



**Important  
Instructions**

- There are FIVE questions printed in the question paper
- Answer all questions in the answer booklet only
- DO NOT use pencils for answering any part, even graphics
- Start answering each question from a fresh page, all sub-sections together

**Q1.** (a) (i) Describe briefly the functioning of TOMS apparatus. (ii) Write the working principle of XRF spectrometer.

(b) (i) What is the ideal fuel/ air ratio for a four cycle engine? (ii) What happens to the HC emissions if the ratio is made more lean? (iii) What happens to the NO<sub>x</sub> emissions if the ratio is made more rich? (iv) What happens to the fuel economy if the ratio is made more lean? (2+4)+(3+2+2)=15

**Q2.** (a) Describe the geological features of a petroleum oil and gas field.

(b) Discuss the salient features of petroleum refining process along with a schematic.

(c) (i) Describe what do you understand by the terms 'nuclear breeder reactor' (ii) The half-life of barium-131 is 12 days. How many grams of barium-131 will remain after 30 days if you begin with 100 g? (iii) Which parameter is plotted in the abscissa in a gas chromatograph? What is the identifier obtained as an outcome of a GC analysis for a compound in a mixture? 3+4+(3+3+2)=15

**Q3.**(a) (i) Name and briefly describe the different stages of LCA? (ii) How is early biorefinery concept different from modern biorefinery concept? (iii) Explain how catalysis plays a pivotal role in obtaining sustainability by implementing green chemistry targets.

(b) What is the steady-state accumulation of methylmercury in a person who eats 500 g of tuna daily that contains 0.2 ppm of methylmercury ( $t_{1/2}$  is 70 days)?

(c) Describe the functioning of ICP-OES instrument including the essential events and chemical reactions. (4+2+2)+4+3=15

**Q4.** (a) How does arsenite ion acts as a potent poison? Explain using appropriate chemical reaction(s).

(b) Describe the different classes of chemical communicating agents used as alternative methods of insect control

(c) (i) How is octanol/water partition coefficient ( $K_{ow}$ ) useful in determining pollution by organic molecules? (ii) Arrange the 'log  $K_{ow}$ ' values for DDT, aldrin, chlordane, dieldrin, and 1,4-dichlorobenzene in decreasing order 4+7+(2+2)=15

**Q5.** (a)(i) Describe the functioning of ECD in a gas chromatography instrument. (ii) What do you understand by the term PM<sub>10</sub>? (iii) What is thermogenic methane and how is this identified? (iv) What do you mean by leapfrog technology?

(b) Discuss the differences between the pyrolysis and gasification of biomass to obtain chemicals sustainably

(c) Write short notes on Oil Shale and Tar Sands (mention two points on each) (3+2+2+2)+2+4=15

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