

THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY
SECOND SEMESTER EXAMINATION
CH 422 --ORGANOMETALLIC COMPOUNDS AND NANOTECHNOLOGY
TUESDAY 25TH OCTOBER 2022 – 12:50 PM

TIME ALLOWED: 2 HOURS

INFORMATION FOR CANDIDATES: -

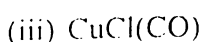
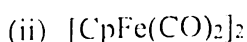
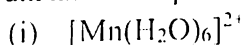
1. You will have 10 minutes to read the question paper. You **MUST NOT** begin writing in the answer book during this time.
2. **ANSWER ALL QUESTIONS.**
3. All answers **MUST** be written on the answer book provided
4. Calculators are permitted in the examination room. Lecture notes, notebooks plain 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** overwrite.
9. Write your name and number clearly on the front page. **DO IT NOW.**

MARKING SCHEME: Total 50 marks

1. (a) How are the organometallic compounds classified?
- (b) Write the FOUR major applications of organometallic compounds.

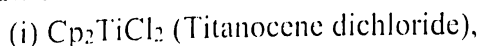
(Total = 8 marks)

2. (a) Apply 18 electron rule to the following compounds and determine their electron counts. Based on the result, classify them as stable or unstable compound:



[6 marks]

- (b) Draw the structures of the following organometallic compounds:



[2 marks]

(Total = 8 marks)

3. (a) Why most of the organometallic compounds are highly reactive and sensitive?

- (b) Use valence bond theory (VBT) and deduce the hybridization, shape and magnetic property of Ferrocene

- (c) Chromium forms two common anionic carbonyls: $[\text{Cr}(\text{CO})_5]^{n-}$ and $[\text{Cr}(\text{CO})_4]^{m-}$. Deduce the probable charges, n and m , on these ions. (Hint: use EAN rule)

(Total = 9 marks)

4. (a) Distinguish between top-down and bottom-up approaches for nanoparticle synthesis.

- (b) Write any THREE advantages of chemical method of synthesis of nanomaterials.

- (c) What are nanomaterials? Why did we not hear about nanotechnology in the past?

- (d) Explain the chemical vapour deposition method for the synthesis of carbon nanotube.

(Total = 12 marks)

5. (a) How are carbon nanotubes (CNTs) classified based on their chirality?
Explain the main types. [4 marks]
- (b) State any TWO characterization tools for nanomaterials.
Explain with suitable example each. [4 marks]
- (c) Explain the role of nanomaterials in space or defence fields. [4 marks]
- (d) What happens if CNTs enter into human or animal body? [1 mark]
- (Total = 13 marks)

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Periodic Table of the Elements

1 IA H 1.008	2 IIA He 4.003																	17 VIIA F 18.998	18 VIIIA Ar 39.948																														
3 IIIA Li 6.941	4 IIA Be 9.012																	9 IIA O 15.999	10 VIIA Ne 20.180																														
11 IA Na 22.990	12 IIA Mg 24.305																	15 VA P 30.974	16 VIA S 32.06	17 VIIA Cl 35.453	18 VIIIA Ar 39.948																												
19 IA K 39.098	20 IIA Ca 40.078	21 IIIB Sc 44.956	22 IVB Ti 47.88	23 VB V 50.942	24 VIB Cr 51.996	25 VIIB Mn 54.938	26 VIIIB Fe 55.845	27 VIII Co 58.933	28 VIII Ni 58.693	29 IB Cu 63.546	30 IIB Zn 65.38	31 IIIA Ga 69.723	32 IVA Ge 72.64	33 VA As 74.922	34 VIA Se 78.96	35 VIIA Br 79.904	36 VIIIA Kr 83.80																																
37 IA Rb 85.468	38 IIA Sr 87.62	39 IIIB Y 88.906	40 IVB Zr 91.224	41 VB Nb 92.906	42 VIB Mo 95.94	43 VIIB Tc [98]	44 VIIIB Ru 101.07	45 VIII Rh 102.905	46 VIII Pd 106.42	47 IB Ag 107.868	48 IIB Cd 112.411	49 IIIA In 114.818	50 IVA Sn 118.710	51 VA Sb 121.757	52 VIA Te 127.6	53 VIIA I 126.905	54 VIIIA Xe 131.29																																
55 IA Cs 132.905	56 IIA Ba 137.327	57-71 Lanthanide Series	72 IVB Hf 178.49	73 VB Ta 180.948	74 VIB W 183.84	75 VIIB Re 186.207	76 VIIIB Os 190.23	77 VIII Ir 192.22	78 VIII Pt 195.08	79 IB Au 196.967	80 IIB Hg 200.59	81 IIIA Tl 204.38	82 IVA Pb 207.2	83 VA Bi 208.98	84 VIA Po [209]	85 VIIA At [210]	86 VIIIA Rn [222]																																
87 IA Fr [223]	88 IIA Ra [226]	89-103 Actinide Series	104 IVB Rf [261]	105 VB Db [262]	106 VIB Sg [266]	107 VIIB Bh [264]	108 VIIIB Hs [277]	109 VIII Mt [276]	110 VIII Ds [285]	111 IB Rg [284]	112 IIB Cn [285]	113 IIIA Nh [284]	114 IVA Fl [289]	115 VA Uup [288]	116 VIA Lv [293]	117 VIIA Uus [294]	118 VIIIA Uuo [294]																																
<table border="0"> <tr> <td>57 Lanthanide Series</td> <td>58 La 138.905</td> <td>59 Ce 140.12</td> <td>60 Pr 140.908</td> <td>61 Nd 144.24</td> <td>62 Pm [145]</td> <td>63 Sm 150.36</td> <td>64 Eu 151.965</td> <td>65 Gd 157.25</td> <td>66 Tb 158.925</td> <td>67 Dy 162.50</td> <td>68 Ho 164.930</td> <td>69 Er 167.259</td> <td>70 Tm 168.930</td> <td>71 Yb 173.054</td> <td>72 Lu 174.967</td> </tr> <tr> <td>89 Actinide Series</td> <td>90 Ac [227]</td> <td>91 Th 232.038</td> <td>92 Pa 231.036</td> <td>93 U 238.029</td> <td>94 Np [237]</td> <td>95 Pu [244]</td> <td>96 Am [243]</td> <td>97 Cm [247]</td> <td>98 Bk [247]</td> <td>99 Cf [251]</td> <td>100 Es [252]</td> <td>101 Fm [257]</td> <td>102 Md [258]</td> <td>103 No [259]</td> <td>104 Lr [260]</td> </tr> </table>																		57 Lanthanide Series	58 La 138.905	59 Ce 140.12	60 Pr 140.908	61 Nd 144.24	62 Pm [145]	63 Sm 150.36	64 Eu 151.965	65 Gd 157.25	66 Tb 158.925	67 Dy 162.50	68 Ho 164.930	69 Er 167.259	70 Tm 168.930	71 Yb 173.054	72 Lu 174.967	89 Actinide Series	90 Ac [227]	91 Th 232.038	92 Pa 231.036	93 U 238.029	94 Np [237]	95 Pu [244]	96 Am [243]	97 Cm [247]	98 Bk [247]	99 Cf [251]	100 Es [252]	101 Fm [257]	102 Md [258]	103 No [259]	104 Lr [260]
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