EASTERN UNIVERSITY, SRI LANKA
SECOND EXAMINATION IN SCIENCE
EXTERNAL DEGREE (2004)
EXCH 203 BORON CHEMISTRY, SILICATES AND PHASE RULE

Time: 02 hours

Answer four questions only

1. Answer all the parts
   (a) (i) Boranes are classified into four structural groups. Give the names of these groups and briefly explain any three types with suitable diagrams, considering their structure and formation.
   (ii) Classify the following boranes into their structural groups according to the formula.
   $B_5H_8^-$, $B_{10}H_{14}^{2-}$, B_4H_{10}, $B_6H_6^{2-}$, $B_2H_7^-$, B_5H_9
   (b) Discuss the bonding in the following compounds
   (i) $B_5H_5^{2-}$ (ii) $C_2B_4H_6$

2. Answer all the parts
   (a) Derive the "styx" number for the borane B_5H_{11}, indicating the equations and rules clearly.
   (b) Show by means of equations how the following transformations could be effected via organometallic intermediates.

   (i) $CH_3-CH=CH_2 \longrightarrow CH_3-CH_2-CH_3$

   (ii) $B_3N_3H_6 \longrightarrow [BNH(NHR)]_3$

   (c) (i) Discuss the structure and nature of bonding in borazine.
   (ii) Give one method for the preparation of borazine in the laboratory.
   (iii) Write balanced equations to show the reactions of $(BNHCl)_3$ with MeMgBr, H_2O and $LiAlH_4$.

3. Answer all parts.
   (a) Silicate minerals are classified according to the linkage pattern of SiO_4^{4-} tetrahedral units. List the types of minerals by giving schematic structure, general formula and an example for each.
   (b) Name the types of 3-D silicate. Briefly explain each of them.

4. a) What are the symmetry elements present in the following molecules?

i)  ii) BF_3 iii) C_2H_4 iv) $PtCl_4^{2-}$

b) i) What are the Miller indices for the planes having the following intercepts in a simple cubic cell?

I) a, b, c II) α a, b, α c III) a/2, α b, c/2.

ii) Draw a schematic diagram for each of the above planes.

c) Potassium crystallizes with body centered cubic lattice and has the density $0.856 g/cm^3$. The length of unit cell is 5.64 Å. (K=39)

i) Draw a schematic diagram of body centered cubic (BCC) unit cell.

ii) How many Potassium atoms are found in a BCC unit cell?

iii) Calculate the Avogadro number.

5. a) State the Gibb's phase rule and explain all the terms in it.

b) Define the following terms.

i) Component ii) Phase iii) Triple point

c) What are the number of components, phases and degrees of freedom in each of the following equilibria?

i) Thermal decomposition of Magnesium Carbonate

ii) Ice-water –vapor system.

d) Draw the phase diagrams of binary liquid mixtures which cannot be separated into pure component using fractional distillation.

e) Explain the term **minimum boiling point** and give an example.

6. Answer **three** of the following parts.

a) Define the terms **Congruent and Incongruent melting points and eutectic point.**

b) Construct the phase diagram for $FeCl_3.H_2O$ system which forms compounds $FeCl_3.3^1/_2H_2O$ ($Fe_2Cl_6.7H_2O$), $FeCl_3.6H_2O$, $FeCl_3.2^1/_2H_2O$ ($Fe_2Cl_6.5H_2O$) and $FeCl_3.2H_2O$ on cooling.
Assume that the melting points of compounds decrease in the following order.
100% $FeCl_3$> $FeCl_3.2H_2O$> $Fe_2Cl_6.5_2O$> $FeCl_3.6H_2O$> $Fe_2Cl_6.7H_2O$>100% H_2O.

c) In a three component system, a point "**P**" has the composition X_A=0.50, X_B=0.10 and X_C=0.40. Draw a labeled phase diagram and show the point "**P**".

d) Draw a cooling curve for an ideal mixture of known composition and explain the cooling behavior.

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