

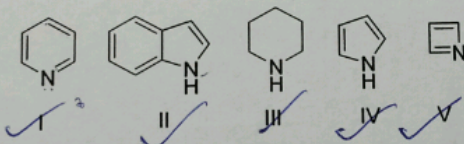


- KEEPING MOBILE PHONE/ELECTRONIC DEVICES EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
 ➤ DON'T WRITE ANYTHING ON THE QUESTION PAPER

Answer any **TEN** Questions

(10 X 10 = 100 Marks)

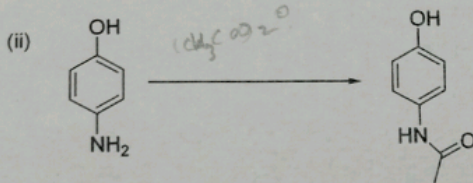
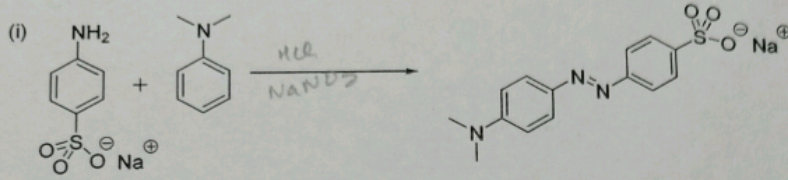
1. a) Analyze the conditions for chemical reactions of spontaneity, non-spontaneity and equilibrium processes in terms of changes in enthalpy, entropy, free energy and temperature. [5]
- b) Ammonia is an important industrial chemical that is prepared from a specific method. Identify the catalyst involved and the principal mechanism associated with the method. [5]
2. From the conceptual understanding of metal complex stability and metals in biological system, write the significance of the following with appropriate examples: a) Spectrochemical series, and b) Role of iron in hemoglobin, c) Role of Mg in chlorophyll. [5+5]
3. Identify the aromatic, antiaromatic, and nonaromatic compounds from the following species with proper explanation.



4. In the evolution of energy storage systems, alkali metals play a vital role. Delineate the importance of lithium ion secondary battery and its mechanism of operation with a neat diagram in the energy discharge-recharge process.
5. Generally, polyacetylene is a less conductive. How can you convert it into highly conductive polymer and elaborate on the mechanism of conduction.
6. Explain in detail with their diagrams on the working principle and instrumentation of UV-Visible absorption spectrophotometer.
7. Describe and compare the hardness removal processes of water by zeolite and ion-exchange method.
8. a) Calculate the work done by 8 moles of an ideal gas expanding reversibly and isothermally; from a pressure of 8 atm to 3 atm at temperature 305 K. [5]
- b) With the given data below, calculate the half-life of a reaction if it follows first – order kinetics. 4.2g of a substance decomposes for 41 minutes, the mass of unreacted substance remaining is found to be 0.295g. [5]

9. Calculate the crystal field splitting energy of a metal with seven 'd' electrons under high and low spin conditions and explain the possibility of $[\text{Ni}(\text{X})_4]^{2-}$ to acquire (a) tetrahedral and (b) square planar geometry. Also mention the hybridization pattern and magnetic properties under each case. [5+5]

10. Establish the condition for the following reactions with appropriate reaction mechanisms. [5+5]



11. a) What is Solid Oxide Fuel Cell (SOFC)? Explain the anode, cathode, and net reactions with a diagram. [5]

b) Find the emf of a cell in which the following cell reaction takes place, $\text{Ni}(s) + 2 \text{Ag}^+ (0.001\text{M}) \longrightarrow \text{Ni}^{2+} (0.001\text{M}) + 2\text{Ag}$ Given $E^\circ_{\text{cell}} = 1.05\text{V}$ and $2.303\text{RT}/\text{F}$ is 0.059 at 298 K. [5]

12. a) Elaborate with appropriate diagrams on cathodic protection of metal against corrosion. [5]

b) On burning 0.58 g of a solid fuel in a bomb calorimeter, the temperature of 5,300 g of water increased from 28.5 °C to 35.5 °C. Water equivalent of calorimeter and latent heat of steam are 385.0 g of and 587.0 cal/g respectively. If the fuel contains 2.5% hydrogen, calculate its gross and net calorific values. [5]

⇔⇔⇔ O/E/TX ⇔⇔⇔

calorific value
Anode → Cu
Cathode → Zn

$[\text{Ni}(\text{X})_4]^{2-}$
 $n = 4 = -2$
NCV = GCV - 0.09 H × 9