



DEPARTMENT OF CHEMISTRY
SCHOOL OF PHYSICAL SCIENCES
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

FIRST SEMESTER EXAMINATION 2021/2022 SESSION

COURSE CODE: CHM 414

COURSE UNITS: 2

COURSE TITLE: ORGANOMETALLIC CHEMISTRY **TIME ALLOWED:** 2 HOURS

INSTRUCTIONS: ANSWER THREE (3) QUESTIONS

Q1(a). Define the term “Hapticity” **(2 marks)**

(b). Give one example (with equation) of the use of Grignard reagent in the synthesis of:

(i) *n*-Butyl alcohol **(2 marks)**

(ii) *tert*-Butyl alcohol **(2 marks)**

(iii) propanal **(2 marks)**

(ci). Using the 18 electron rules: (i.) account for the stability of the compound $(C_2H_4)_2PdCl_2$. (ii) is the compound likely going to undergo an associative addition of CO or dissociative loss of C_2H_4 ? **(3 marks)**

(cii) Choose from the following compounds the isoelectronic pair;

a. $[V(CO)_6]$ b. $[Cu(\eta^5-C_5H_5)(CO)]$ c. $[Co(CO)_4]$ d. $[IrCl(CO)(PPh_3)_2]$ **(2 marks)**

(d) (i) Explain how methylmagnesium iodide solution can be prepared? **(3marks)**

(ii) Why should methylmagnesium iodide be prepared with exclusion of moisture? **(1 mark)**

(iii) Give examples (with equations) of the use of organoboranes to carry out:

(a) Synthesis of alcohols **(2 marks)** (b) conversion to aldehydes **(2 marks)**

Q2.(a) Define organometallic Chemistry **(2 marks)**

(b). State the 18 electron rule **(2 marks)**

(c) In each case of the following provide the reagent you would use to convert isopropylmagnesium bromide to:

(i) $(\text{CH}_3)_2\text{CHCOOH}$ (1 mark) (ii) $(\text{CH}_3)_2\text{CHD}$ (1 mark) (iii) $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$ (1 mark)

(d) Which compound in each of the following pairs would have more polar carbon-metal bond?

(i) $\text{CH}_3\text{CH}_2\text{Li}$ or $(\text{CH}_3\text{CH}_2)\text{Al}$ (1 mark) (ii) $(\text{CH}_3)\text{Zn}$ or $(\text{CH}_3)_2\text{Mg}$ (1 mark)

(e) Give the major organic product of the following reactions:

(i) $\text{CH}_3\text{MgI} + \text{CH}_3\text{CN} \rightarrow$ (2 marks) (ii) $\text{CH}_3\text{MgI} + \text{HCN} \rightarrow$ (2 marks)

(iii) $\text{CH}_3(\text{CH}_3)\text{CHCH}_2\text{CH}=\text{CH}_2 \xrightarrow[\text{H}_2\text{O}_2/\text{OH}^-]{\text{BH}_3, \text{ether}} \rightarrow$ (2 marks) (iv) $(\text{CH}_3)_2\text{C}=\text{CHCH}_3 \xrightarrow[\text{CrO}_3]{\text{BH}_3, \text{ether}} \rightarrow$ (2 marks)

marks)

(v) $(\text{CH}_3)_2\text{C}=\text{CHCH}_2\text{CH}_3 \xrightarrow[\text{CH}_3\text{COOH}]{\text{BH}_3, \text{ether}} \rightarrow$ (2 marks)

(Q3.ai) Mention two uses of ferrocene (2 marks)

(ii) Does ferrocene display aromatic behaviour? Explain. (2 marks)

(b) Provide the preparation of 3-ethylhexan-3-ol using three different Grignard reagents only

(6 marks)

(ci) Identify the species which follows 18-electron rule (a). $\text{Mo}(\text{CO})_6$ (2 marks) (b). $[\text{M}(\text{CO})_7]^+$ (2 marks) (c). $[\text{Co}(\text{CO})_5]^Z$ (2 marks)

(cii) The following compounds: $[\text{Ti Cp}_2\text{Cl}_2]$ and $\text{Pt}(\text{PPh}_3)_2$ despite being electron deficient are quite stable. Give reason to account for their stability. (4 marks)

(4ai) Heating the sample $[(\eta^5\text{-C}_5\text{H}_5)\text{Mo}(\text{CO})]_2$ results in the formation of $[(\eta^5\text{-C}_5\text{H}_5)\text{Mo}(\text{CO})_2]_2$. Determine the change in metal-metal (Mo-Mo) bond order. (2 marks)

(aii) Give the IUPAC names of the following compounds: a. $(\text{CH}_3\text{CH}_2)_3\text{B}$ b. $\text{Si}(\text{CH}_3)_4$ c. $\text{Ar}(\text{C}_6\text{H}_5)_3$ d. $(\text{C}_2\text{H}_5)_2\text{AlBr}$ e. $(\text{CH}_3)_3\text{SiCH}_2\text{CH}_3$ f. $\text{C}_5\text{H}_5\text{Na}$ (3 marks)

- (b) Methylmagnesium bromide is combined with each of the following compounds and then with water. What products are obtained in each case? (i) HBr (**2 marks**)
(ii) CH₃COCl (**2 marks**) (iii) H₂CO (**2 marks**) (iv) C₂H₅OH (**2 marks**)
- (ci) Give reason why further addition of BH₃ to tetramethylethylene cannot take place. (**2 marks**) (ii) Draw the structural formula for ethylmagnesium bromide showing:
(a) An electrovalent bond (b) A polar bond (c) A covalent bond (**1 mark**)
- (d) Propose a synthesis for each of the following alcohols using organoborane reagent:
(i) Hexanol (**2 marks**) (ii) 2-ethylpentan-2-ol (**2 marks**)