

M.SC. CHEMISTRY
FOURTH SEMESTER
ADVANCED INORGANIC CHEMISTRY
MSC - 402B

**SET
A**

[USE OMR FOR OBJECTIVE PART]

Duration: 3 hrs

Full Marks: 70

[Objective]

Time: 30 min.

Marks: 20

Choose the correct answer from the following:

1×20=20

- Which of the following inorganic pigment shows charge transfer spectra:
 - PbCrO_4
 - CoAl_2O_4
 - $\text{CaCuSi}_4\text{O}_{10}$
 - Both (a) and (b)
- Which of the following complex is used in ink:
 - Tris(carboxyl)-terpyridine Ruthenium complex
 - Ferrocyanide
 - $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$
 - Both (b) and (c)
- Which one of the following metal hydride is an example of hydrogen storage materials:
 - Mg_2FeH_6
 - Mg_2CoH_5
 - Mg_2NiH_4
 - All of them
- In ZnS phosphor host, which of the following metal ions are used as an activator:
 - Ag^+ , Ni^{2+} , Mn^{2+}
 - Mn^{2+} , Ni^{2+} , Cu^{2+}
 - Ag^+ , Cu^{2+} , Mn^{2+}
 - Ag^+ , Ni^{2+} , Cu^{2+}
- Band gap order of the semiconductors like AlP, BN and InSb are follows the trend respectively:
 - 2.5:0.23:6.08
 - 2.5:6.08:0.23
 - 6.08:0.23:2.5
 - 0.23:2.5:6.08
- Wilkinson's Catalyst is represented as
 - $[\text{RhCl}_4]$
 - $[\text{RhCl}(\text{PPh}_3)_3]$
 - $[\text{Rh}(\text{PPh}_3)_4]$
 - None of the above.
- In Fischer-Tropsch Process, Cobalt catalysts have
 - a higher conversion rate and a long life
 - a lower conversion rate and a long life
 - Lower conversion rate and a shorter life
 - none of the above
- In Steam Reforming
Carbon monoxide is treated with
 - hydrogen
 - Natural Gas is mixed with steam at high temperature and pressure over heterogeneous catalyst
 - Natural Gas is mixed with oxygen.
 - None of the above

9. Ziegler-Natta catalyst consists of
- TiCl₄
 - Al(C₂H₅)₃
 - TiCl₄ in hydrocarbon solvent in presence of Al(C₂H₅)₃
 - none of the above
10. In Sharpless epoxidation, allyl alcohol or a derivative is
- oxidised with tertiary hydro peroxide in presence of a Chiral ligand
 - alcohol in presence of Zeigler-Natta catalyst
 - Propyl alcohol is treated with Rhodium- alloy
 - none of the above
11. Total number of electrons and protons present in the biological nitrogen cycle respectively
- 8, 8
 - 6, 6
 - 7, 9
 - 6, 10
12. Which of the following diseases may occur due to deficiency of copper
- Menkes disease
 - Wilson's disease
 - Arthritis disease
 - None of the above
13. Biominerals can be either infinite
- Metallic bond or ionic
 - Hydrogen bond or ionic
 - Covalent networks or Ionic
 - None of the above
14. A specific interaction region on the RNA is known as the
- Fron regulatory protein
 - Fron-responsive element
 - Transferrin
 - Ferritin
15. Which of the following statement is not true about phtosubstitution reaction ?
- Ligand exchange between primary and secondary coordination sphere happens
 - Oxidation state of the metal ion remains same
 - Coordination number of metal ion remains same
 - None of the above
16. "Light must be absorbed by a chemical substance in order for a photochemical reaction to take place" stated by
- Grotthuss-Draper law
 - Stark-Einstein law
 - Beer-Lambert Law
 - None of the above
17. $cis-[CoCl_2(en)_2]^+ \xrightleftharpoons{h\nu} trans-[CoCl_2(en)_2]^+$ is example of
- Isomerisation reaction
 - Racimization reaction
 - Substitution reaction
 - Dissociation reaction
18. Transition metal complexes results in photochemical reaction due to
- Electronic transition from t_{2g} to e_g orbital
 - Electronic transition from ligand to metal orbital
 - Electronic transition from metal to ligand orbital
 - All of the above

19. $[\text{Co}(\text{NH}_3)_5\text{SCN}]^+$ shows isomerization reaction due to
- d-d transition
 - LMCT
 - MLCT
 - None of the above
20. Nitrogenase contains which of the following proteins
- MoFe-protein
 - Fe-protein
 - Both (a) and (b)
 - None of the above

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(Descriptive)

Time : 2 hrs. 30 mins.

Marks : 50

[Answer question no.1 & any four (4) from the rest]

- Define photochemical reaction. Give examples where photochemistry plays crucial roles in nature. 3+3+2+2
=10
 - Discuss the mechanism of metal hydrides as hydrogen storage materials.
 - Give a brief account of the activation of small molecules by Coordination.
 - Define the terms biomineralization and demineralization with examples
- Classify photochemical reactions with a flowchart. 5+5=10
 - Explain in detail, using the concept of inert and labile complexes, why $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{Co}(\text{CN})_6]^{3-}$ complexes are generally inert under thermal conditions but reactive in the presence of light.
- Draw molecular orbital diagram for a metal complex and show d-d and charge transfer transitions with arrows. 4+3+3
=10
 - Give examples of photosubstitution, photoisomerization, photorecimization reactions.
 - Calculate the mass percentage of hydrogen in NaBH_4 and state whether or not this material might be used as hydrogen storage?

4. a. Egyptian blue is pale blue and the spinel CoAl_2O_4 is an intense blue-green. Explain the differences. 3+5+2
=10
- b. Describe the properties of an ideal photocatalyst for water splitting.
- c. Why is not BeH_2 Considered to be suitable hydrogen storage materials?
5. a. "Substitution of Mg by small amounts of Li and Al into MgH_2 improves its hydrogen-storage properties." Write a formula for this lithium aluminium magnesium dihydride and explain how Li and Al would be incorporated into the structure. 4+3+3
=10
- b. How hydrogen and carbon monoxide can be converted to hydrocarbon and water by reaction over iron or cobalt catalysts by Fisher-Trops Process.
- c. Give a short account of the Asymmetric oxidation where appropriate Chiral ligands can be used in conjunction with d-metal catalyst to introduce chirality.
6. a. Give the general mechanism of cobalt carbonyl catalysed hydroformylation reaction as proposed by Heck and Breslow. 5+5=10
- b. Give an account of the Rhodium based Monsanto Process for highly selective generation of ethanoic acid.
7. a. Discuss the characteristics of Wilkinson's Catalyst for generation of alkene. 2+4+4
=10
- b. What are the enzymes involves in the nitrogen cycle? Explain mechanism of the nitrogen cycle.
- c. Write the active site of hydrogenases and explain the mechanism of the hydrogen cycle.
8. a. Write the hierarchy of control mechanisms of the formation of biominerals. 5+5=10
- b. Explain how Proteins that sense Cu and Zn levels in the cells.

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