



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
END OF FIRST SEMESTER EXAMINATIONS – DECEMBER 2004
PHYSICAL CHEMISTRY FOR TXT - SCH 1122
TIME: (3) THREE HOURS

INSTRUCTIONS TO CANDIDATES

Answer Two questions from Section A and Two questions from Section B.

Answer each Section on a separate answer sheet.

SECTION A

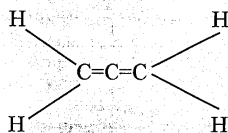
1. (a) Derive the 1st Law of Thermodynamics and explain each term involved. (15 marks)
- (b) Explain fully the Zeroth Law of Thermodynamics. (10 marks)
2. (a) Calculate the osmotic pressure of a sucrose solution of concentration 0.10dm³mol at 303K. The molecular weight of sucrose is 342.3g/mol. (10 marks)
- (b) The emf of the cell Ag/AgCl(s)/HCl(aq)/Hg₂Cl₂/Hg is 0.0421V at 298K and 0.0489V at 308K. Use this information to estimate ΔG, ΔS and ΔH for the cell reaction.
2Ag + Hg₂Cl₂ → 2AgCl + 2Hg at 298K (15 marks)
3. (a) There is need to heat 1 mol of air from 200°C to 700°C at 1 atm pressure. Determine the heat required?
C_p between 25°C and 200°C is 29.39kJ/Kmol
C_p between 25°C and 700°C is 30.71kJ/Kmol (15 marks)
- (b) Determine the standard heat of formation for the following reactions:
 - (i) HCl(g) + NH₃(g) → NH₄Cl(s)
 - (ii) 2FeS₂(s) + 11/2O₂(g) → Fe₂O₃(s) + 4SO₂(g)

Component	ΔH _f ^o kJ/mol
HCl(g)	-92.3557
NH ₃ (g)	-46.2134
NH ₄ Cl(s)	-315.541
FeS ₂ (s)	-177.989
O ₂ (g)	0
FeO ₃ (s)	-822.549
SO ₂ (g)	-297.039

(10 marks)

SECTION B

4. (a) List at least five (5) rules of hybrid construction. (10 marks)
- (b) The allene molecule C_3H_4 has the line structure shown below:



What hybridization is required for the central carbon atom? For terminal carbon atoms, draw an orbital bonding diagram for the molecule showing why the four hydrogen atoms are not all in the same plane. (15 marks)

5. A light beam irradiates simultaneously the surface of two metals A and B. At wavelength λ_1 , electrons are ejected only from metal A. At wavelength λ_2 , metals A and B eject equal numbers of photons. Consequently,
- (a) The wavelength λ_1 is (shorter, longer) than λ_2 .
- (b) Electrons need more energy to escape metal (A,B)
- (c) Under λ_2 irradiation, the kinetic energy of electrons emitted from A is (greater, less) than the kinetic energy of electrons from B.
- (d) Electrons emitted from A have the greater kinetic energy when produced by (λ_1, λ_2) light. (25 marks)
6. (a) In general, the first ionization energies increase as we go across the second period. Why?
- (b) Why does the Helium atom, with 2 electrons have a smaller radius than that of hydrogen and that of the lithium atom so much larger than that of the hydrogen atom?
- (c) Write the complete ground state electronic configuration of the first three members of the nitrogen family (N, P, As), showing all unpaired electrons underline the parts responsible for their similarity in chemical behaviour.

(25 marks)

END OF QUESTION PAPER!!!!