Unique Paper Code   :   32177901

Name of the Paper   :   DSE: Novel Inorganic Solids

Name of the Course   :   B.Sc. Prog.

Semester   :   V

Duration   :   3 hours

Maximum Marks   :   75

Instructions for Candidate
Attempt FOUR QUESTIONS in all.
QUESTION NO.1 is compulsory.
All Questions carry equal marks

1. **(a)** Fill in the blanks:
   (i) Ag_2HgI_4 is a good solid ionic conductor due to the mobility of ……….ions.
   (ii)   ……………….. materials are fluid, but with positional order in at least one dimension.
   (iii)   …………….is an example of p-type semiconductors.
   (iv)   …………….is an example of black pigment.
   (v)   …………….is the most suitable source reagent of SiO_2 in Sol-gel method of synthesis of solids.
   (vi)   ……………..is a visible radiation source in the visible spectrophotometer.

                                                                            (6×1=6)

   (b) Answer the following as True or False:
   (i)   Graphene is a carbon atom monolayer. It is possible to roll it, but not to wrap it.
   (ii)   Porcelain is an example of ceramic material.
   (iii)   Scanning Probe microscopy is used to characterize a conductive surface of nanomaterials.
   (iv)   Tamman's rule suggests that a temperature of about two-thirds of the melting point (K) of the lower melting reactant is required for the reaction to occur in a reasonable time.
   (v)   Due to interactions between molecules, single-molecule magnets stay magnetized even when the magnetic field is turned off.
   (vi)   Prussian blue pigment imparts color due to d-d transition.

                                                                            (6×1=6)

   (c) Answer the following very short type questions:
   (i)   Carbon nanotubes and DNA are 1D nanomaterials because these can be elongated in one direction only.
   (ii)   Why does increased pressure reduce the conductivity of K^+ in β-alumina more than that of Na^+ in β -alumina?

(iii) Why do Quantum dots of the same material may exhibit different colors?

(iv) An intercalation reaction is an example of a Topochemical reaction. Explain.

(v) How does Pt-Pt bond distance is affected in $K_2Pt(CN)_4$ complex on oxidation?

(vi) Does λ_{max} of sample change within the same solvent but with the difference in molarity? If so, why?

(1.25+1.25+1.25+1.25+1.25+1.75=6.75)

2. (a) What is Peierls distortion? Give its significance in one-dimensional metals.
   (b) What are Single Molecular Magnets? Explain giving examples.
   (c) What are condensates? What role do they play in *in-vitro* DNA synthesis control?
   (6.25×3=18.75)

3. (a) Discuss the working of Solid Oxide Fuel Cells (SOFCs). What are its advantages and disadvantages?
   (b) What are topotactic reactions? Discuss nucleation of $MgAl_2O_4$ Spinel on the surface of: (i) MgO & (ii) Al_2O_3.
   (c) Discuss different types of Solid Electrolytes with examples. Why are cationic electrolytes more common than solid anionic electrolytes?
   (6.25×3=18.75)

4. (a) What are the differences between SEM and TEM techniques used for characterizing nanoparticles. Which one is more suitable for measuring the size and shape of nanoparticles, and why?
   (b) Discuss the conduction mechanism of conducting polymer polypyrrole. Also, give its applications.
   (c) What are nematic liquid crystals? Describe the various applications of inorganic liquid crystals.
   (6.25×3=18.75)

5. (a) What is the Reinforcement or Reinforcing phase? Give its significance. Discuss different types of Reinforcements used in Composites.
   (b) Explain the hydrothermal process of synthesis of solids. Also, give its limitations.
   (c) Explain biomimetics with respect to artificial fossilization. Discuss the shell of Red Abalone, a natural composite
   (6.25×3=18.75)

6. Write short notes on *any three* of the following:
   (a) Refractories
   (b) Self-assembly of nanostructures
   (c) Ion-exchange resins
   (d) Quantum confinement

   (6.25×3=18.75)

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