



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 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:

MgCO₃ = 192 ppm; CaCO₃ = 37 ppm; CaCl₂ = 105 ppm; MgCl₂ = 100 ppm; NaCl = 18 ppm; Na₂SO₄ = 26 ppm; Fe₂SO₄ = 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

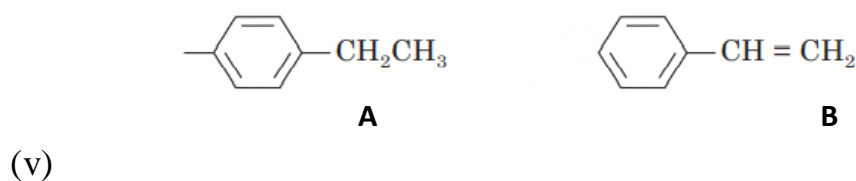
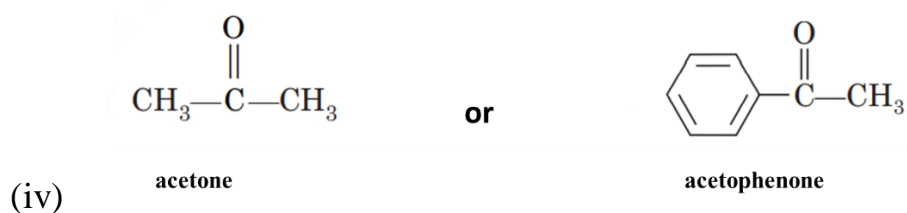
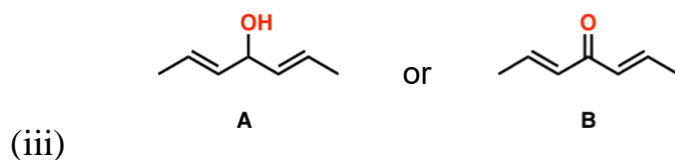
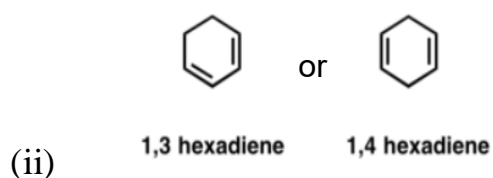
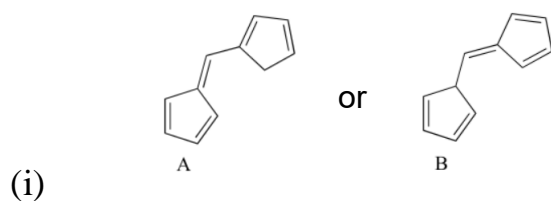
(f) Conjugated systems tend to absorb in the visible region because:

1 mark

- (i) Electrons are coloured
- (ii) Overlapping π orbital increased the energy gap b/w orbitals
- (iii) Overlapping π 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

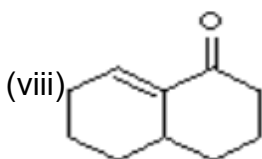
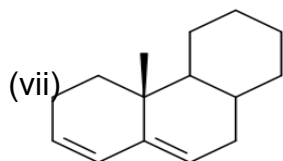
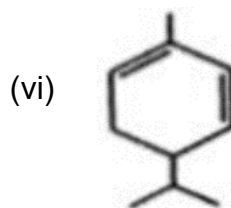
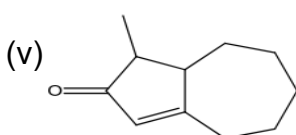
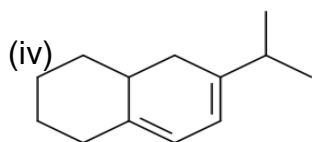
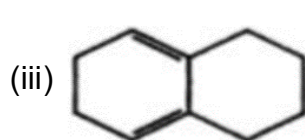
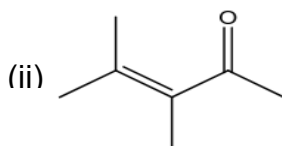
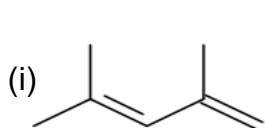
Or

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) λ_{\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