B.Sc. 6th Semester (Honours) Examination, 2023 (CBCS)

Subject : Chemistry

Course : DSE-3

(Green Chemistry)

Time: 2 Hours   Full Marks: 40

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

2×5=10

1. Answer *any five* questions:

   (a) List two important differences between 'Conventional heating' and 'Microwave heating'.

   (b) What is 'Eutrophication'? How does it affect the ecosystem?

   (c) Calculate the atom economy of the following reaction:

   $$HOCH_2CHOHCH_2OH + H_2 \xrightarrow[\text{200°C, 200 psi}]{CuCrO_4} CH_3CHOHCH_2OH$$

   (d) Mention two characteristics of water that makes it a benign solvent.

   (e) Write two advantages of use of supercritical carbon dioxide 'scCO$_2$' as a solvent in extraction process in food industry.

   (f) Elucidate the working definition of 'Green Chemistry'.

   (g) Why are ionic liquids called designer solvents?

   (h) Identify the non-ionising radiation among the following:
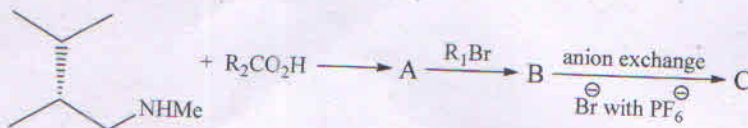
   X-rays, γ-rays, MW, UV-Visible and justify your choice.
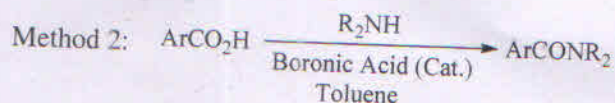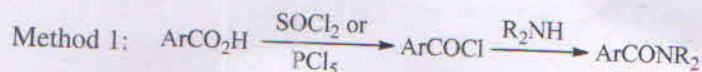
5×2=10

2. Answer *any two* questions:

   (a) (i) Provide two arguments in favour of the statement— "Oxidation of cyclohexanol/cyclohexanone to adipic acid by concentrated nitric acid is not considered a green synthesis".

   (ii) Suggest a suitable green alternative route to the above transformation.   3+2

   (b) (i) In the successful synthesis of an ionic liquid (IL) what are the two important factors that should be maintained?

27237

(ii) Complete the synthesis of the following ionic liquid by providing the structures of the missing compounds.

2+3

$$+ R_2CO_2H \longrightarrow A \xrightarrow{R_1Br} B \xrightarrow[\overset{\ominus}{Br} \text{ with } PF_6^{\ominus}]{\text{anion exchange}} C$$

(structure with NHMe)

(c) (i) Two methods of synthesis of following secondary amide are given below:

Method 1: $ArCO_2H \xrightarrow[PCl_5]{SOCl_2 \text{ or}} ArCOCl \xrightarrow{R_2NH} ArCONR_2$

Method 2: $ArCO_2H \xrightarrow[\substack{\text{Boronic Acid (Cat.)} \\ \text{Toluene}}]{R_2NH} ArCONR_2$

Which method is greener and why? Which principle of green chemistry do your choice satisfy?

(ii) Name the chemical responsible for 'Bhopal Gas Tragedy' in 1984? $(1+2+1)+1$

(d) (i) List two points to prove polylactic acid (PLA) is a green polymer.

(ii) How can the monomer of PLA be generated? In which category of polymer does PLA fall into?

$2+(2+1)$

3. Answer *any two* questions:

$10 \times 2 = 20$

(a) (i) Draw the pyramid that represents the waste management hierarchy indicating options to manage waste. Which is the most preferred option and why?

(ii) What is the relationship between Risk and Hazard? Explain the factors on which risk depends to justify the relation.

(iii) Give correct abbreviation of any two of the following: $(2+1+2)+(1+2)+(1+1)$
CCS, ISD, EMY

(b) (i) Explain the following terms giving one example in each case (*any three*):
(a) VOC   (b) Toxic Chemical
(c) Green Solvent   (d) Non-biodegradable polymer

(ii) What is cavitation? How does ultrasound vibration lead to acoustic cavitation?

$(2 \times 3) + (2+2)$

(c) (i) Define E-Factor. Name the scientist who used this term first. Mention the basic difference between 'E-Factor' and 'Atom Economy'.
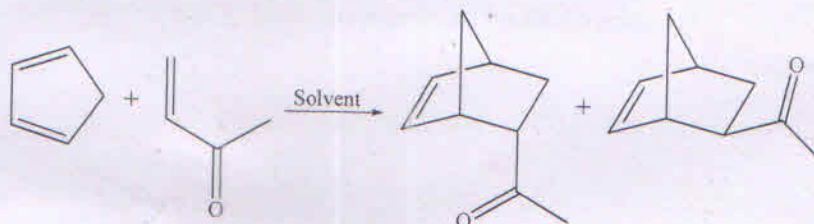
(ii) Consider the synthesis of hydroquinone by two routes as depicted below. In which case do you expect E-Factor is substantially less? And why?
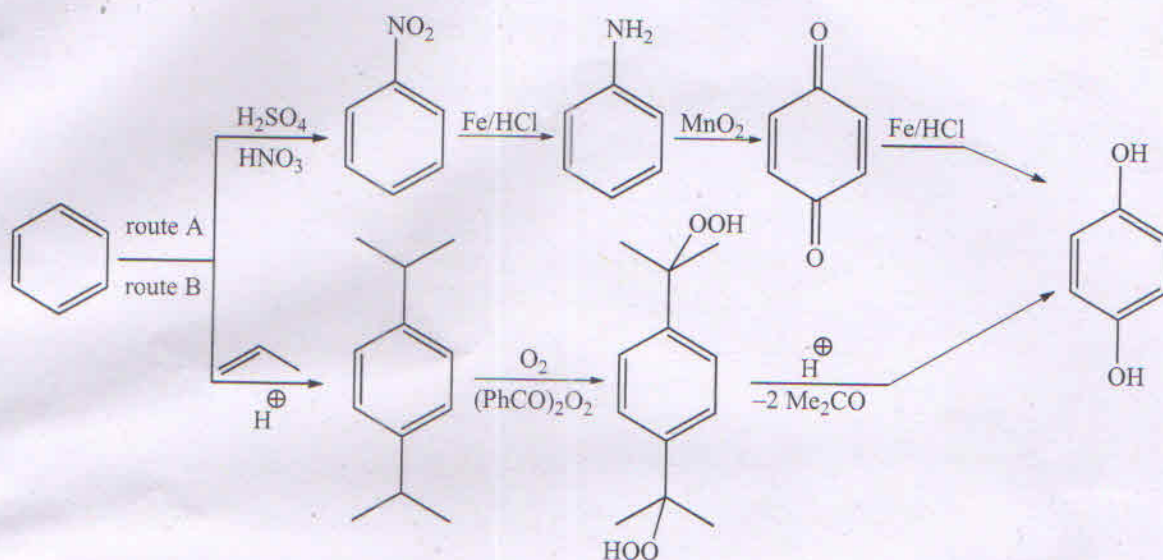
(iii) Name the tool that is used to assess potential environmental impacts and sustainability of products and process. Name the different domains of such assessment.

$$(1+1+2)+(1+2)+(1+2)$$

(d) (i) Consider the following Diels Alder reaction.

Solvent	endo: exo
EtOH	8.5
H_2O	21.4

Comment with proper justification why greater *endo* selectivity is observed in water. Why most Diels-Alder reaction is reasonable faster in water than methanol?

(ii) What is bio-diesel? How can benzoin condensation be carried out without the use of cyanides?

(iii) Suggest an environmentally safer alternative reagent to bromine. $(3+2)+(2+2)+1$

B.Sc. 6th Semester (Honours) Examination, 2023 (CBCS)
Subject : Chemistry
Course : DSE-3 (OR)
(Polymer Chemistry)

Time: 2 Hours

Full Marks: 40

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

1. Answer *any five* questions from the following:

   2×5=10

   (a) How are polymers classified on the basis of structures of polymers?

   (b) Differentiate between addition and condensation polymerisations.

   (c) Write the monomers and monomeric repeating units of nylon 6, 6.

   (d) What is functionality? What is its minimum value for branched polymer formation?

   (e) Why is bakelite a thermosetting polymer? Write the uses of hard Bakelite.

   (f) Is it possible to prepare an ideal solution of polymer? Give reason to justify your answer.

   (g) What do you mean by glass transition temperature(T_g) of a polymer? What is glassy state of a material?

   (h) What is conducting polymer? Give an example.

2. Answer *any two* questions from the following:

   5×2=10

   (a) (i) Compare the structures of isotactic and syndiotactic configurations of polypropylene.

       (ii) What is primary structure of a polymer?

   4+1

   (b) (i) Define viscosity average molecular weight of polymer. How can it be determined from intrinsic viscosity?

       (ii) What is vulcanisation of rubber?

   4+1

   (c) (i) Differentiate natural rubber and synthetic rubber.

       (ii) Between step-growth polymer and chain polymer which one will have generally the higher average molecular weight and why?

   3+2

   (d) (i) Classify copolymers depending upon the distribution of monomer units in the chain.

       (ii) Write the properties of thermoplastic with example.

   3+2

3. Answer *any two* questions from the following:

$10 \times 2 = 20$

(a) (i) Define monodisperse and polydisperse polymers. Draw the molecular weight distribution curves for them.

(ii) Among the colligative properties only osmotic pressure is useful to determine the average molecular weight of polymer.— Why? Name the average molecular weight obtained from the osmotic pressure method. State its principle.

(iii) Can enzyme be a polymer?

$(2+2)+(2+1+2)+1$

(b) (i) Show that the average degree of polymerisation is $\frac{1}{1-p}$, where p is the extent of polymerization.

(ii) A hydroxy acid $HO - (CH_2)_5 - COOH$ is polymerised and the polymer has a number average molar mass of $20,000 \text{ g mol}^{-1}$. Find the average degree of polymerisation and the extent of reaction.

(iii) What is free volume of polymer? How does it affect glass transition temperature, T_g?

$4+4+2$

(c) (i) Derive the rate expression for the step-growth polymerisation in terms of extent of reaction, considering an example of polyester formation in absence of catalyst.

(ii) Could a copolymer be formed in both addition and condensation polymerisations? Explain with example.

(iii) Discuss the enthalpy change in polymerisation process.

$4+4+2$

(d) (i) How many types of intermolecular forces may be operating in polymers? State their effects.

(ii) Define number average molecular weight and weight average molecular weight of polymer.

(iii) What is PVC? How is it synthesized from its raw materials? Write its uses. $3+3+4$

———————