Total number of printed pages–15

3 (Sem–6/CBCS) CHE HE 1/2/3

2024

CHEMISTRY

(Honours Elective)

Answer the Questions from any one Option.

OPTION–A

(Green Chemistry)

Paper : CHE–HE–6016

OPTION–B

(Industrial Chemicals and Environment)

Paper : CHE–HE–6026

OPTION–C

(Inorganic Materials of Industrial Importance)

Paper : CHE–HE–6036

Full Marks : 60

Time : Three hours

The figures in the margin indicate full marks for the questions.

Contd.

OPTION–A

(Green Chemistry)

Paper : CHE–HE–6016

1. Answer ***any seven*** questions as directed : 1×7=7

   (a) Define atom economy.

   (b) What are designer solvents ?

   (c) In the green synthesis of catechol _____ is used as biocatalyst. *(Fill in the blank)*

   (d) Use of biodiesel is best related to which principle of Green Chemistry ?

   (i) Use of safer chemicals

   (ii) Use of renewable feedstocks

   (iii) Use of catalyst

   (iv) Use of safer fuels

   (e) What is 'Carbon neutral balance' ?

   (f) Give example of an ionic liquid.

   (g) What is supercritical carbon dioxide ?

   (h) How can ultrasound act as an alternative to conventional energy with its chemical effect ?

   (i) What is Green Fries rearrangement ?

2. Answer the following questions : ***(any four)*** 2×4=8

   (a) What do you mean by combinatorial green chemistry ? Give an example.

   (b) Explain the working principle of phase transfer catalysis with an example.

   (c) Name the rearrangement reaction involved in green synthesis of paracetamol. Write the reaction.

   (d) What is Diels-Alder reaction ? Which principle of green chemistry does it fulfill ? Explain.

   (e) What is a solid-supported catalyst ? Explain its significance with an example.

3. Answer ***any three*** questions : 5×3=15

   (a) Discuss the principle of inherent safer design (ISD). How does it work for designing the green processes in industry ? Mention the advantage of green synthesis of paracetamol using titanium(IV) catalyst over the conventional methods ? 2+2+1=5

(b) What is the role of solvent in a chemical reaction ? How is the role fulfilled in solvent-free reaction ? What are the advantages of solvent-free synthesis ? Explain with suitable reactions 1+2+2=5

(c) How does the use of protection/de-protection group(s) reduce the atom economy of the reaction ? Explain using appropriate example.

(d) Give a greener replacement to the conventional synthesis of carbaryl insecticide that was used by Union Carbide, India. How is this method greener over the conventional method ? 3+2=5

(e) What is biocatalysis ? Give *two* relevant advantages and *two* limitations of biocatalysts used in chemical reactions.

(f) The Pollution Prevention Act, 1990 incepted by the US Environmental Protection Agency related to risk, exposure and hazard resulted a paradigm shift to Green Chemistry. Discuss.

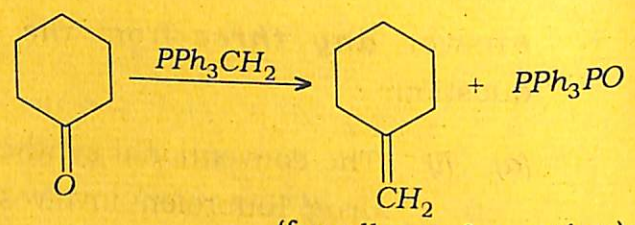
4. Answer ***any three*** from the following questions : 10×3=30

(a) (i) 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 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. 5

Or

Calculate the atom economy of the following reactions :

(a) $CH_3CH_2COOC_2H_5 + CH_3NH_2 \rightarrow CH_3CH_2CONHCH_3 + CH_3CH_2OH$ (for amide formation)

(b) 

(for alkene formation)

(ii) Elaborate sonochemical Simmons-Smith reaction. What are its *(any three)* advantages over conventional method? 5

(b) Discuss the twelve principles of Green Chemistry with suitable examples.

(c) (i) Give green synthetic method for the following : ***(any two)*** 2.5×2=5

BHT, Citral, Furfural

(ii) What are green reagents? Explain the use of dimethyl carbonate in selective methylation of active methylene compounds and solid state polymerization using diphenyl carbonate. 1+4=5

(d) (i) What is biodiesel? How is it synthesised? Mention the advantages and limitations of using biodiesel as an alternative fuel. 1+1+3=5

(ii) Give *one* method for synthesis of adipic acid from a suitable reactant by using a green oxidising agent. 5

(e) (i) What is biomimetic synthesis? Give an example. How is it different from biocatalysis? 1+2+2=5

(ii) Microwave-assisted reaction is suitable for polar medium. Illustrate with suitable example. 5

(f) (i) Free-radical bromination of toluene is conventionally done by using NBS/CCl_4. Mention the disadvantages of this method. How are these drawbacks minimised by using supercritical CO_2 in the green method. 5

(ii) Why is water called a universal solvent? Explain how water behaves differently at ordinary, near critical and supercritical conditions at different temperature and pressure. 2+3=5

(g) (i) What is 'CLAYAN'? Write the chemical reactions showing its use in the deprotection of dithianes and thioacetals. 2+3=5

(ii) Why tellurium has versatile applications in green chemistry? Write a short note on application of tellurium reagent in debromination of vic dibromides. 2+3=5

OPTION–B

(Industrial Chemicals and Environment)

Paper : CHE–HE–6026

1. Answer the following questions : 1×7=7

(a) Give *one* use of acetylene gas.

(b) Give an example of a ferrous metal.

(c) What is photochemical smog?

(d) What is the most common method to estimate NO_x in the laboratory?

(e) What is nuclear fusion?

(f) What is green chemistry?

(g) *CO* is a non-toxic gas. *(True/False)*

2. Answer the following questions : 2×4=8

(a) Give *two* uses of industrial hydrogen gas.

(b) How is bleaching powder produced industrially?

(c) What are CFCs? Mention *one* source of CFCs.

(d) Name *two* toxic metals that are used in tannery industry.

3. Answer **any three** questions : 5×3=15

(a) Write briefly about the industrial production of oxygen gas. Mention *one* use of the gas. 4+1=5

(b) Describe the Carbon cycle.

(c) Describe the methods for the estimation of NO_x.

(d) Describe *one* method for the purification of water for drinking purpose.

(e) Write a note on nuclear fission.

4. Answer **any three** questions : 10×3=30

(a) Describe with reactions how commercial sulphuric acid is prepared. Give *three* industrial uses of sulphuric acid. 7+3=10

(b) What is ozone layer? Discuss how anthropogenic activity is contributing to the depletion of the layer. What are the implications of ozone layer depletion? 2+6+2=10

(c) What are the various sources of water pollution? Describe *one* method to estimate water pollution. 5+5=10

(d) Write about industrial waste management. What is incineration of waste? Write about the water quality parameters for domestic water. 5+2+3=10

(e) (i) What is solar energy? How can solar energy be a renewable source of energy for a sustainable future? 5

(i) Write briefly about nuclear disaster management. 5

(f) What is biocatalyst? Discuss the importance of biocatalysts in green chemistry. 2+8=10

OPTION-C

(*Inorganic Materials of Industrial Importance*)

Paper : CHE-HE-6036

1. Answer the following questions : 1×7=7

   (a) Which halogen acid is used for etching in glass?

   (b) Name *one* nitrogeneous fertilizer.

   (c) Give the percentage composition of brass.

   (d) Give the full form of PETN.

   (e) Which catalyst is used in the manufacture of sulphuric acid by contact process?

   (f) Which emulsifying agent is present in milk?

   (g) What is the chemical name of RDX?

2. Answer the following questions : 2×4=8

   (a) Explain autocatalysis.

   (b) What is fuel cell?

(c) Discuss the explosive properties of $Pb(N_3)_2$?

(d) Give the general composition of glass.

3. Answer the following questions : ***(any three)*** 5×3=15

(a) Discuss the manufacture of ammonium nitrate fertilizer.

(b) Explain the working of Li battery.

(c) What do you mean by phase transfer catalyst ? Explain properly.

(d) Write a note on eco-friendly paints.

(e) What are high technology ceramics ? Give their applications. 2+3=5

4. Answer the following questions : ***(any three)*** 10×3=30

(a) Write short notes on : 5+5=10

(i) Borosilicate glass

(ii) Photosensitive glass

(b) How is cement manufactured ? Discuss the chemistry involved in the setting process of cement. 6+4=10

(c) How is steel manufactured from cast iron ? Explain with necessary reactions. What do you mean by desulphurization of steel ? 7+3=10

(d) Give the characteristic properties of catalyst. Explain homogeneous and heterogeneous catalysis reactions. 4+3+3=10

(e) What are rocket propellants ? Discuss different types of rocket propellants. Explain the origin of explosive properties in organic compounds. 2+4+4=10

(f) Give the formulation, composition and related properties of paint and pigments.

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