



Eastern University, Sri Lanka
External Degree

Second year Second Semester Examination in Science
2004/2005 (January/ March 2011)

EXTCH 206 X-Ray Crystallography, Symmetry and Symmetry Elements and Phase Rule.
(Proper & Repeat)

Answer all questions

Time: One Hour

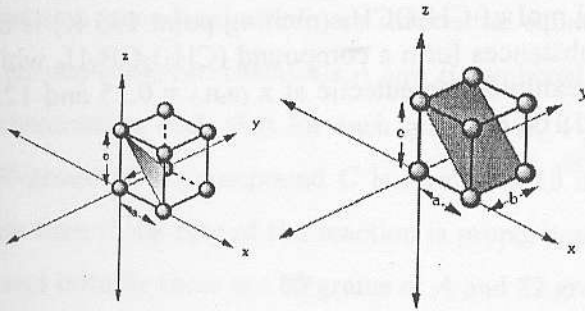
1. (a) Draw sketches to identify the following symmetry elements.

(a) a C_3 axis and a σ_v plane in the NH_3 molecule

(b) a C_4 axis and a σ_h plane in the square-planer $[\text{PtCl}_4]^{2-}$

(20 marks)

(b) Determine the miller indices of the planes of the cubic system shown below.



(a)

(b)

(20 marks)

(c) Calculate the Miller indices of planes whose intercepts on (a), (b) and (c) axes are,

(i) $\frac{1}{4} a, \frac{1}{4} b, a$ (ii) $\frac{1}{2} a, \frac{1}{2} b, \frac{1}{2} c$ (iii) a, b, c

Draw the above planes in a cubic unit cell.

(40 marks)

cont..

(d) Titanium metal has a body centered cubic lattice and has the density 4.50 g cm^{-3} . Assuming that the length of the unit cell is 3.28 \AA , calculate the numbers of titanium atoms are found in the unit cell (Atomic weight of titanium is 47.88 g mol^{-1}).

(20 marks)

2) (a) State the number of degrees of freedom for the following reactions

i. PCl_5 decomposes to PCl_3 and Cl_2 in the gas phase

ii. $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ crystal decomposes to insoluble $\text{CuSO}_4 \cdot 3\text{H}_2\text{O}$ and water vapour.

(30 marks)

(b) At 90°C , the vapour pressure of toluene is 400 Torr and that of o-xylene is 150 Torr. What is the composition of the liquid mixture that boils at 90°C when the pressure is 0.50 atm? What is the composition of the vapour produced?

(35 marks)

(c) Describe the phase changes of a liquid mixture of 4.0 mol of B_2H_6 (melting point 131 K) and 1.0 mol of CH_3OCH_3 (melting point 135 K) is cooled from 140 K to 90 K. These substances form a compound $(\text{CH}_3)_2\text{OB}_2\text{H}_6$ which melts congruently at 133 K. The exhibits one eutectic at $x_{(\text{B}_2\text{H}_6)} = 0.25$ and 123 K and another at $x_{(\text{B}_2\text{H}_6)} = 0.90$ and 104 K.

(35 marks)