SARDAR PATEL UNIVERSITY

[61/62]

M. Sc. (Semester – IV) Examination
Saturday, 1st December 2012
10.30 a.m. to 1.30 p.m.

PS04CPCH02/PS04CINC03 : Solid State Chemistry

Total Marks : 70

Note : Figures to the right indicate full marks.
(Useful constants are, h = 6.63 × 10^{-34} J.s, R = 1.987 cal.K^{-1} mol^{-1}, k = 1.38 × 10^{-23} J.K^{-1},
k = 0.695 cm^{-1}, k = 8.617 eV.K^{-1}, N$_A$ = 6.023 × 10^{23} mol^{-1})

Q . 1 Select the correct answer from the alternatives given below to the each questions; (08)

[i] In case of Band theory, potential energy was considered as ;

(a) constant (b) variable
(c) positive (d) negative

[ii] What is the coordination number for BCC system;

(a) 2 (b) 4
(c) 6 (d) 8

[iii] In terms density, which defect is higher;

(a) Frenkel
(b) Schottky
(c) Color center
(d) Interstitial

[iv] Graphite possess low melting point, it belongs to ;

(a) Ionic solid, (b) Metallic solid, (c) Covalent solid, (d) Molecular solid

[v] Roto-inversion occurs through ;

(a) point, (b) line (axis), (c) plane, (d) mirror

[vi] Solid state reactions are not used in industry very frequently, they are occurring at ;

(a) high temp. (b) low temp.
(c) high pressure (d) low pressure

[vii] Laser is powerful source of light because of ;

(a) population inversion (b) high fluorescence
(c) high electron life time (d) name of a English girl

[viii] Neutrons are scattered by neutrons only while x-rays are scattered by ;

(a) nucleus (b) protons only
(c) neutrons only (d) electrons only

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Q.2 Answer the following questions in short; (ANY SEVEN) (14)

[a] Calculate the miller indices of crystal plane which cut through the crystal axes at (2a, 3b, 3c).

[b] What are organic semiconductors ?

[c] Why solid state reactions are not so popular ?

[d] Define interstitial defects with example.

[e] In the X-ray diffraction of a set of crystal planes having $d = 0.36$ nm and a second order reflection is found to be at an angel of 12°. Calculate the wavelength of X-ray.

[f] Define symmetry. Discuss the centre of symmetry.

[g] Discuss the applications of *semiconductors*.

[h] Draw figure to represent a point group 2 m m.

[i] Explain Wagner mechanism in short.

Q.3 [a] [i] With proper figure show roto-reflection for 1-, 2-, 3-, 4- and 6- fold axis. (03)

[ii] For Frenkel defects, derive the following equation ; (03)

$$\left(N_F/N\right) = const. \exp\left(-\Delta H/2RT\right)$$

[b] Answer **ANY TWO** from the following questions; (06)

[i] Write a note on Hexagonal Crystal System.

[ii] Discuss construction of Laser in short.

[iii] Discuss Color center defects.

[iv] The average energy required to create Frenkel defect in an ionic crystal $A^{2+}B^{2-}$ is 1.2 eV. Calculate the ratio of the number of Frenkel defects at 25 $^\circ$C and 400 $^\circ$C in 1 g. of the crystal.

Q.4 [a] [i] What is semiconductor ? Discuss applications of *pn*-junction in detail. (04)

[ii] For the following relation, justify with necessary diagram that certain values of α are only allowed i.e. all values of E are not allowed. (02)

$$\cos k\alpha = p\frac{\sin \alpha a}{\alpha a} + \cos \alpha a$$

[b] Answer **ANY TWO** from the following questions: (06)

[i] Write a note on "Super conductor"

[ii] Define; Defects, Conduction band, Fermi electrons

[iii] Write a note on "RUBY laser".

[iv] Explain "Mg is metal while Si is semiconductor".

Q.5 [a] [i] Discuss sol-gel method for the preparation of silica gel. (04)

[ii] Discuss principle of Fluorescence Lamp ? (02)

[b] Answer **ANY TWO** from the following questions: (06)

[i] Discuss Wagner mechanism for the reaction between MgO and Al_2O_3.

[ii] Write a note on "Schottky defects".

[iii] Discuss the structure and properties of Graphine.

[iv] Discuss the effect of doping on conducting polymers.

Q.6 [a] [i] How electron and neutron diffraction are differ from each other? (04)

[ii] Explain Rotating crystal method for structural determination of crystal. (02)

[b] Answer **ANY TWO** from the following questions: (06)

[i] CsBr crystallizes in a BCC unit lattice with an edge length of 4.287 Å. Calculate the angle at which the first order reflection maxima ($n = 1$) may be expected for the (1 0 0), (1 1 0) and (1 1 1) plane. When X-rays of 1.5 Å wavelengths is used.

[ii] Derive the relation which correlate wavelength, incident angle, order of reflection and inter layer spacing of the crystal.

[iii] The density of NaCl at 30 °C is 1.362×10^3 Kg.m^{-3}. When X-rays from a palladium target having a wavelength of 58.1 pm are used, the 2 0 0 reflection of NaCl occurs at an angle of 5.91°. Calculate the number of Na^+ and Cl^- in the unit cell. (Mol. wt. of NaCl = 58.45 g.mol^{-1}).

[iv] Calculate the d-spacing for following crystals,
(1) Cubic, (2 0 2), $a = 3$ Å.
(2) Cubic, (0 0 1), $a = 7$ Å.

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