4/11/19 M

[This question paper contains 6 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 7638 **J**

Unique Paper Code : 32177908

Name of the Paper : Green Chemistry

Name of the Course : **B.Sc. (H) Chemistry / B.Sc. (Prog.) : DSE-1/1A**

Semester : V

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **five** questions.
3. Each question carries **15** marks.
4. Attempt all parts of a question together.

1. (a) Give any one example in each of the following cases, stating the green chemistry principle involved : **(Any six)**

   (i) Ultrasonic reaction (Chemical equation)

   (ii) Rightfit pigment (structure)

P.T.O.

(iii) Ionic liquid (formula)

(iv) Aqueous phase reaction (Chemical equation)

(v) Microwave-assisted reaction (Chemical equation)

(vi) Analytical technique for real analysis for pollution prevention

(vii) Green solvent

(b) Which is better: A reaction that uses a stoichiometric amount of a reagent or the one that uses a catalytic amount of the same reagent? Justify your answer. (2×6,3)

2. Attempt any **three** of the following :

(a) Give the greener route to replace the conventional synthesis of the Carbaryl insecticide (once produced in Union Carbide India Ltd., M.P., India). Why the route is considered greener?

(b) What is cradle to cradle approach? Elaborate using the Ecoworx® carpet tiles that won US Presidential Green Chemistry Challenge Award in 2003.

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

(d) Give the principle of inherent safer design (ISD)? How does it work for designing the green processes in industries? (5×3)

3. (a) Do the following conversions considering the greener route :

(i) Glucose to adipic acid

(ii) Corn to polylactic acid

(b) Highlight the importance of asymmetric catalysts illustrating the thalidomide babies' case.

OR

What is biocatalysis? Give two relevant advantages and two limitations of biocatalysts used in the chemical reactions. (5×2,5)

4. (a) Write short notes (with emphasis on description, one example and two benefits wherever applicable) on any **three** of the following :

(i) Twelve principles of green chemistry

(ii) Solvent less reactions

(iii) Combinatorial green chemistry

(iv) Green chemistry in sustainable development

(v) Enzymatic interesterification for the production of healthier fats and oils

(b) How the pollution prevention act of 1990 by US environmental Protection Agency (EPA) relating risk, exposure and hazard leads to a paradigm shift to green chemistry? (4×3,3)

5. (a) Giving the formula for % atom economy, calculate the % atom economy of the following reaction :

$(Ph)CH(CH_3)OH + 2\ Cr_2O_3 + 3\ H_2SO_4 \longrightarrow 3(Ph)CO(CH_3) + Cr_2SO_4 + 6H_2O$

OR

The conventional synthesis of the drug, Ibuprofen, involves six steps with the % atom economy of 40%. The synthesis was replaced with a three step process and having % atom economy of 77%. Explain the role of % atom economy and number of steps involved in the adoption of the replaced

synthesis of the drug. Also state the green chemistry principle(s) involved in reinforcing the above two factors while considering any synthesis of the chemical compounds.

(b) Suggest one green solvent that can replace perchloroethylene (PERC) in the dry cleaning of garments. Give any two drawbacks of PERC that provides a rationale for its replacement. Also give two greener relevance of the replaced solvent.

(c) In 1980, US Environmental Protection Agency (EPA) and chemical industry focused mainly on Pollution Remediation while the scientists' concern was Pollution Prevention in first place. Give the explanation to this statement. How can one design a greener chemical synthesis? (5,5,5)

6. (a) Explain the following terms giving one example in each case **(any two)** :

(i) VOC

(ii) Toxic chemical

(iii) Auxiliary substance in a chemical reaction

(iv) Depleting feedstock

(b) What are antifoulants? Why the marine antifoulant tributyl tinoxide (TBTO) has been replaced by Sea Nine 211? Which green chemistry principle is being followed in this case?

(c) Give (name or draw) the worldwide accepted symbol for toxicity. The chemical substance X causes blindness to human beings on its exposure to the concentration of more than 10 parts per billion, while the substance Y affects in the similar way but on its exposure to the concentration more than 1 million parts per billion. Then which out of the two, X or Y, should be chosen for the chemical synthesis as per green chemistry rules? Give reasons for your answer. (5,5,5)