BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE PILANI
Pilani Campus, Chemistry Department
Chemistry of Materials, CHEM F333, Semester II, 2016 - 17

MIDSEM Test, 09 March 2017, 2.00 pm

Maximum Marks: 60 **CLOSED BOOK** **Duration: 90 min**

NOTE

1. **There are TWO pages in the question paper with SIX questions.**
2. **Use PEN only for both answering and drawing. NO PENCIL USE**

Answer all Questions

1. **(a)** Compute the % ionic character of the interatomic onds of the intermetallic compound Al_6Mn. Given that the χ values for Al and Mn are 1.5 and 1.6 respectively. **(b)** On the basis of this result, what type of interatomic bonding is expected for Al_6Mn. **(c)** Mention the four possible types of unit cells in crystallography **(d)** Name the types of Bravais lattices that can have two different types of unit cell patterns. **[3+2+2+2 = 9]**

2. **(a)** Define the terms Atomic Packing Factor (APF) and Theoretical Density with their mathematical expressions. **(b)** Cite the cubit unit cell having the lowest APF, mentioning the value. **(c)** Mention the Unit Cell Content for all the types of cubic lattice **[6+2+3 = 11]**

3. **(a)** Determine the Miller indices for the planes A and B as mentioned in the adjacent Figure 1. **(b)** Convert $[00\bar{1}]$ into the four index Miller-Bravais scheme for hexagonal unit cell, AND represent this diagrametically **(c)** The interplanar spacing d_{hkl} in an orthorhombic unit cell is given as follows, where a, b, c are the lattice parameters. Transform the expression appropriately for a **(i)** cubic lattice and **(ii)** tetragonal lattice, with a ONE-LINE reason for each. **[4+6+6 = 16]**

$$\frac{1}{d_{hkl}^2} = \frac{h^2}{a^2} + \frac{k^2}{b^2} + \frac{l^2}{c^2}$$

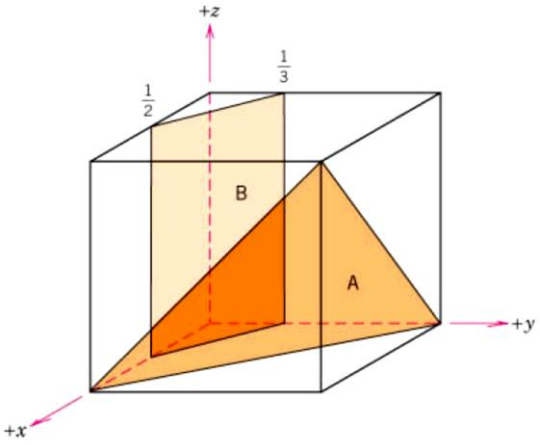

Figure 1

4. **(a)** **(i)** Calculate the fraction of atom sites that are vacant for copper at its melting temperature of 1357 K, assuming the energy for vacancy formation as 0.9 eV/atom. **(ii)** Repeat the calculation at 298 K, **(iii)** What is the ratio of the 'N_v/N' terms at 1357 K and 298? **(b)** What is the composition in atom percent of an alloy that contains 33 g Cu, 47 g Zn. **[6+4 = 10]**

5. **(a)** Cite TWO differences between Fick's First law and Second law of diffusion. **(b)** A steel alloy initially has a uniform C-content of 0.25%. It is thermotreated at 1750 K with a surface C-concentration of 1.2 wt%, How long will this take to achieve 0.8 wt% C at 0.5 mm below surface? Given diffusion coefficient for C in Fe at this temperature us 1.6×10^{-11} m^2s^{-1}, & table of error functions (see overleaf) **(c)** Describe with appropriate diagrams all the phenomena and identify all the phases involved while a binary eutectic alloy liquid is cooled down across the eutectic isotherm at any point other than the eutectic point and eutectic isotherm end-points. **[4+4+6 = 14]**

NO SCRIBBLING ON QUESTION PAPER

Table of Error Function values

z	*erf(z)*	*z*	*erf(z)*	*z*	*erf(z)*
0	0	0.55	0.5633	1.3	0.9340
0.025	0.0282	0.60	0.6039	1.4	0.9523
0.05	0.0564	0.65	0.6420	1.5	0.9661
0.10	0.1125	0.70	0.6778	1.6	0.9763
0.15	0.1680	0.75	0.7112	1.7	0.9838
0.20	0.2227	0.80	0.7421	1.8	0.9891
0.25	0.2763	0.85	0.7707	1.9	0.9928
0.30	0.3286	0.90	0.7970	2.0	0.9953
0.35	0.3794	0.95	0.8209	2.2	0.9981
0.40	0.4284	1.0	0.8427	2.4	0.9993
0.45	0.4755	1.1	0.8802	2.6	0.9998
0.50	0.5205	1.2	0.9103	2.8	0.9999

NO SCRIBBLING ON QUESTION PAPER