

Total number of printed pages-7

14 (CHM-1) 101

2022

CHEMISTRY

Paper : CH-101

(Inorganic Chemistry-I)

Full Marks : 60

Time : Three hours

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

1. Answer **any six** of the following questions :
3×6=18

- (a) Using Wade's rules, determine the polyhedral skeletal structure of the borane with STYX code 4012.
- (b) What are the carboranes? Describe a method for the synthesis of closo-1, 12- $C_2B_{10}H_{12}$ (ortho isomer).
- (c) Discuss the salient features and importance of hydroboration-oxidation reaction.

Contd.

(d) Give a method for the preparation of phenyl boronic acid and discuss its importance in organic synthesis.

(e) (i) Al_2Me_6 melts at $15^\circ C$ but Al_2Ph_6 has a melting point of $225^\circ C$. Give reasons. $1\frac{1}{2}$

(ii) Compare the reducing strengths of lithium borohydride, lithium aluminium hydride and lithium triethyl borohydride. $1\frac{1}{2}$

(f) Discuss the synthesis, properties and applications of metal borides.

(g) Reaction of calcium phosphide with water produces a colourless poisonous gas with the smell of rotten fish. Identify the gas and mention some of its applications.

(h) Write a short note on **any one** of the following:

(i) $(SN)_x$

(ii) Metal-oxo compounds

2. Answer **any two** the following questions:

(a) Write the differences between metal carbonyl and metal halide cluster compounds. Why are 4d and 5d metals more capable of forming metal cluster compounds compared to 3d metals? $2+1=3$

(b) Show the overlap between the d-orbitals of two Re centers in $[Re_2Cl_8]^{2-}$. 3

(c) Discuss the structure of $[Mo_6O_{19}]^{2-}$. 3

3. Answer (a) and **any three** from (b) to (e):

(a) What are superconducting materials? Describe different types of superconducting materials with examples. 4

(b) Explain the effect of temperature on the electrical conductivity of extrinsic semiconductors. 3

(c) Explain the factors that determine the fluorescence properties of materials. 3

(d) Discuss the hydrothermal method of synthesizing polycrystalline compounds. 3

(e) What are ferrimagnetic materials? Explain with examples. 3

4. Answer the following questions :

(a) What makes the bonding between transition metal and CO ligand strong? Does CO make a strong interaction with BF_3 ? 1+1=2

Or

How are IR spectroscopy and X-ray crystallography helpful in determining the existence of π back donation in metal-carbonyl bonds?

(b) Find the Total Electron Count (TEC) and the number of skeletal electron pairs in $[Fe_4C(CO)_{12}]^{2-}$. 2

(c) Draw the orbital overlap between the metal d -orbital and the π^* orbital of CO. 2

(d) Illustrate the interactions between metal d -orbitals and the π orbitals of allyl ligand in a transition metal-allyl complex. 3

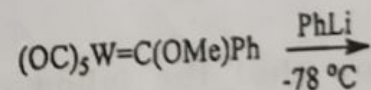
Or

Draw the 10 ligand group orbitals of ferrocene.

(e) Write the general structural characteristics of Fischer carbene complexes. 2

Or

Why is the carbon center of Fischer carbene electrophilic in nature? Identify the product of the following reaction:

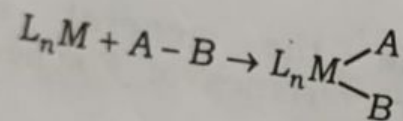


(f) Show the catalytic cycles of the following reactions: (**any one**) 3

(i) Suzuki coupling reaction

(ii) Hydroformylation reaction catalysed by $Co_2(CO)_8$

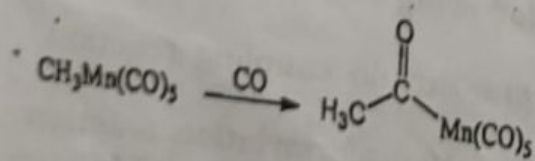
- (g) How is the reactivity of the following oxidative addition reaction influenced by 'oxidation state of the metal' and the ligand 'L'? Which substrate, CH_4 or CH_3I , has greater tendency to undergo oxidative addition to L_nM ?
 $1+1+1=3$



- (h) Explain why alkene insertion in M-H is common but insertion in M-R is much less common.
 [M = transition metal, R = alkyl group].

Or

Show that the following reaction proceeds via methyl migration:



- (i) Identify the products of the following reactions: (**any three**) 3

