



University School of Automation and Robotics  
GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY  
East Delhi Campus, Surajmal Vihar  
Delhi - 110092



Paper Code : BS104  
Name of the Paper : Engineering Chemistry- II  
Semester : II

**Time : 60 minutes (+15 minutes extra for uploading)**

**Maximum Marks : 30**

**Instructions for Candidates**

1. Write your Enrollment number, Name, Program, Subject and page number on each A4 sheet.
2. Soft copy of the answer sheet has to be uploaded as a single PDF file.
3. **Section A is compulsory. Attempt any 2 questions from Section B.**

**SECTION A**

**This section is compulsory.**

**10 marks**

(Atomic masses of Na=23, Mg= 24, O=16, C= 12, Ca=40, Fe=56, Cl=35.5, S=32 a.m.u.)

**Q 1 (a)** Distinguish between permanent and temporary hardness of water. How can temporary and permanent hardness of water be removed? **2 marks**

**(b)** A sample of water is found to contain following analytical data in milligrams per litre  $\text{Mg}(\text{HCO}_3)_2 = 14.6$ ,  $\text{MgCl}_2 = 9.5$ ,  $\text{MgSO}_4 = 6.0$ ,  $\text{Ca}(\text{HCO}_3)_2 = 16.2$  and  $\text{NaCl} = 5.0$ . Calculate temporary, permanent and total hardness of water in parts per million (ppm) and Degree French. **2 marks**

**Or**

1 g of  $\text{CaCO}_3$  was dissolved in dil. HCl and diluted to 500 ml of water. 50 ml of this solution required 27 ml of EDTA solution for the titration. 50 ml of a hard water sample required 20 ml of same EDTA solution for titration. Calculate the total hardness of a water of the given water sample. **2 marks**

**(c)** Define calorific value of a fuel. Differentiate between gross and net calorific values.

**1 mark**

(d) Explain bomb-calorimeter with its principle and working. **2 marks**

**Or**

On burning 0.96 g of a fuel in a bomb calorimeter, the temperature of 4400 g of water increased from 25.1 °C to 29.7 °C; water equivalent of calorimeter and latent heat of steam are 484 and 587 cal/g, respectively. Fuel contains 0.9% H, calculate gross calorific value and net calorific value. **2 marks**

(e) Explain the following terms (**any three**): **3 marks**

- (i) Chromophores
- (ii) Auxochromes
- (iii) Bathochromic shift
- (iv) Hypsochromic shift
- (v) R-band

### **SECTION B**

**This section contains 3 questions: Q2, Q3 and Q4. Attempt any 2 questions. **20 Marks****

**Q 2 (a)** Calculate the amount of soda and lime required for the softening of 65,000 litres of hard water containing:

MgCO<sub>3</sub> = 192 ppm; CaCO<sub>3</sub> = 37 ppm; CaCl<sub>2</sub> = 105 ppm; MgCl<sub>2</sub> = 100 ppm; NaCl = 18 ppm; Na<sub>2</sub>SO<sub>4</sub> = 26 ppm; Fe<sub>2</sub>SO<sub>4</sub> = 20 ppm. **2 marks**

**(b)** How can cation and anion exchange columns be regenerated in an ion-exchanger process? What are the advantages and disadvantages of ion-exchanger method? **2 marks**

**(c)** Give the composition of:

- (i) Natural gas
- (ii) Producer gas
- (iii) Water gas

Which of the above has the highest calorific value? **2 marks**

**Or**

What are conventional and non-conventional sources of energy?

**(d)** Predict the electronic transitions involved in the following compounds: **2 marks**

- (i) Methyl chloride
- (ii) Methyl alcohol
- (iii) Acetone
- (iv) Methane

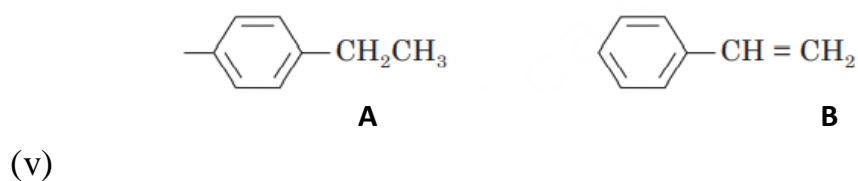
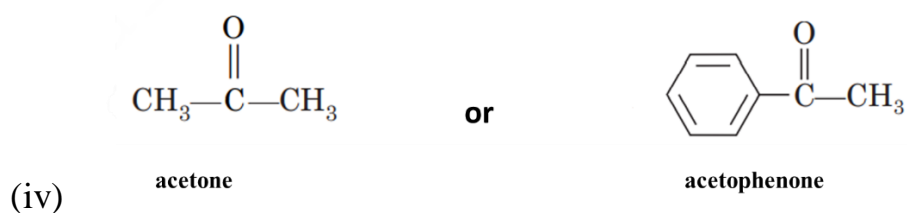
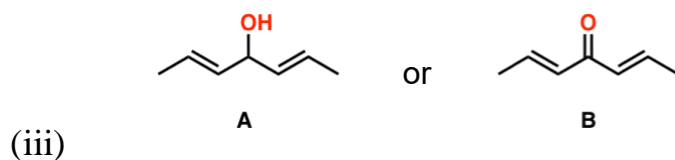
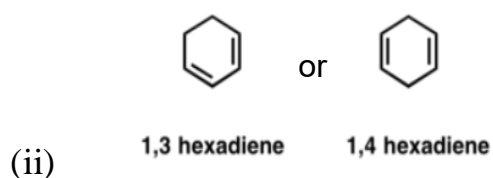
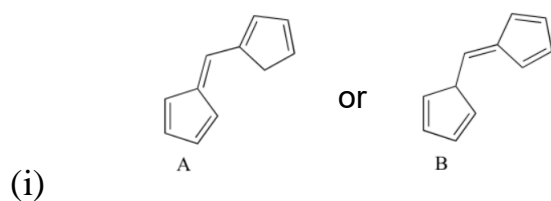
**(e)** Name a compound which contains sigma (σ), pi (π) and n-electrons. **1 mark**

(f) Conjugated systems tend to absorb in the visible region because:

**1 mark**

- (i) Electrons are coloured
- (ii) Overlapping  $\pi$  orbital increased the energy gap b/w orbitals
- (iii) Overlapping  $\pi$  orbital reduced the energy gap b/w orbitals
- (iv) 100% transmittance occurs

**Q 3 (a)** Which of the following compounds would exhibit UV absorption peak at longer wavelength? Explain your answer. (**Any Four**) **2 marks**



(b) A coal sample was analysed as follows: 3 g of coal was weighed in silica crucible. Upon heating for 1 hour at 110 °C, the residue was weighed to be 2.956 g. The crucible was then covered with a lid and strongly heated at 1000 °C for 7 minutes. The residue was weighed to be 1.678 g. Then the crucible was heated without cover until a constant weight to 0.345 g was obtained. From the above data, calculate the proximate analysis of coal. **3 marks**

(c) Name the lamps widely used as a source of light (both UV & Visible) in UV-Vis spectrophotometer. Give the wavelength range of UV and visible regions.

**Or**

Explain Lambert-Beer's Law.

**2 marks**

(d) What is caustic embrittlement? How can it be prevented (three ways)?

**3 marks**

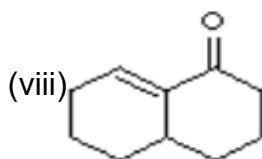
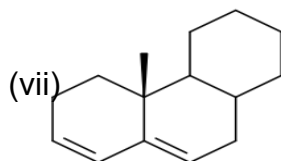
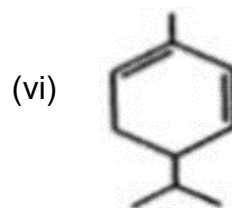
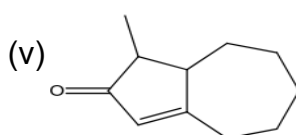
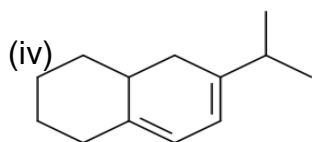
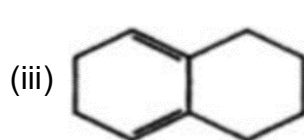
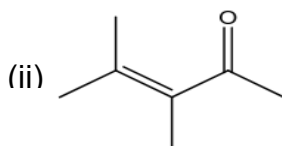
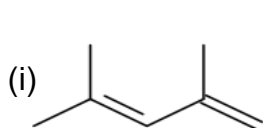
**Or**

Name the gases dissolved in water that causes corrosion. How they can be removed?

**Or**

How are scales and sludge formed in boilers? What are their disadvantages? How can their formation be prevented?

**Q 4 (a)** Using Woodward-Fieser's rule, calculate wavelengths of maximum UV absorption for following compounds: **(any 5)** **5 marks**



**Or**

(I) Comment on following statements:

**3 + 2 marks**

(i) Less energy is only required for a  $\pi \rightarrow \pi^*$  of 1,3-butadiene than similar transition in ethene.

(ii)  $\lambda_{\max}$  for methyl chloride of 173 nm and that of methyl iodide is 258 nm

(II) The absorption coefficient of a glycogen-iodine complex is 0.20 at light of 450 nm. What is the concentration when the transmission is 40 % in a cuvette of 2 cm?

**Or**

Discuss the principle and complete working of UV spectroscopy.

**5 marks**

(b) Differentiate between the following term (**any three**)

**3 marks**

- a) Thermal and Catalytic Cracking
- b) Proximate and Ultimate Analysis of Coal
- c) Phosphate conditioning and Calgon conditioning
- d) Octane and cetane number
- e) Priming and foaming
- f) Hot lime and cold lime soda process

(c) What are the correction factors taken into account while calculating the calorific values of a fuel using bomb calorimeter?

**2 marks**