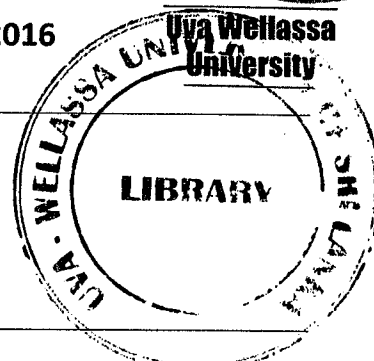


Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Science and Technology
200 Level Second Semester Examination – Jan/Feb 2016
SCT 233-1 Physical Chemistry



Instructions to candidates

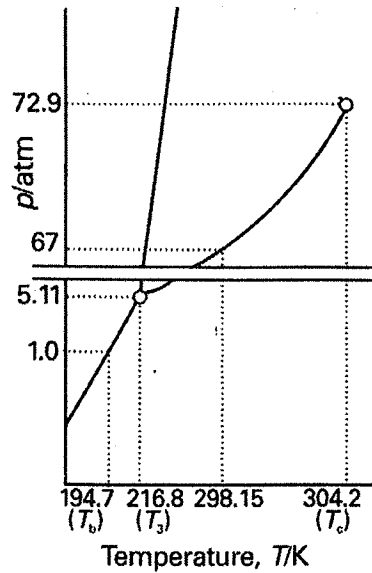
Duration: One (01) hour

Number of questions: Two (02)

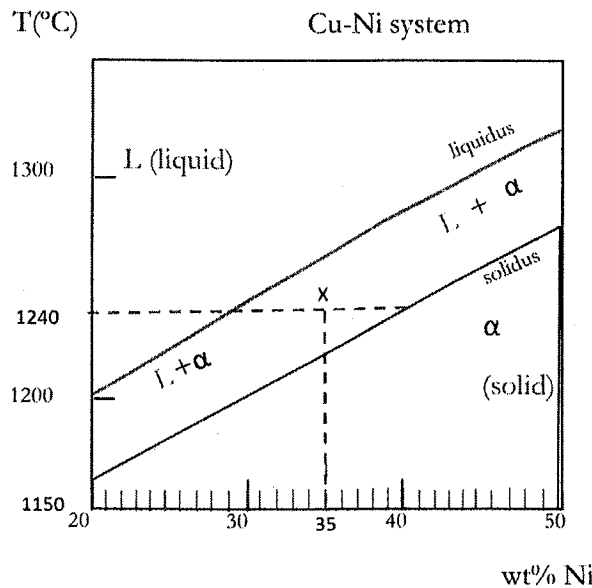
Mark allocation: 100 marks

1. a. What is the main difference between Helmholtz vs. Guoy-Chapman model about electrode solution interface? Plot how the variation of electrode potential with distance across the electrode solution interface for the above models. (5 marks)
- b. Write reduction half reactions for following electrodes
- Hg(l) | Hg₂Cl₂(saturated), KCl(saturated)
 - Pt(s) | H₂(g) | H⁺(aq) (5 marks)
- c. i. Explain the AgCl/Ag reference electrode using an appropriate diagram.
ii. Write reduction half reaction of the AgCl/Ag electrode
iii. Calculate the electrode potential of the AgCl/Ag electrode in 0.0500 M NaCl solution.
($E^0_{AgCl/Ag} = 0.222 \text{ V}$) (10 marks)
- d. An electrochemical cell was devised to precipitate copper ions in acidic solution. The initial concentration of copper ions is 0.010 M and solution has pH=4. The net reaction is given below.
 $2\text{Cu}^{2+}(\text{aq}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{Cu}(\text{s}) + \text{O}_2(\text{g}) + 4\text{H}^+(\text{aq})$
- Write the reduction half reactions of two redox couples present in this solution. (5 marks)
 - Calculate the electrode potentials of above two electrodes.
($E^0_{\text{Cu}^{2+}/\text{Cu}} = 0.337\text{V}$, $E^0_{\text{O}_2/\text{H}_2\text{O}} = 1.229\text{V}$) (10 marks)
 - Calculate the overall electrochemical cell potential assuming reaction proceeds according to the forward direction. Indicate whether the forward reaction is spontaneous or not. (5 marks)
 - If a constant current of 0.800A is used to deposit copper, calculate the number of grams of copper deposited after 10 minutes of electrolysis.
(Faraday constant = 96485C, Cu = 63.55 g/mol) (10 marks)
2. a. State Gibbs Phase rule. Indicate how many components, phases and degree of freedom when blue CuSO₄ is heated to remove water (5 marks)
- b. The following is the phase diagram for pure CO₂. Copy the diagram to your answer book and indicate,
- solid, liquid, and gas phases
 - triple point
 - critical point (6 marks)
- iv. Using above phase diagram explain how CO₂ at high pressure is used as a fire extinguisher. (4 marks)

CO₂ phase diagram



- c. Draw phase diagrams for following under constant pressure conditions and label regions. (15 marks)
- Two component ideal liquid-vapour temperature vs. composition diagram in which boiling point of A is greater than component B
 - Two component high boiling azeotropic mixture, liquid-vapour temperature vs. composition diagram in which boiling point of B is greater than component A
- d. A part of the phase diagram for Cu-Ni system is given below. Use the information given in this phase diagram to answer following questions.



- At 1240°C temperature and 35% Ni composition, find the composition of Ni at liquid phase and solid phase. (5 marks)
- Calculate the percentage (%) of liquid and solid phases at 1240°C and 35% Ni composition. (10 marks)
- Draw changes in morphology of mixture, if 35% Ni composition is cooled from 1300°C to 1150°C (5 marks)