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BR—126—2016

FACULTY OF SCIENCE

M.Sc. (Second Year) (Third Semester) EXAMINATION

NOVEMBER/DECEMBER, 2016

(CBCS Course)

PHYSICAL CHEMISTRY

Paper XVI (CH-532/3)

(Solid-State Chemistry)

(Friday, 18-11-2016)

Time : 2.00 p.m. to 5.00 p.m.

Time—Three Hours

Maximum Marks—75

N.B. :— (i) All questions are compulsory.

(ii) Log table and calculator is allowed.

(iii) Solve Question No. 5 (A) in one attempt only.

1. Solve any *three* out of five : 15

(a) Explain in brief kinetics of solid-state reactions.

(b) Explain the difference between intrinsic and extrinsic defects.

(c) Explain in detail photoelectric effect.

(d) Write a note on electrically conducting solids.

(e) Write a note on Meissner effect.

2. Solve any *three* out of five : 15

(a) Write a note on co-precipitation as a precursor to solid state reaction.

(b) What fraction $[n/N]$ of the lattice sites are vacant at 298 K for a crystal for which $E_v = 1$ eV ?

(c) Explain in detail p-n junction.

(d) Write a note on organic metals.

P.T.O.

- (e) An intrinsic semiconductor has a band gap of 1.5 eV. Calculate the wavelength of the electromagnetic radiation required to cause the material photoconducting.
3. (a) If there are $10^{10}/\text{m}^2$ of edge dislocations in a simple cubic crystal, how much would each of these climb down on an average when the crystal is heated from 0 to 1000 K ?

The enthalpy of formation of vacancies is 1.03 eV/atom. The lattice parameter is 2\AA and the volume of one mole of crystal is 5.5 cm^3 . 8

Or

Explain in brief magnetic domain hysteresis and magnetic susceptibility.

- (b) State the assumptions which govern and limit the energy band theory of solids. 7

Or

Explain in brief Schottky and Frenkel defects. Derive :

$$n = N \exp[-E/2kT].$$

4. (a) Estimate the mole fraction of Schottky and Frenkel defects in a NaCl crystal at 1000 K.

Given the energies of formation of these defects are 2 eV and 3 eV respectively. 8

$$[1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}, k = 1.38 \times 10^{-23} \text{ JK}^{-1}].$$

Or

Explain in detail Quantum theory of paramagnetism.

- (b) Explain in brief general principles in solid-state reactions. 7

Or

Explain in detail experimental procedure of solid-state reaction.

5. (A) Select the correct alternative from the following : 5

- (i) Metal excess defect shows
- (a) NaCl (b) FeO
- (c) FeS (d) None of these
- (ii) Electron trapped at anion vacancy is known as
- (a) F-centre (b) V_K -centre
- (c) H-centre (d) None of these
- (iii) TiO_2 shows structure.
- (a) Spinel (b) Rutile
- (c) Perovskite (d) None of these
- (iv) Metal deficiency defect shows
- (a) FeO (b) NiO
- (c) FeS (d) All of these
- (v) If the current in the superconductor exceeds a critical current, the superconductivity is destroyed. It is known as
- (a) Silsbee effect (b) Meissner effect
- (c) Sintering (d) None of these

(B) Write short notes on any *two* of the following : 10

- (a) Charge-transfer complex
- (b) Edge dislocations
- (c) Colour centres.