

**M.SC. CHEMISTRY
FOURTH SEMESTER
ADVANCED INORGANIC CHEMISTRY
MSC - 402B [SPECIAL REPEAT]
[USE OMR FOR OBJECTIVE PART]**

Duration: 3 hrs

Full Marks: 70

SET
A

Marks: 20

Time: 30 min.

Marks: 20

Choose the correct answer from the following:

$$1 \times 20 = 20$$

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

9. Ziegler-Natta catalyst consists of
 a. TiCl_4
 b. $\text{Al}(\text{C}_2\text{H}_5)_3$
 c. TiCl_4 in hydrocarbon solvent in presence of $\text{Al}(\text{C}_2\text{H}_5)_3$
 d. none of the above
10. In Sharpless epoxidation, allyl alcohol or a derivative is
 a. oxidised with tertiary hydro peroxide in presence of a Chiral ligand
 b. alcohol in presence of Zeigler-Natta catalyst
 c. Propyl alcohol is treated with Rhodium- alloy
 d. none of the above
11. Total number of electrons and protons present in the biological nitrogen cycle respectively
 a. 8, 8
 b. 6, 6
 c. 7, 9
 d. 6,10
12. Which of the following diseases may occur due to deficiency of copper
 a. Menkes disease
 b. Wilson's disease
 c. Arthritis disease
 d. None of the above
13. Biominerals can be either infinite
 a. Metallic bond or ionic
 b. Hydrogen bond or ionic
 c. Covalent networks or Ionic
 d. None of the above
14. A specific interaction region on the RNA is known as the
 a. Fron regulatory protein
 b. Fron-responsive element
 c. Transferrin
 d. Ferritin
15. Which of the following statement is not true about photosubstitution reaction ?
 Ligand exchange between primary
 a. and secondary coordination sphere happens
 b. Oxidation state of the metal ion remains same
 c. Coordination number of metal ion remains same
 d. None of the above
16. "Light must be absorbed by a chemical substance in order for a photochemical reaction to take place" stated by
 a. Grotthuss-Draper law
 b. Stark-Einstein law
 c. Beer-Lambert Law
 d. None of the above
17. $cis-\text{[CoCl}_2(\text{en})_2]^+ \xrightleftharpoons{h\nu} trans-\text{[CoCl}_2(\text{en})_2]^+$ is example of
 a. Isomerisation reaction
 b. Racimization reaction
 c. Substitution reaction
 d. Dissociation reaction
18. Transition metal complexes results in photochemical reaction due to
 a. Electronic transition from t_{2g} to e_g orbital
 b. Electronic transition from ligand to metal orbital
 c. Electronic transition from metal to ligand orbital
 d. All 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]

1. a. Define photochemical reaction. Give examples where photochemistry plays crucial roles in nature. 3+3+2+2
=10

b. Discuss the mechanism of metal hydrides as hydrogen storage materials.

c. Give a brief account of the activation of small molecules by Coordination.

d. Define the terms biomineralization and demineralization with examples

2. a. Classify photochemical reactions with a flowchart. 5+5=10

b. 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.

3. a. Draw molecular orbital diagram for a metal complex and show d-d and charge transfer transitions with arrows. 4+3+3
=10

b. Give examples of photosubstitution, photoisomerization, photorecimerization reactions.

c. 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 hydro formylation reaction as proposed by Heek 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 involved 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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