# EASTERN UNIVERSITY, SRILANKA

## SECOND EXAMINATION IN SCIENCE 1994/ 95 (AUGUST/SEPT. 1997)

### BORON CHEMISTRY, SILICATES , PHASE RULE AND

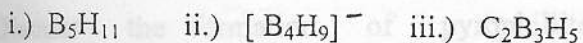### X-RAY CRYSTALLOGRAPHY (CH 203)

Time : 02 Hours

Answer **four** questions only.

1.) Answer **all** the parts.

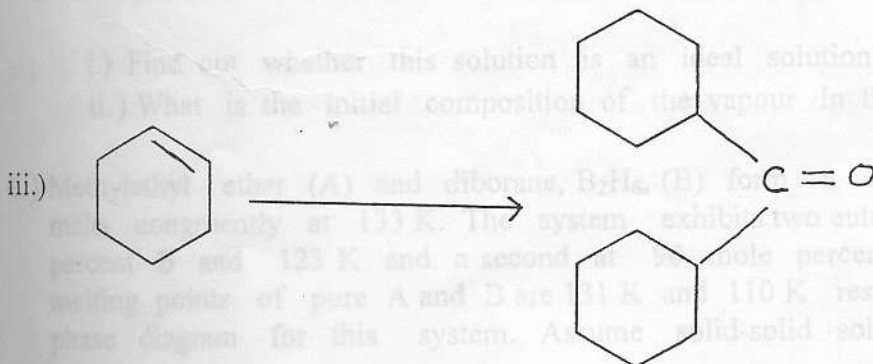a.) Discuss the type of bonding and structures of the following boron compounds using Wade's rule.

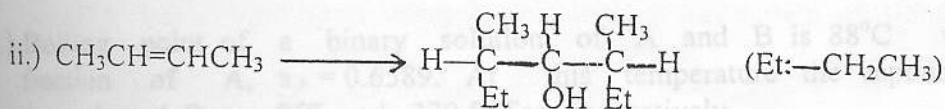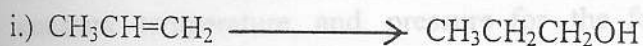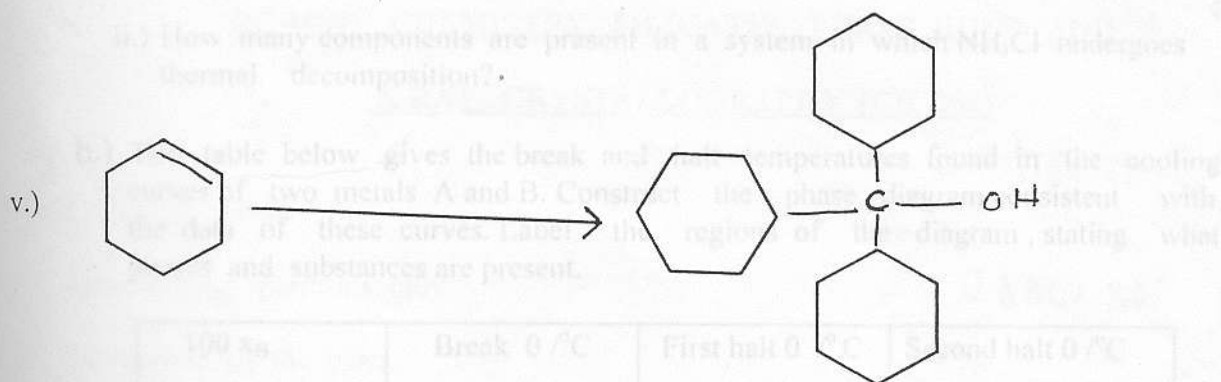   i.) $B_5H_{11}$    ii.) $[B_4H_9]^-$    iii.) $C_2B_3H_5$

b.) i.) Derive the styx number for $B_2H_6$.

   ii.) Draw the schematic diagram corresponding to styx number.

2.) Answer **all** the parts

How can the following transformations be effected through organo- metallic intermediate/ intermediates.

   i.) $CH_3CH=CH_2 \longrightarrow CH_3CH_2CH_2OH$

   ii.) $CH_3CH=CHCH_3 \longrightarrow$
$$H-\overset{CH_3}{\underset{Et}{C}}-\overset{H}{\underset{OH}{C}}-\overset{CH_3}{\underset{Et}{C}}-H \qquad (Et:-CH_2CH_3)$$

   iii.)



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iv.)

v.)
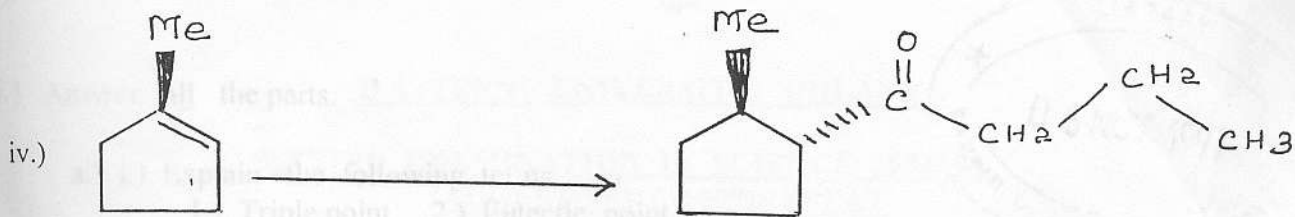
3.) a.) Discuss the structure of Talc $Mg_3(OH)_2(Si_4O_{10})$ and explain why it is extremely soft and it is used as a lubricant.

b.) Discuss the formation of pyrophillite $(Al_2O_3.4SiO_2.H_2O)$ and phlogopite $(K_2O. 6MgO. Al_2O_3. 6SiO_2. H_2O)$ from Talc.

c.) Discuss the structure of mica (Mucovite) and explain why mica being split into thin slices.

4.) Answer all the parts.

a.) State the phase rule and explain all the terms in it.
What is the maximum number of phases that can be in equilibrium at constant temperature and pressure for the following systems.

i.) One, ii.) Two, iii.) Three, component systems.

b.) Boiling point of a binary solution of A and B is 88°C when a mole fraction of A, $x_A = 0.6589$. At this temperature the vapour pressures of pure A and B are 957 and 379.5 Torr respectively.

i.) Find out whether this solution is an ideal solution or not.
ii.) What is the initial composition of the vapour in the system.

c.) Methylethyl ether (A) and diborane, $B_2H_6$, (B) form a compound AB that melts congruently at 133 K. The system exhibits two eutectics, one at 25 mole percent B and 123 K and a second at 90 mole percent B and 104 K. The melting points of pure A and B are 131 K and 110 K respectively. Sketch the phase diagram for this system. Assume solid-solid solubility is negligible.

5.) Answer all the parts.

a.) i.) Explain the following terms
 1.) Triple point 2.) Eutectic point

ii.) How many components are present in a system in which $NH_4Cl$ undergoes thermal decomposition?

b.) The table below gives the break and halt temperatures found in the cooling curves of two metals A and B. Construct the phase diagram consistent with the data of these curves. Label the regions of the diagram, stating what phases and substances are present.

| 100 $x_B$ | Break θ/°C | First halt θ/°C | Second halt θ/°C |
|---|---|---|---|
| 0.0 | | 1100 | |
| 10.0 | 1060 | 700 | |
| 20.0 | 1000 | 700 | |
| 30.0 | 940 | 700 | 400 |
| 40.0 | 850 | 700 | 400 |
| 50.0 | 750 | 700 | 400 |
| 60.0 | 670 | 400 | |
| 70.0 | 550 | 400 | |
| 80.0 | | 400 | |
| 90.0 | 450 | 400 | |
| 100.0 | | 500 | |

6.) Answer all the parts.
a.) Derive the Bragg's equation.

b.) Calculate the angles at which the first and second order reflections are obtained from planes 500pm apart, using X-rays with a wavelength of 100pm.

c.) Sketch the following types of lattices
 d.) a face centered cubic and b.) a body centered cubic.

d.) Tungsten forms body-centered cubic crystals. Density and formula weight of tungsten are 19.3 $gcm^{-3}$ and 183.85 $gmol^{-1}$ respectively. Calculate

i.) the length of the side of this unit cell, and

ii.) $d_{200}$

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