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4 SEM PG CHM (CBCS) IC-V 402

2026

(June)

CHEMISTRY

Paper : Core-402

(Inorganic Chemistry-V)

Full Marks : 60

Time : Three hours

***The figures in the margin indicate
full marks for the questions.***

***Answer UNIT-I to UNIT-III and
UNIT-IV to UNIT-V in separate booklet.***

UNIT-I

(Marks : 08)

1. Choose the correct answers/options from the following : 1×2=2

(i) In beta emission or decay, a neutron transforms into :

- (a) Proton + positron + neutrino
- (b) Proton + electron + antineutrino
- (c) Proton + electron only
- (d) Neutron + neutrino

(ii) A controlled nuclear chain reaction is maintained in a reactor using :

- (a) Moderators and control rods
- (b) Only high temperature
- (c) Only pressure
- (d) Only neutrons

2. Answer **any three** from the following :

2×3=6

- (a) Define the term binding energy per nucleon. What are magic numbers?
- (b) What are the various radioactive decay series? How do they differ from each other?
- (c) Discuss how beta emission (β) stabilizes the N/P ratio?
- (d) What is Neutron Activation Analysis and how does it work?
- (e) Calculate the binding energy of the lithium nucleus, given that: mass of proton = 1.00814 u, mass of neutron = 1.00893 u, mass of lithium nucleus = 7.01822 u.

UNIT-II

(Marks : 12)

3. Answer **any four** from the following :

3×4=12

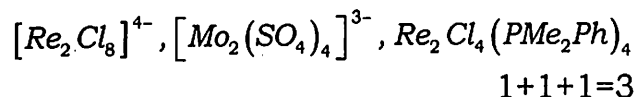
- (a) Define synergistic effect. Explain how the synergistic bonding (π back bonding) can be inferred from the magnitude of the C-O stretching frequency, with examples.
- (b) Write a brief note on tensor surface harmonic theory of clusters.
- (c) Give examples of reduction of metallic salt in presence of CO. Explain the reason behind for faster substitution reaction rate of $Ni(CO)_4$ over $Cr(CO)_6$.
- (d) For the square planar complexes $[M(CO)LCI_2]$, where ligand L is trans to CO and $L = Py, NH_3$ and NMe_3 , arrange these ligands in the order of increasing C-O stretching frequency. Give a justification for your order.

1+2=3

1+2=3

(e) Discuss how bonding occurs in binuclear clusters. Support your explanation by describing the structure of a representative example.

(f) Using molecular orbital considerations, determine the bond order in the following binuclear clusters —



(g) Discuss various chemical reactions of fullerene. Classify fullerene-based complexes according to their structural features and illustrate each type with examples. 1+2=3

UNIT-III

(Marks : 06)

4. Describe the host-guest concept and explain the types of interactions involved in molecular recognition. 2+2=4

5. Compare the selectivity of crown ethers and cryptands toward alkali metal ions, giving reasons for their preference. 2

Or

Explain the concept of molecular recognition and chiral recognition with examples.

UNIT-IV (A)

(Marks : 18)

6. Give *one* example of a fast ion conductor and explain its structure-property relationship. Compare solid electrolytes with liquid electrolytes. 3+1=4

7. Explain with example how pillared clays are formed. 2

Or

Explain the structure of TiS_2 with suitable diagram.

8. Answer **any four** of the following questions : 3×4=12

(a) What is solid-state reaction? Explain the principle of solid-state diffusion reactions. 1+2=3

(b) What is coprecipitation? Describe how the sol-gel method is used for synthesizing inorganic solids and it is different from the coprecipitation method. 1+2=3

(c) What are luminescent materials? Explain the role of host lattice and activator ion in determining emission properties. Give *one* example. 1+1+1=3

- (d) What do you understand by the term composite? Why is a uniform distribution of reinforcement within the matrix important for improving composite properties? $1+2=3$
- (e) What are the required properties of an autoclave used in the hydrothermal synthesis method? Explain the pressure-temperature relationship with volume in this method. $1+2=3$
- (f) Write a brief discussion on drilling muds.

UNIT-IV (B)

(Marks : 16)

9. Explain the size- and morphology-dependent properties of nanomaterials. How do these factors influence their physical and chemical behavior? $2+2=4$

10. Answer **any four** of the following questions : $3 \times 4 = 12$

- (a) Compare the structural features and properties of graphite and graphene oxide. Write *two* applications of each. $2+1=3$

- (b) What is quantum confinement effect? Explain how it affects the optical properties of semiconductor nanoparticles. $1+2=3$
- (c) What are semiconductor nanoparticles? Explain the photocatalytic mechanism of such nanoparticles for any degradation reaction. $1+2=3$
- (d) Why is XRD important in basic research? How do you differentiate crystalline bulk particles with its nano counterpart on the basis of peak intensity? $1+2=3$
- (e) Write application of various solid materials in fuel cell and capacitor application.
- (f) What are nanoclusters? Write a brief discussion on important properties and applications of nanoclusters and nanotubes compared to bulk materials. $1+2=3$