subsequently, an additional volume (e.g., 2 mL) of the solution from the first burette is added directly into the same flask without adding more indicator, and the titration

is continued using the second burette to determine the new endpoint. This process of repeated addition from the first burette and titration with the second burette is repeated to achieve accurate and efficient results. This method eliminates the need for transferring solutions using a pipette and reduces preparation time while maintaining precision. - **3 mark**

Any 3 advantages **– 3 mark**

16) Common ion effect with any one example- **4 mark**

Common ion effect of AgCl in HCl with equations.

$AgCl\ (s) \longleftrightarrow Ag^+ + Cl^-$

$HCl \longrightarrow H^+ + Cl^-$

Due to the common ion Cl^-, the solubility of AgCl significantly reduces in the presence of HCl -**2 mark**

17) Concept of atom economy: Synthetic methods should be designed to maximize the incorporation of all the materials used in the process to final material -**1 mark**

Equation to calculate atom economy: atom economy= (Molecular mass of desired product/ sum of molecular mass of all the product) x 100 %- **1 mark**

Example for reactions giving 100 % atom economy- any one rearrangement reaction/ an addition reaction with example- **2 mark**

Calculation of atom economy of any one reaction using equation - **2 mark**

18) Concept of green solvents: These are biodegradable and nontoxic solvents designed to replace traditional solvents that are hazardous to human health and the environment-giving examples for green solvents -**1.5 mark**

Explaining water as a green solvent: water is the ideal environmentally benign solvent and is the safest possible solvent- use of water is cost effective and separation of products and byproducts easier.

Explaining super critical CO_2 as green solvent: at super critical state CO_2 has viscosity similar to that of a gas and density similar to that of liquid, making it an ideal solvent.

Explaining ionic liquids as green solvent: Ionic liquids contains a cationic and an anionic part and they can be designed with a particular end use in mind, known as designer solvents. – **1.5 marks each**

<u>Section C.</u> *Answer any ONE. Each Question carries 10 marks (1×10 = 10 Marks)*

19) Complexometric titration is a volumetric analysis in which a solution of a chelating agent (complexing agent) is used to titrate metal ions in a solution. The reaction involves the formation of a stable, water-soluble complex between the metal ion and the titrant. – **2 marks**

Principle and procedure -The principle of complexometric titration is based on the coordination-complex formation between the metal ion and the chelating agent. The endpoint is detected when all the free metal ions have been complexed, often indicated by a color change in the presence of a metal ion indicator.

EDTA (Ethylenediaminetetraacetic acid) is a common chelating agent that forms stable 1:1 complex with most metal ions. (include EDTA structure: the importance of buffer, fully deprotonated structure) **-3 mark**

Indicators example- **1 mark**

Mode of action: with equations showing the complexation of metal, EDTA/ Indicator- **3 mark**

Application: determination of metal ion concentration **- 1 mark**

20) Any two points on the concept of hybridization with characteristic features (general) **-1 mark**

Bonding, bond angles and shape using VSEPR theory(lp:lp repulsion>lp;bp>bp;bp)

XeF_2 – linear, two bond pairs and three lone pairs, three lone pairs occupy equatorial positions while 2 bond pairs occupy axial positions – **1.5 marks,** drawing the structure **-1.5 marks**

XeF_4 - square planar, four bond pairs and two lone pairs, 2 lone pairs arrange axially and 4 bond pairs occupy the remaining four coplanar positions – **1.5 marks,** drawing the structure **- 1.5 marks**

XeF_6 - distorted octahedral, 6 bond pairs and one lone pair **1.5 marks,** drawing the structure **- 1.5 marks**

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