The solid state & surface chemistry

SUBJECTIVE PROBLEMS:

Q 1.

The density of mercury is 13.6 g/ml. Calculate approximately the diameter of an atom of mercury assuming that each atom is occupying a cube of edge length equal to the diameter of the mercury atom. **(IIT JEE 1983 – 3 Marks)**

Q 2.

Sodium metal crystallizes in body centred cubic lattice with the cell edge, a = 4.29Å. What is the redius of sodium atom? **(IIT JEE 1994 – 2 Marks)**

Q 3.

A metallic element crystallizes into a lattice containing a sequence of layers of ABABAB……. Any packing of spheres leaves out voids in the lattice. What percentage by volume of this lattice is empty space? **(IIT JEE 1996 – 3 Marks)**

Q 4.

A unit cell of sodium chloride has four formula units. The edge length of the unit cell is 0.564 nm. What is the density of sodium chloride? **(IIT JEE 1997C – 2 Marks)**

Q 5.

Chromium metal crystallizes with a body centered cubic lattice. The length of the unit cell edge is found to be 287 pm. Calculate the atomic radius. What would be the density of chromium in g/cm^3? **(IIT JEE 1997 – 3 Marks)**

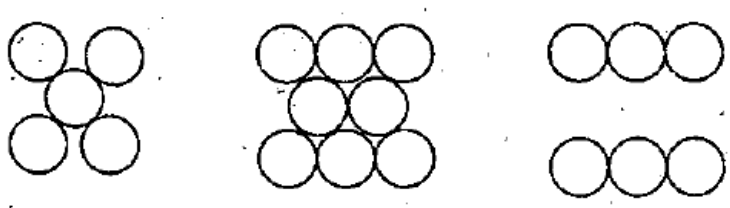
Q 6.

A metal crystallizes into cubic phases, face centered cubic (BCC), whose unit cell lengths are 3.5 and 3.0 Å, respectively, Calculate the ratio of densities of FCC and BCC.

(IIT JEE 1999 – 3 Marks)

Q 7.

The figures given below show the location of atoms in three crystallographic planes in a FCC lattice. Draw the unit cell for the corresponding structure and identify these planes in your diagram. **(IIT JEE 2000 – 3 Marks)**



Q 8.

You are given marbles of diameter 10 mm. They are to be placed such that their centres are lying in a square bound by four lines each of length 40 mm. What will be the arrangements of marbles in a plane so that maximum number of marbles can be placed inside the area? Sketch the diagram and derive expression for the number of molecules per unit area.

(IIT JEE 2000 – 2 Marks)

Q 9. 1 gm of charcoal adsorbs 100 ml 0.5 M CH_3COOH to form a monolayer, and thereby the molarity of CH_3COOH reduces to 0.49. Calculate the surface area of the charcoal adsorbed by each molecule of acetic acid. Surface area of charcoal = $3.01 * 10^2$ m^2/gm.

(IIT JEE 2003 – 2 Marks)

Q 10.

A compound AB has rock slat type structure. The formula weight of AB is 6.023 Y amu, and the closest A – B distance is $Y^{1/3}$ nm, where Y is an arbitrary number. **(IIT JEE 2004 – 2 Marks)**

(a) Find the density of lattice

(b) If the density of lattice is found to be 20 kg m^{-3}, then predict the type of defect.

Q 11.

In face centered cubic (fcc) crystal lattice, edge length is 400 pm. Find the diameter of greatest sphere which can be fit into the interstitial void without distortion of lattice.

(IIT JEE 2005 – 2 Marks)

Q 12.

20% of surface sites are occupied by N_2 molecules. The density of surface site is $6.023 * 10^{14}$ cm^{-2} and total surface area is 1000 cm^2. The catalyst is heated to 300 K while N_2 is completely desorbed into a pressure of 0.001 atm and volume of 2.46 cm^3. Find the number of active sites occupied by each N_2 molecule. **(IIT JEE 2005 – 4 Marks)**

Q 13.

The edge length of unit cell of a metal having molecular weight 75 g/mol is 5 Å which crystallizes in cubic lattice. If the density is 2 g/cc then find the radius of metal atom ($N_A = 6 * 10^{23}$). Give the answer in pm. **(IIT JEE 2006 – 6 Marks)**