

THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

SECOND SEMESTER EXAMINATION

CH 452 – TOPICS IN ADVANCED CHEMISTRY

FRIDAY 30<sup>th</sup> OCTOBER 2020 – 08:20 AM

**TIME ALLOWED: 2 HOURS**

**INFORMATION FOR CANDIDATES: -**

1. You will have 10 minutes to read the question paper. You **MUST NOT** begin writing in the answer book during this time.
2. **ANSWER ALL QUESTIONS.**
3. All answers **MUST** be written on the answer book provided
4. Calculators are permitted in the examination room. Lecture notes, notebooks plain papers and textbooks are **NOT** allowed.
5. Mobile phones are not allowed. **SWITCH OFF THE MOBILE PHONES.**
6. Show all workings and calculations in the answer book.
7. **DRAW** the **STRUCTURES** clear and visible.
8. **DO NOT** over write.
9. Write your name and number clearly on the front page. **DO IT NOW.**

**MARKING SCHEME: Total 60 marks**

1. (a) Describe the classification of organometallic compounds. [3 marks]
- (b) Write the methods of synthesis of organometallic compounds. [3 marks]
- (c) Write the major applications of organometallic compounds. [4 marks]
- (Total = 10 marks)
2. (a) Use neutral ligand method (method B) to determine whether the organometallic compound  $(\eta^3\text{-C}_5\text{H}_5)\text{Ni}(\eta^1\text{-C}_5\text{H}_5)(\text{CO})\text{Cl}$  is stable or not? Calculate the oxidation state of the metal. [3 marks]
- (b) Draw the structures of the following and indicate the metal as "M":
- (i)  $\eta^5\text{-pentadienyl}$ ,
  - (ii)  $\eta^5\text{-cyclopentadienyl}$
  - (iii)  $\sigma\text{-allyl}$ .
- [3 marks]
- (c) Draw the structures of the following metal carbonyl compounds:
- (i)  $[\text{Rh}(\text{CO})_4]^+$
  - (ii)  $[\text{Fe}(\text{CO})_5]$
  - (iii)  $[\text{Mn}(\text{CO})_5]^-$
  - (iv)  $[\text{Cr}(\text{CO})_6]$
- [4 marks]
- (Total = 10 marks)
3. (a) An ammine complex of Pt(IV) possesses EAN as that of  $\text{Rn}$  configuration. Draw the structure and predict the shape and hybridisation of the complex. [3 marks]
- (b) Draw a NEAT catalytic loop for the hydrogenation of alkene using Wilkinson's catalyst and give the name of each step in the loop. [5 marks]
- (c) When but-1-ene is polymerised without catalyst, mixtures of stereoisomers are obtained. What are they? Draw their structures. [2 marks]
- (Total = 10 marks)

4. (a) Why ferrocene is diamagnetic? Explain with help of valence bond theory. [3 marks]
- (b) Complete the following reactions and predict balance them wherever required.
- i)  $\text{Mn}_2(\text{CO})_{10} + \text{Br}_2 \rightarrow$
- ii)  $\text{C}_2\text{H}_4 + \text{RhCl}_3 \rightarrow$
- iii)  $\text{Co}_2(\text{CO})_8 + \text{Na} / \text{Hg} \rightarrow$  [3 marks]
- (c) Why the organometallic compounds are stable to hydrolysis? Explain with TWO examples. [4 marks]
- (d) Discuss the structures of  $[(\eta^5\text{-C}_5\text{(CH}_3)_5)_2\text{Fe}]$  in gaseous and solid states [4 marks]
- (Total = 14 marks)
5. (a) What are nanomaterials? Why did we not hear about nanotechnology in the past? [3 marks]
- (b) Distinguish between top-down and bottom-up approach for nanoparticle synthesis. [3 marks]
- (c) Explain the application of nanotechnology in cancer therapy. [3 marks]
- (d) Explain the electric arc deposition method for the synthesis of carbon nanotube. [3 marks]
- (e) What is the term chirality in carbon nanotube terminology? Explain the types based on the indices (n, m) of chiral vector. [4 marks]
- (Total = 16 marks)

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