THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

SECOND SEMESTER EXAMINATION

CH222 – ADVANCED INORGANIC CHEMISTRY

MONDAY 25th OCTOBER 2021 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** over write.
9. Write your name and number clearly on the front page. **DO IT NOW.**

MARKING SCHEME: Total 50 marks

1. (a) What are linkage isomers? Give ONE example.

(b) Most of the nuclear reactions involving α- and β- emissions are accompanied by gamma ray emissions. Why?

(c) What are mirror nuclei? Give ONE example.

(f) Draw *cis-* and *trans-* geometrical isomer of $[Pt(NH_3)_2Cl_2]$

(8 marks)

2. (a) Calculate the Crystal Field Stabilization Energy (CFSE) for Fe^{3+} in an octahedral coordination complex (*No need of an entire crystal field splitting diagram*).

(b) Give ANY FOUR postulates of Werner's coordination theory (WCT). How would you structurally represent $CoF_3.6NH_3$ according to WCT?

(c) Which 'factor' is responsible for the nuclear stability? In the 'zone of stability' curve, what happens if this 'factor' lies ***above*** and ***below*** the curve?

(d) Use VBT (Valence Bond Theory) to $[Co(CN)_6]^{3-}$ ion and deduce the shape, hybridization and magnetic property. Identify whether the complex is inner orbital or outer orbital complex.

(e) What are the FOUR factors (*with respect to the properties of ligands*) that govern the stability of the complexes.

(f) Compare the velocities and penetrating powers of alpha, beta and gamma rays.

(g) Balance the following nuclear reactions:

(i) $^{23}_{11}Na + {}^{1}_{0}n \rightarrow$ _____ $+ \gamma$

(ii) $^{14}_{7}N +$ _____ $\rightarrow {}^{17}_{8}O + {}^{1}_{1}H$

(iii) _____ $\rightarrow {}^{220}_{86}Rn +$ alpha particle

(iv) $^{133}_{56}Ba \; {}^{0}_{-1}e \rightarrow$ X-ray + _____

(h) What are slow neutrons? How are they produced?

(32 marks)

3. (a) (i) Draw a NEAT and COMPLETE crystal field splitting diagram for $[Mn(H_2O)_6]^{2+}$ and fill the electrons.
(ii) Identify whether this complex is high or low spin.
(iii) Calculate the Crystal Field Stabilization Energy (CFSE) for this complex.

(b) Use the IUPAC rules and write the exact and proper formula for the following compounds:

(i) Sodium tetrabromocuprate(II)

(ii) Tricarbonyltrichloromolybdenum(III)

(iii) *trans*-aquabis(ethylenediamine)fluorocobalt(III) nitrate

(iv) Di-μ-chlorobis[diammineplatinum(II)] bromide

(10 marks)

DATA SHEET

Periodic Table of the Elements