TDC (CBCS) Even Semester Exam., 2023

CHEMISTRY

(Honours)

(6th Semester)

Course No. : CHMHCC-601T

(Inorganic Chemistry)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

The figures in the margin indicate full marks for the questions

SECTION—A

(*Marks* : 20)

Answer any *ten* of the following questions : 2×10=20

1. Give two examples of naturally occurring organometallic compounds and mention the metal atoms present in them.

2. What does x in the symbol for hapticity (η^x) represent? What is the oxidation state of Mo in $[(\eta^7\text{-}C_7H_7)\,Mo(CO)_3]^+$? 1+1=2

3. Can a ligand act as both monohapto and trihapto ligands? Explain taking suitable example. 1+1=2

4. Give an example of multicentred bonded organometallic compound and draw its structure. 1+1=2

5. Write a short note on Schlenk equilibrium.

6. What type of metal-carbon bond is present in Grignard reagent? Why is Grignard reagent water-sensitive? 1+1=2

7. What is acid hydrolysis? Give an example. 1+1=2

8. What is *trans*-effect? Which theory explains better the *trans*-effect of CO compared to that of pyridine? 1+1=2

9. Define electrophilic substitution reaction in octahedral complexes. Give a suitable example. 1+1=2

10. Why is Wilkinson catalyst called a homogeneous catalyst?

11. What is water-gas shift reaction? Mention one suitable catalyst for this reaction. 1+1=2

12. Name the reaction in which synthetic gasoline is obtained from water gas. Mention the commonly used catalysts in this reaction. 1+1=2

13. What is the advantage of preparing sodium carbonate extract?

14. Define group reagents. What is the group reagent for second group? 1+1=2

15. Define solubility product. What is the effect of temperature on solubility product? 1+1=2

SECTION—B

(*Marks* : 30)

Answer any *five* of the following questions : 6×5=30

16. *(a)* What are metallocenes? Give an example. 1+1=2

(b) Determine the number of metal-metal bonds in the following complexes which obey the 18-electron rule and draw their structures : 1+1+1=3

(i) $Rh_4(CO)_{12}$

(ii) $(\eta^5\text{-}C_5H_5)Fe(\mu\text{—}CO)_3Fe(\eta^5\text{-}C_5H_5)$

(iii) $[CpMo(CO)_3]_2$

(c) Explain aromaticity in ferrocene. 1

17. *(a)* What is Zeise's salt? Explain the structure and bonding in Zeise's salt. 1+3=4

(b) What happens when ferrocene—

(i) undergoes carboxylation;

(ii) reacts with $HCHO$ and $HNMe_2$ in presence of base? 1+1=2

18. Taking suitable example, explain the concept of multicentred bonding in organometallic compounds.

19. *(a)* Discuss Ziegler-Natta catalysis. 3

(b) Mention the active species involved in this catalytic reaction. 1

(c) What type of polymer is formed in this reaction? Mention its characteristics. 1+1=2

20. *(a)* Explain the mechanism of nucleophilic substitution reaction in square planar complexes. 3

(b) Use the *trans*-effect series to suggest synthetic routes to *cis*- and *trans*-$[PtCl_2(NH_3)_2]$ from $[Pt(NH_3)_4]^{2+}$ and $[PtCl_4]^{2-}$ respectively. 3

21. *(a)* What is an inert ligand? What type of intermediates are formed if the inert ligand is *(i)* pi-acceptor and *(ii)* pi-donor? 1+1=2

(b) Discuss briefly the $S_N1(CB)$ mechanism in octahedral complexes by taking a suitable example. 4

22. *(a)* What is Wilkinson catalyst? What is the hybridization of central metal ion in Wilkinson catalyst? 1+1=2

(b) Explain the catalytic pathway involved in the homogeneous hydrogenation reaction using Wilkinson catalyst. 3

(c) What is the rate-determining step in this catalytic reaction? 1

23. *(a)* What is hydroformylation reaction? 1

(b) Explain the mechanistic pathway (Co-catalysts) involved in hydro-formylation reaction. 4

(c) Mention the active species involved in this reaction. 1

24. What are interferring acid radicals? Explain, in detail, the method of detection and removal of PO_4^{3-} radical from an inorganic salt mixture. 1+5=6

25. *(a)* Give a brief note on buffer solutions. 3

(b) What is common-ion effect? Explain why in presence of HCl, Zn^{2+} ions cannot be precipitated as ZnS while Cu^{2+} ions can be precipitated as CuS. 1+2=3

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