Q. 1: Select and write the most appropriate answer from the given alternatives for each sub-
question:
(i) The enthalpies of all elements in their standard states are ........ . (1)
(a) less than zero (b) zero (c) unity (d) greater than unity
(ii) A conjugate acid-base pair differs by ........... . (1)
(a) one electron (b) one neutron (c) one proton (d) one electron pair
(iii) The unit of electrochemical equivalent is ............... . (1)
(a) gram (b) coulomb gram⁻¹ (c) gram amp⁻¹ (d) gram coulomb⁻¹
(iv) The minimum amount of fissionable material required to continue the chain reaction is called
............. . (1)
(a) fission mass (b) critical mass (c) active mass (d) atomic mass
(v) In a zero order reaction, the rate of reaction is independent of .............. . (1)
(a) concentration of products (b) catalyst (c) concentration of reactants (d) temperature
(vi) The chemical formula of willemite is ........... . (1)
(a) ZnS (b) ZnCO₃ (c) ZnO (d) Zn₂SiO₄
(vii) The volume of water to be added 0.1 dm³ of 0.5 N H₂SO₄ to get decinormal solution is ....... . (1)
(a) 0.1 dm³ (b) 0.4 dm³ (c) 0.45 dm³ (d) 0.5 dm³
(viii) The enthalpy change for combustion of methane is − 890 kJ/mol. What is the amount of heat
liberated on combustion of 8 × 10⁻³ kg of methane? (1)
(Given: Atomic weights C = 12, H = 1)
(a) − 890 kJ (b) − 445 kJ (c) + 445 kJ (d) + 890 kJ

Q. 2 (A) Attempt any ONE: 
(i) Derive an expression for the effect of temperature on the heat of reaction at constant pressure. (2)
(ii) Define : (a) Solubility product (b) Corrosion. (2)

Q. 3 (A) Answer any ONE: 
(i) Describe Landsberger and Walker method for determination of molecular weight from
boiling point elevation. (3)
(ii) Define isotopes. Explain the use of radio-isotope in carbon dating. (3)

Q. 4 (A) Answer the following: 
(i) Define : (i) Enthalpy. (ii) Molar heat capacity at constant volume. (2)
(ii) Derive an integrated rate equation for the first order reaction. (3)
(iii) Define single electrode potential. Explain Nernst theory of electronation and de-electronation
with suitable example. (4)

Q. 5 (A) Attempt any ONE: 
(i) Calculate the heat of formation of sucrose from the following data:
(1) C₆H₁₂O₆(s) + 12O₂(g) → 12CO₂(g) + 11H₂O(l) ΔH₁ = − 5835.16 kJ
(2) \( \text{C}_4\text{H}_6 + \text{O}_2 \rightarrow \text{CO}_2\text{H}_2; \Delta H_f = -394.96 \text{ kJ} \)

(3) \( \text{H}_2\text{O} + \frac{1}{2} \text{O}_2 \rightarrow \text{H}_2\text{O}_2; \Delta H_f = -286.18 \text{ kJ} \)

(ii) The pH of decimolar solution of \( \text{NH}_4\text{Cl} \) is 5.1276. Calculate \( K_w \), \( h \) and \( K_a \) for same solution.

(Given: \( K_w = 1 \times 10^{-14} \))

(B) Answer any TWO:

(i) Calculate mass defect and binding energy per nucleon of \( ^{58}\text{Co} \) if the isotopic mass of cobalt is 58.997 a.m.u.

Given:
- Mass of Proton = 1.0078 a.m.u.
- Mass of neutron = 1.0086 a.m.u.

(ii) Calculate the amount of electricity required to reduce all silver ions from 1 dm\(^3\) of 0.25 M silver nitrate solution. (At. Wt.: \( \text{Ag} = 108, \text{N} = 14 \) and \( \text{O} = 16, 1\text{F} = 96500 \text{C} \))

(iii) \( 1 \times 10^{-3} \) kg of non-volatile substance, when dissolved in 5.05 \( \times 10^{-2} \) kg of benzene, freezing point of the solvent was lowered by 0.4 K. If the freezing point depression constant of benzene is 5.12 K. kg. mol\(^{-1}\), calculate molecular mass of the solute.