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[A-35]

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SARDAR PATEL UNIVERSITY

M. Sc. (Semester - IV) CBCS Examination
Thursday, 23rd April 2015
10.30 a.m. to 1.30 p.m.

PS04CPHC02 Solid State Chemistry (Physical Chemistry)

Total Marks : 70

Note : Figures to the right indicate full marks.
(Useful constants are, $h = 6.63 \times 10^{-34}$ J.s , $R = 1.987$ cal. $K^{-1}.mol^{-1}$, $k = 1.38 \times 10^{-23}$ J. K^{-1}, $k = 0.695$ cm^{-1}, $k = 8.625 \times 10^{-5}$ eV.K^{-1}, $N_A = 6.023 \times 10^{23}$ $molecule^{-1}$)

Q . 1 Select the correct answer from the alternatives given below to the each question; [08]

[i] Which solid will have the weakest intermolecular forces;

(a) Ice, (b) phosphorus, (c) naphthalene, (d) sodium fluoride

[ii] Graphite exists in hexagonal lattice form, its lattice parameters are;

(a) $a = b = c$, $\alpha = \beta = 90^\circ$, $\gamma = 120^\circ$ (b) $a = b \neq c$, $\alpha = \beta = \gamma = 90^\circ$
(c) $a \neq b \neq c$, $\alpha = \gamma = 90^\circ$, $\beta \neq 90^\circ$ (d) $a = b \neq c$, $\alpha = \beta = 90^\circ$, $\gamma = 120^\circ$

[iii] The bond length and bond angles in molecules in solid state are calculated by X-ray diffraction technique because, X-rays are scattered by,

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

[iv] For a crystal, the angle of diffraction (2θ) is 90° and the second order line has a value of 2.28 Å. The wavelength (in Å) of X-rays used for Bragg's diffraction is;

(a) 2.28, (b) 2.00, (c) 1.613, (d) 4.00

[v] For silicone to behave like a *p*-type semiconductor, the impurity to be added must have valence electrons equal to ;

(a) 4, (b) 3, (c) 2, (d) 6

[vi] In *n*-type semiconductor, Fermi level is located;

(a) between conduction band and valence band (b) near to valence band
(c) near to conductance band (d) difficult to measure accurately

[vii] When $m > m^*$, $\partial \Delta G / \Delta m =$ _____

(a) positive, (b) negative, (c) zero, (d) half integer

[viii] The time lapse between excitation and emission is $\leq 10^{-8}$ sec, the process is known as _____.

(a) fluorescence, (b) phosphorescence,
(c) thermal quenching, (d) scattering

Cont..... 2.....

Q . 2 Answer the following in short : (ANY SEVEN) [14]

[a] Explain "X-rays are energetic".

[b] Define : rotoinversion, superconductivity

[c] What are color centres ? How they appear?

[d] Give limitations of co-precipitation methods for solid preparation.

[e] What are miller indices ? How are they determine?

[f] Calculate the angles at which first, second and third order reflections are obtained from inter planner distance 500 pm, using X-rays of wavelength 100 pm.

[g] What are extrinsic semiconductors? Discuss briefly with appropriate diagram.

[h] Explain working principle of fluorescence lamp?

[i] Give brief about organic charge transfer complexes.

Q . 3 [a] What are defects ? What is the cause of Schottky defects ? Derive an expression for the number of Schottky defects. [06]

[b] [i] Write a note on "Tetragonal crystal system". [03]

[ii] Define symmetry. With the help of cubic crystal, explain line of symmetry, point of symmetry and plane of symmetry. [03]

OR

[b] [i] Write a note on "Covalent solid". [03]

[ii] The average energy required to create a Frenkel defect in an ionic crystal, $A^{2+}B^{2-}$ is 1.4 eV. Calculate the ratio of the number of Frenkel defects at 20 °C and 300 °C in 1 g of the crystal. [03]

Q . 4 [a] With the help of appropriate diagram, explain effect of temperature on extrinsic and intrinsic semiconductors. [06]

[b] [i] Explain band structure of metal, insulator and semiconductor. [03]

[ii] Enlists limitations of free electron theory. [03]

OR

[b] [i] Explain band structure of silicone on the basis of quantum mechanics approach. [03]

[ii] Draw and explain dispersion curves. Explain Fermi energy and Fermi level. [03]

Q . 5 [a] Explain Wagner mechanism for solid state reaction. Also discuss Kirkindall Effect. [06]

Cont..... 3.....

Q.5 [b] [i] Write a note on "Zeolites". [03]

[ii] Discuss working principle of optical fibre. [03]

OR

[b] Using potential energy diagram, explain mechanism of luminescence. [06]

Q.6 [a] Metallic iron (Fe) at 20 °C is studied by the Bragg method reflections are first obtained at $\theta = 11.11^{\circ}, 8.00^{\circ}, 21.0^{\circ}$. What type of cubic lattice does iron have ? The density of iron at 20 °C is 7.86 $g.cm^{-3}$. What is the side length of the unit cell at 20 °C. What is the wavelength of X-rays used? (Atomic weight of iron = 55.85 $g.mol^{-1}$) [06]

[b] [i] Discuss factors which affect intensity of X-rays. [03]

[ii] Give differences between electron and neutron diffraction. [03]

OR

[b] [i] Derive Bragg equation. [03]

[ii] Ag crystallizes in a cubic lattice. The density is 10.7×10^{3} $kg.m^{-3}$. If the edge length of the unit cell is 406 pm, determine the type of the lattice. (Atomic weight of Ag = 107.87 $g.mol^{-1}$) [03]

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