RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. Honours in Chemistry
Fourth Year - Semester I Examination – July / August 2023

CHE 4204 – ADVANCED INORGANIC CHEMISTRY II

Time: Two (02) hours

Answer all questions.

Use of a non-programmable calculator is permitted.

1. a) Predict the number of peaks and the splitting patterns for the compounds given below [^{2}D (I=1), ^{19}F (I=1/2), ^{14}N (I=1), ^{31}P (I=1/2), ^{35}Cl (I=3/2), ^{127}I (I=5/2), ^{n}X (I=1/2), ^{m}Y (I=0), ^{p}E (I=3, abundance 60%) , ^{q}E (I=5/2, abundance 40%)].

   Assume all the compounds are consisted with only the isotopes indicated here.

   hint: You do not have to draw the spectra.

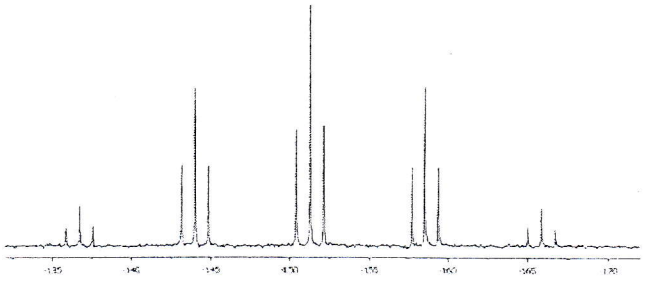
   i. $[EX_4]^-$ - ^{1}X NMR

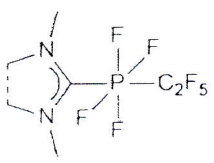
   ii. $[P(YZ_3)_2]^-$ - ^{31}P NMR

   iii. IX_4Cl - ^{n}X NMR

   iv. ECl_2I - ^{q}E NMR (34 marks)

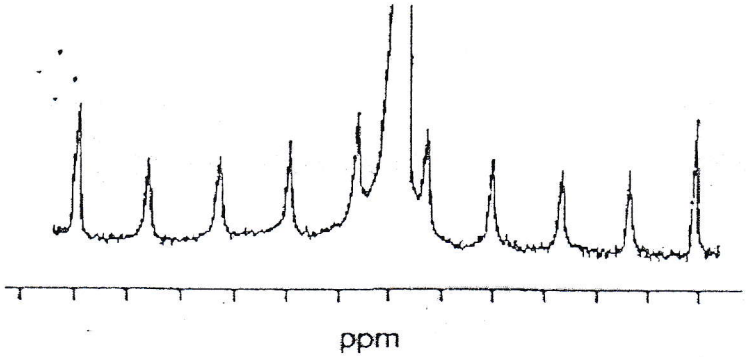
   b) ^{31}P NMR spectra and the structure of a phosphorous compounds are given below. Correlate the spectra with the compound. Explain the splitting pattern.





(30 marks)

c) ^{1}H NMR of GeH_4 samples is given below. For Germanium two isotopes present namely ^{73}Ge and ^{71}Ge. Calculate the spin quantum number I for each isotope, comment about the abundance of each isotope in the sample.



(36 marks)

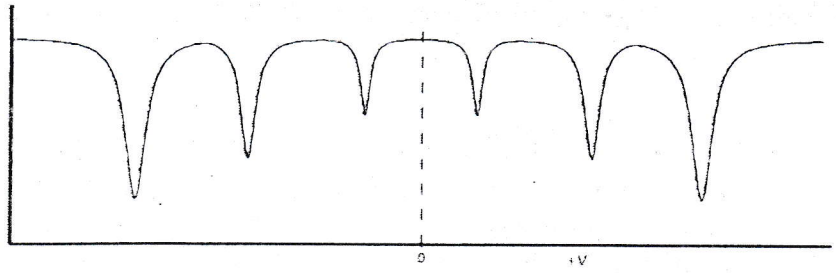
3. a) Discuss the phenomena zero field splitting found in ESR spectroscopy. (20 marks)

b) Consider the XY^+ ion. [^{n}X (I=1), ^{m}Y (I=3/2)]

i. With the aid of an energy level diagram, show the transitions corresponding to the ESR spectrum of the XY^+ ion.

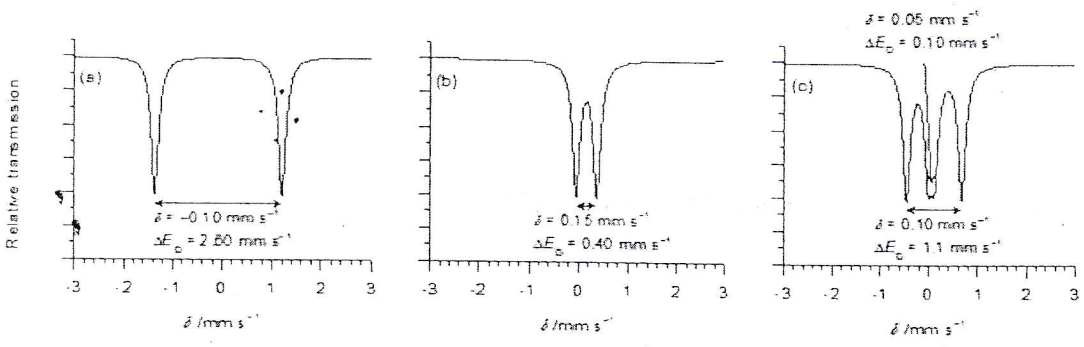
ii. Draw the relevant ESR spectrum. (30 marks)

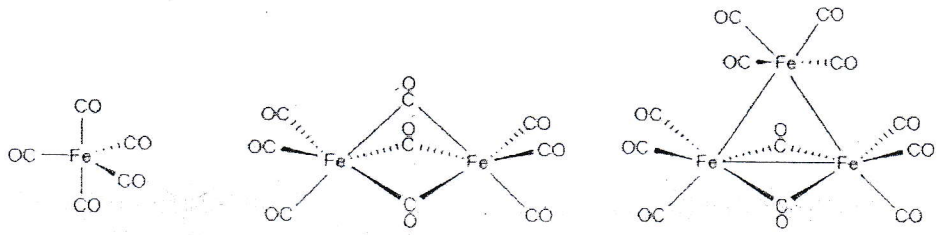
c) Account for the given Mossbauer spectrum corresponding to ^{57}Fe nuclei using an energy level diagram and showing the transitions relevant to the spectrum. (^{57}Fe, I=1/2 - ground state and ^{57}Fe, I=3/2 - excited state)



(20 marks)

d) The ^{57}Fe Mossbauer spectra and structures of some iron carbonyls are shown below. Assign the spectra to the correct structure and justify the selection.





(30 marks)

3. a) Account for the Hard Soft Acid Base theory and symbiosis. (40 marks)

b) H^+ also can act as electron acceptor. However, it is not the prominent electron acceptor in biological systems. Explain. (20 marks)

c) Illustrate the active site of the enzyme responsible for the conversion of dinitrogen to ammonia. Propose a mechanism for this process. (40 marks)

4. a) Illustrate the oxygen uptake mechanism of Hemerythrin. (30 marks)

b) Exemplify for the activity of multipair oxido-reductases. (30 marks)

c) What is the enzyme corresponding to removal of terminal carboxylic group in biological systems. Propose a mechanism. (40 marks)

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