

POSTGRADUATE FOURTH SEMESTER EXAMINATION, 2022

CHEMISTRY

Course Code: CHEM 403E

Course ID: 41453

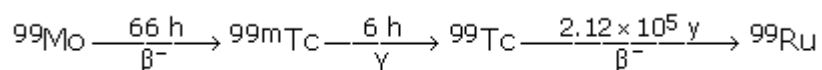
Inorganic Chemistry Special

Time: 2 Hours

Full Marks: 40

*The figures in the right-hand side margin indicate full marks.
Candidates are required to give their answers in their own words
as far as practicable.*

1. Answer *any five* of the following questions: 2×5 = 10
- (a) What factors determine the pharmacokinetic behavior of a drug?
 - (b) Draw the block diagram of Raman spectrometer.
 - (c) What is prolate and oblate symmetric top molecule? Give one example of each type.
 - (d) Why is edta^{4-} not a suitable ligand for use in chelation therapy for the removal of excess iron?
 - (e) Which of the following compounds is most likely to have its base peak at $m/z = 43$?
 $\text{CH}_3(\text{CH}_2)_4\text{CH}_3$, $(\text{CH}_3)_3\text{CCH}_2\text{CH}_3$, cyclohexane, $(\text{CH}_3)_2\text{CHCH}(\text{CH}_3)_2$
 - (f) Give the biological functions of Ca and Mg.
 - (g) What is mass accuracy in mass spectrometry? What is the unit of mass resolution?
2. Answer *any four* of the following questions: 5×4 = 20
- (a) (i) Write the key criteria that are important in the design of new chelators for Fe.
(ii) Which of the high-spin metal ions, Fe^{3+} , Cr^{3+} , Mn^{2+} and Gd^{3+} , would you expect to have the highest magnetic moment? 3+2 = 5
 - (b) (i) At what wavelengths in nanometres would the Stokes and anti-Stokes Raman lines for chloroform ($\Delta\bar{\nu}=218, 314, 790 \text{ cm}^{-1}$) appear if the source is a helium–neon laser (632.8) nm?
(ii) Discuss the basic differences between the Raman and IR spectroscopy. 3+2 = 5
 - (c) Describe some basic principles of mass spectrometry. Explain the nitrogen rule. 2.5+2.5 = 5
 - (d) (i) Briefly discuss the properties of a good MRI contrast agent.
(ii) The ^{99}Mo slowly decays to the metastable $^{99\text{m}}\text{Tc}$ and then to non-radioactive ruthenium:



How much ${}^{99\text{m}}\text{Tc}$ is left in the body after 24 hrs? 3+2 = 5

(e) (i) Discuss the origin and frequency of Stokes, anti-stokes and Rayleigh scattering.

(ii) In Raman spectrometer why source is kept perpendicular to 'wavelength selector'?

3+2 = 5

(f) (i) Calculate the ratio of M, (M+1) and (M+2) of BrCl in Mass spectrometry.

(ii) Identify the fragments corresponding to the peaks observed at $m/Z = 55.9401$,
121.0103 and 186.0132 in mass spectrum of ferrocene. 3+2 = 5

3. Answer *any one* of the following questions: 10×1 = 10

(a) (i) What are the requirements for a vibrational mode in a molecule to be IR active and Raman active? Why do these requirements differ? Under what circumstances vibrational modes will be both Raman and IR active? What is virtual state in Raman Spectroscopy?

(ii) Differentiate between base peak and molecular ion peak in EI Mass Spectrometry. Why does chemical ionization method give $[M+1]^+$ peak? Describe using chemical equations. (1+1+2+2+1)+1+2 = 10

(b) (i) Write down the side effects of cisplatin.

(ii) Why would you expect Pt(IV) centres to be more inert to ligand substitution than Pt(II) centres?

(iii) Why do the Au(I) drugs contain S (and P)?

(iv) What is chelation therapy? How does it work? Write down the side effects of chelation therapy. 2+2+1+(1+2+2) = 10
