

DEPARTMENT OF CHEMISTRY
RANI RASHMONI GREEN UNIVERSITY
M. Sc. COURSE IN CHEMISTRY
SEMESTER III FINAL EXAMINATION: 2024
Course ID: CHEM-C32

Full Marks: 40

Time: 2 hrs

Answer any ONE question from each UNIT in your own words with proper scientific justification.

Unit-1: Nuclear Chemistry

Q-1.(a) Both Nuclear Reactors and Accelerators are used for production of radioactive isotopes. Write at least two main differences between the mode of radioisotope production by reactor and accelerator.

(b) Give an example of charged particle induced nuclear reaction.

(c) What is Parent-daughter generator system? In what condition parent-daughter system is established? Discuss with example. Why this system is important in the field of nuclear medicine?

(d) What are the criteria of a radioisotope for in vivo application?

[2+1+3+2 = 8]

Q-2.(a) 100 mg Eu metal was bombarded with neutrons of flux $10^{14} \text{ n cm}^{-2} \text{ S}^{-1}$ for 12 h. What will be the activity of ^{152}Eu if measured after 24 h of end of bombardment?

[You may use following data, if required:

Cross section of ^{151}Eu (n, γ) reaction is 700 mb.

$T_{1/2}$ of ^{152}Eu = 13.5 years.

Natural abundance of ^{151}Eu and ^{153}Eu are 47.8% and 52.2% respectively.

Atomic weight of Eu = 151.96]

(b) Define (i) cross section (ii) excitation function (iii) saturation activity.

[5+3 = 8]

Unit-2: Photochemistry-2

Q-3.(a) Define photon upconversion with an example.

(b) Explain mirror image rule in photochemistry.

(c) Illustrate chemical actinometer with examples.



(d) Define excimer and exciplex.

[2+2+2+2 = 8]

Q-4. (a) Discuss photo redox reaction with a suitable example.

(b) Describe the mechanism of decay of excited singlet state.

(c) Explain Stokes and anti-Stokes shift in photoluminescence.

(a) Illustrate cage effect in photochemistry.

[2+2+2+2 = 8]

Unit-3: Bioinorganic Chemistry-2

Q-5. (a) Sketch the mechanism of dioxygen reduction catalyzed by *cytochrome c oxidase*.

(b) Differentiate *hemoglobin*, *hemerythrin* and *hemocyanin* in the light of (i) O-O stretching frequency and chemical state for the coordinated oxygen; (ii) magnetic properties

(c) “*2Fe-2S* protein has the negative reduction potential value where as analogous *Rieske* protein shows positive reduction potential value.” Explain why?

(d) Comment on the origin of colour and magnetic property for the ‘radical cation intermediate’ formed during the catalytic cycle of *cytochrome P-450* in the hydroxylation of alkane.

[2+2+2+2 = 8]

Q-6.(a) Give evidences that oxygen is evolved from water and not from carbon dioxide in photosynthesis.

(b) “Incorporation of Mg into chlorin ligand, makes the system becomes phosphorescent.” Explain the advantage of this phenomenon in photosynthesis process.

(c) Explain the role of water splitting complex (Mn_4CaO_5) in supply of electrons in the photosynthesis process.

(d) Why biological nitrogen fixation is difficult without *nitrogenase* enzyme?

[2+2+2+2 = 8]



Unit-4: Environmental Chemistry

Q-7.(a) Explain the mode of action of an organophosphate insecticide in insects' body. Write a name of an antidote for organophosphate poisoning and how does it work to restore the normal nerve impulse transmission?

(b) What is the basic difference in the mode of action of DDT and organophosphate insecticides? If an insect develops DDT resistivity, what is your probable solution as a chemist to destroy the insect without using other insecticides?

(c) Exemplify one each environment friendly herbicide and fungicide.

[4+2+2 = 8]

Q-8. (a) Discuss different steps of waste water treatment.

(b) Explain the process of Reverse Osmosis (RO) in desalination of water with diagram.

(c) How eutrophication is related to BOD of a water sample? What is the meaning of 'BOD = 25 mg/L' of a water body?

[4+2+2 = 8]

Unit-5: Green Chemistry

Q-9.(a) Give two important uses of Sc-CO_2 as solvent.

(b) Why is % atom economy a better parameter than % atom utilization for measuring greenness of a reaction?

(c) How can you vary the melting point of a particular 'ionic liquid'?

(d) Give an example of aldol condensation reaction using a 'Green Solvent'.

[2+2+2+2 = 8]

Q-10.(a) Can microwave irradiation (MWI) affect the structure of an organic molecule?

Explain.

(b) How will you carry out Claisen rearrangement under microwave using suitable green methods?

(c) How can you classify 'Organic Reaction' in aqueous medium?

(d) What are the utilities of PEG as a solvent in green synthesis?

[2+2+2+2 = 8]



