

THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

SECOND SEMESTER EXAMINATION

CH222 – ADVANCED INORGANIC CHEMISTRY

WEDNESDAY 26th OCTOBER 2022 8:20 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** overwrite.
9. Write your name and number clearly on the front page. **DO IT NOW.**

MARKING SCHEME: Total 50 marks

1. (a) Square planar complexes do not exhibit optical isomerism. Why?
- (b) Why tetrahedral complexes always form high spin complexes?
- (c) What is meant by K-capture? Give ONE example.
- (d) Draw *cis*- and *trans*- geometrical isomers of $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{NO}_2)]$.

(8 marks)

2. (a) Give any FOUR postulates of Werner's Coordination Theory (WCT).
- (b) Radioactive iodine-131 decays to stable xenon-131. After eight days, exactly one-half of a two-gram sample of iodine-131 has disappeared. What mass of the original iodine-131 will remain after an additional twenty-four days have passed?
- (c) Calculate the Crystal Field Stabilization Energy (CFSE) for a d^5 LOW spin complex.
- (d) Use VBT (Valence Bond Theory) and deduce the shape, hybridization and magnetic property of $[\text{Fe}(\text{CO})_5]$.
- (e) U-238 (at. no. 92), during various disintegration steps, loses 6α and 4β particles. What will be the atomic weight and atomic number of the new product?
- (f) Compare the velocities and ionizing powers of alpha, beta and gamma rays.
- (g) Balance the following nuclear reactions:
- (i) ${}^{22}_{11}\text{Na} \rightarrow {}^{22}_{10}\text{Ne} + \underline{\hspace{2cm}}$
- (ii) (D, n) reaction of Nitrogen – 14: $\underline{\hspace{2cm}}$
- (iii) ${}^7_3\text{Li} + \underline{\hspace{2cm}} \rightarrow \text{alpha particle}$
- (iv) Tellurium-131 + neutron $\rightarrow \underline{\hspace{2cm}} + \text{beta particle}$
- (h) Explain how the radiotracer such as I-131 is useful in the diagnosis and treatment of defective thyroid glands?

(32 marks)

3. Use the IUPAC rules and write the exact and proper formula for the following compounds:

- Tetraaquadichlorochromium(III) chloride
- Potassium tetraiodocuprate(II)
- Pentaamminecobalt(III)- μ -amidotetraammineaquacobalt(III) chloride
- trans*-aquabis(ethylenediamine)iodocobalt(III) nitrate
- Diamminedifluoroplatinum(II)

(5 marks)

4. (a) Draw a NEAT and COMPLETE crystal field splitting diagram for $[\text{Fe}(\text{CN})_6]^{4-}$ and fill the electrons. At. No. of Fe is 26. [2 marks]

(b) Identify whether this complex is high or low spin. [1 mark]

(c) Calculate the Crystal Field Stabilization Energy (CFSE) for this complex. [2 marks]

(Total = 5 marks)

DATA SHEET

Periodic Table of the Elements

1 H 1.01																	18 He 4.00																														
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 18.99	10 Ne 20.18																														
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																														
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 51.99	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.63	33 As 74.92	34 Se 78.97	35 Br 79.90	36 Kr 83.80																														
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 98.91	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 121.76	52 Te 127.6	53 I 126.90	54 Xe 131.29																														
55 Cs 132.91	56 Ba 137.33	57-71 La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	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 [209]	86 Rn 222.02																														
87 Fr 223.02	88 Ra 226.03	89-103 Rf [261]	104 Db [262]	105 Sg [266]	106 Bh [264]	107 Hs [265]	108 Mt [276]	109 Ds [271]	110 Rg [272]	111 Cn [285]	112 Nh [286]	113 Fl [288]	114 Mc [289]	115 Lv [293]	116 Ts [294]	117 Og [294]																															
<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>57 La 138.91</td> <td>58 Ce 140.12</td> <td>59 Pr 140.91</td> <td>60 Nd 144.24</td> <td>61 Pm 144.91</td> <td>62 Sm 150.36</td> <td>63 Eu 151.96</td> <td>64 Gd 157.25</td> <td>65 Tb 158.93</td> <td>66 Dy 162.50</td> <td>67 Ho 164.93</td> <td>68 Er 167.26</td> <td>69 Tm 168.93</td> <td>70 Yb 173.05</td> <td>71 Lu 174.97</td> </tr> <tr> <td>89 Ac 227.03</td> <td>90 Th 232.04</td> <td>91 Pa 231.04</td> <td>92 U 238.03</td> <td>93 Np 237.05</td> <td>94 Pu 244.05</td> <td>95 Am 243.05</td> <td>96 Cm 247.07</td> <td>97 Bk 247.07</td> <td>98 Cf 251.08</td> <td>99 Es [254]</td> <td>100 Fm 257.10</td> <td>101 Md 258.1</td> <td>102 No 259.10</td> <td>103 Lr [262]</td> </tr> </table>																		57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm 144.91	62 Sm 150.36	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 173.05	71 Lu 174.97	89 Ac 227.03	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu 244.05	95 Am 243.05	96 Cm 247.07	97 Bk 247.07	98 Cf 251.08	99 Es [254]	100 Fm 257.10	101 Md 258.1	102 No 259.10	103 Lr [262]
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