

THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

SECOND SEMESTER EXAMINATION

CH 452 – TOPICS IN ADVANCED CHEMISTRY

MONDAY 1ST NOVEMBER 2021 – 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) Draw a NEAT catalytic loop for alkene polymerisation using Zeigler-Natta catalyst.
- (b) How are organometallic compounds stable to hydrolysis? Explain with TWO examples.
- (c) Write FOUR major applications of organometallic compounds.

(Total = 12 marks)

2. (a) Use neutral ligand method (method B) to determine whether the organometallic compound $(\eta^5\text{-C}_5\text{H}_5)\text{Fe}(\text{CO})_2\text{Cl}$ is stable or not? Calculate the oxidation state of the metal.
- (b) Draw the structures of the following and indicate the metal as "M":
 - (i) η^7 - Cycloheptatrienyl,
 - (ii) η^8 - Cyclooctatetraene
 - (iii) η^4 - cyclobutadiene
 - (iv) η^2 - Alkene
- (c) Draw the structures of the following metal carbonyl compounds:
 - (i) $[\text{Au}(\text{CO})_2]^+$
 - (ii) $[\text{Fe}(\text{CO})_5]$
 - (iii) $[\text{Mn}(\text{CO})_5]^-$
 - (iv) $[\text{Cr}(\text{CO})_6]$

(Total = 12 marks)

3. (a) When but-1-ene is polymerised without a catalyst, mixtures of stereoisomers are obtained. What are they? Draw their structures.
- (b) Explain, why $\text{Co}_2(\text{CO})_8$ exists as two isomers?
- (c) Nickel forms two common anionic carbonyls: $[\text{Ni}(\text{CO})_6]^{n-}$ and $[\text{Ni}(\text{CO})_4]^{m-}$. Deduce the probable charges, n and m , on these ions.

(Total = 12 marks)

4. (a) What are nanomaterials? Why did we not hear about nanotechnology in the past?
- (b) Distinguish between top-down and bottom-up approach for nanoparticle synthesis.
- (c) Describe the application of nanotechnology in the medical field.
- (d) Explain the electric arc deposition method for the synthesis of carbon nanotube.

(Total = 12 marks)

5. (a) Explain the applications of nanotechnology in space or defense field.
- (b) How do you synthesize single wall carbon nanotube using Laser-vapourisation (ablation) method?
- (c) What are the advantages of chemical synthesis of nanomaterials?

(Total = 12 marks)

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The Periodic Table

	The Periodic Table																	
	IA											VIII A						
1	1 H 1.01											2 He 4.00						
2	3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
3	11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
4	19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
5	37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (99)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.29
6	55 Cs 132.91	56 Ba 137.33	57 La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.21	76 Os 190.2	77 Ir 192.22	78 Pt 195.09	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
7	87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Unq (261)	105 Unp (262)	106 Unh (263)	107 Uns (262)	108 Uno (265)	109 Uue (266)									
	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.4	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97				
	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)				

Active Metals
 Li > K > Ba >
 Sr > Ca > Na