


Previous HSE Questions from the chapter “The Solid State”

- 1) Teacher explained the stoichiometric defects in a class room.
 - a) Explain with the help of diagrams the important differences in Schottky and Frenkel defects. (2)
 - b) What are the consequences? (1) [March 2008]
- 2) a) Write an equation for the calculation of density of a crystal from its structure? (1)
b) Calculate the density of PbS crystal (fcc) if the edge length of its unit cell is 500pm. ($N_A = 6.022 \times 10^{23}$, atomic mass of Pb = 207.2, S = 32) (2) [SAY 2008]
- 3) Defects are found even in crystals prepared very carefully.
 - a) Which stoichiometric defect causes decrease in density of the solid? (1)
 - b) Frenkel defect is not found in NaCl. Why? (1)
 - c) KCl crystal is colourless. But on heating it in an atmosphere of potassium vapour, it becomes violet in colour. Account for this. (1) [March 2009]
- 4) In magnesium crystal, the layers of atoms are being stacked in a pattern ABABAB..... type of arrangement.
 - a) Name the close packed structure. (1)
 - b) Calculate the number of tetrahedral and octahedral voids, if the Mg crystal contains 'n' atoms. (2) [March 2010]
- 5) a) Schottky and Frenkel defects are two stoichiometric defects shown by crystals.
 - i) Classify the crystals into those showing Schottky defects and Frenkel defects: NaCl, AgCl, CsCl, CdCl₂ (2)
 - ii) Name a crystal showing both Schottky defect and Frenkel defect. (½)b) Schematic alignment of magnetic moments of ferromagnetic, antiferromagnetic and ferrimagnetic substances are given below. Identify each of them.
 - i) $\uparrow\downarrow\uparrow\downarrow\uparrow\downarrow\uparrow\downarrow$
 - ii) $\uparrow\uparrow\uparrow\uparrow\downarrow\downarrow\downarrow\downarrow$
 - iii) $\uparrow\uparrow\uparrow\uparrow\uparrow\uparrow\uparrow\uparrow$ (1 ½) [March 2010]
- 6) Crystal defects give rise to some special properties in the solids.
 - a) What is mean by Frenkel defect? (1)
 - b) Why does LiCl does not exhibit Frenkel defect? (1)
 - c) Explain the pink colour of LiCl when heated in the vapour of Li? (2) [March 2011]
- 7) A cubic unit cell is characterized by $a = b = c$ and $\alpha = \beta = \gamma = 90^\circ$.
 - a) Name the three important types of cubic unit cells. (1 ½)
 - b) Calculate the number of atoms in one unit cell in the above three cases. (1 ½)
 - c) A metal forms cubic crystals. The mass of one unit cell of it is M/N_A gram, where M is the atomic mass of the metal and N_A is the Avogadro number. What is the type of cubic unit cell possessed by the metal? (1) [SAY 2011]
- 8) Solids can be classified into three types based on their electrical conductivities.

- i) Name three types of solids classified on the basis of electrical conductivity. (1 ½)
 ii) How will you explain such classification based on band theory? (2 ½) [March 2012]
- 9) Schottky and Frenkel defects are stoichiometric defects.
 i) Write any two differences between Schottky and Frenkel defects. (2)
 ii) When pure NaCl crystal is heated in an atmosphere of sodium vapours, it turns yellow. Give reason. (2) [SAY 2012]
- 10) a) NaCl has fcc structure. Calculate the number of NaCl units in a unit cell of NaCl. (2)
 b) Calculate the density of NaCl, if edge length of NaCl unit cell is 564 pm. [Molar mass of NaCl = 58.5 g/mol]. (2) [March 2013]
- 11) Unit cells can be broadly classified into 2 categories – primitive and centred unit cells.
 a) What is a unit cell? (1)
 b) Name the three types of centred unit cells. (1 ½)
 c) The unit cell dimension of a particular crystal system is $a = b = c$ and $\alpha = \beta = \gamma = 90^\circ$. Identify the crystal system. (1)
 d) Give one example for the above crystal system. (½) [SAY 2013]
- 12) a) Every substance has some magnetic properties associated with it. How will you account for the following magnetic properties?
 i) Paramagnetic property (1)
 ii) Ferromagnetic property (1)
 b) A compound is formed by two elements P and Q. Atoms of Q (as anions) make hcp lattice and those of the element P (as cations) occupy all the tetrahedral voids. What is the formula of the compound? (2) [March 2014]
- 13) a) Crystalline solids are 'anisotropic'. What is anisotropy? (1)
 b) Copper crystals have fcc unit cells.
 i) Compute the number of atoms per unit cell of copper crystals. (1)
 ii) Calculate the mass of a unit cell of copper crystals. (Atomic mass of Cu = 63.54u) (2) [SAY 2014]
- 14) Unit cells can be divided into two categories – primitive and centred unit cells.
 a) Differentiate between unit cell and crystal lattice. (2)
 b) Calculate the number of atoms per unit cell in the following:
 i) Body centred cubic unit cell (bcc)
 ii) Face centred cubic unit cell (fcc) (2) [March 2015]
- 15) a) Which of the following is not a characteristic of a crystalline solid?
 i) Definite heat of fusion ii) isotropic nature iii) A regular orderly arrangement of constituent particles iv) A true solid (1)
 b) Frenkel defect and Schottky defects are two stoichiometric defects found in crystalline solids.
 i) What are stoichiometric defects? (1)
 ii) Write any two differences between Schottky and Frenkel defects? (2) [SAY 2015]
- 16) a) Which of the following is a molecular solid?
 (a) Diamond (b) graphite (c) ice (d) quartz (1)
 (b) Unit cells can be classified into primitive and centered unit cells. Differentiate between primitive and centered unit cells. (1)



(c) Presence of excess sodium makes NaCl crystal coloured. Explain on the basis of crystal defects. (2)

[March 2016]

17) A unit cell is a term related to crystal structure.



- a) What do you mean by unit cell? (1)
- b) Name any two types of cubic unit cells. (1)
- c) Calculate the number of atoms in each of the above mentioned cubic unit cells. (1)
- d) Identify the substance which shows Frenkel defect:
(i) NaCl (ii) KCl (iii) ZnS (iv) AgBr (1) [SAY 2016]

18) a) Identify the non-stoichiometric defect

- (i) Schottky defect (ii) Frenkel defect (iii) interstitial defect (iv) Metal deficiency defect (1)
- b) What type of substance could make better permanent magnets – ferromagnetic or ferromagnetic? Justify your answer. (2)
- c) In terms of band theory, write the difference between conductor and insulator. (1) [March 2017]

19) a) From the following choose the incorrect statement about crystalline solids.

- i) Melt at sharp temperature ii) They have definite heat of fusion iii) They are isotropic iv) They have long range order (1)
- b) Cubic unit cells are divided into primitive, bcc and fcc.
i) Calculate the number of atoms in a unit cell of each of the following: bcc and fcc (2)
ii) Write two examples for covalent solids. (1) [SAY 2017]

20) What is the co-ordination number of particles present in *fcc* crystal structure? (1)

21) ZnO turns yellow on heating. Why? (2)

22) An element crystallises as *fcc* with density 2.8 g cm^{-3} . Its unit cell having edge length $4 \times 10^{-8} \text{ cm}$. Calculate the molar mass of the element. (Given $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$) (3) [March 2018]

23) If N spheres are there in a close packing, what is the total number of tetrahedral and octahedral voids present in it? (1)

24) Distinguish Ferromagnetism and Ferrimagnetism. (2)

25) Silver atoms are arranged in *ccp* lattice structure. The edge length of its unit cell is 408 pm . Calculate the density of silver. (Atomic mass of silver is 108.4) (3) [SAY 2018]

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