Ch. 12 Practice Questions on Crystal Structure

The molar volume of a certain form of solid lead is 18 cm^3/mol. Assuming cubic closest packed structure, determine the following:

1. The number of Pb atoms per unit cell.
   A) 1
   B) 2
   C) 4
   D) 6
   E) 10

2. The volume of a single cell.
   A) 1.20×10^2 pm^3
   B) 1.20×10^4 pm^3
   C) 1.20×10^6 pm^3
   D) 1.20×10^8 pm^3
   E) none of these

3. The radius of a Pb atom.
   A) 1.74 pm
   B) 17.4 pm
   C) 174 pm
   D) 1740 pm
   E) none of these

4. In any cubic lattice an atom lying on an edge of a unit cell is shared equally by how many unit cells?
   A) 1
   B) 4
   C) 6
   D) 2
   E) 8

5. Aluminum metal crystallizes in a face-centered cubic structure. The relationship between the radius of an Al atom (r) and the length of an edge of the unit cell (E) is:
   A) $r = E/2$
   B) $r = \frac{E}{\sqrt{8}}$
   C) $r = \frac{\sqrt{3}E}{4}$
   D) $r = 2E$
   E) $r = \sqrt{2}E$

6. You are given a small bar of an unknown metal, M. You find the density of the metal to be 10.5 g/cm^3. An X-ray diffraction experiment measures the edge of the unit cell as 409 pm. Assuming that the metal crystallizes in a face-centered cubic lattice, what is M most likely to be?
   A) Ag
   B) Rh
   C) Pt
   D) Pb
   E) none of these

7. A metal crystallizes with a face-centered cubic lattice. The edge of the unit cell is 385 pm. The diameter of the metal atom is:
   A) 385 pm
   B) 136 pm
   C) 272 pm
   D) 193 pm
   E) none of these

8. If equal, rigid spheres are arranged in a simple cubic lattice in the usual way (i.e., in such a way that they touch each other), what fraction of the corresponding solid will be empty space? [The volume of a sphere is $(4/3)\pi r^3$, with $\pi = 3.14$.]
   A) 0.52
   B) 0.32
   C) 0.68
   D) 0.48
   E) none of these

9. The unit cell in a certain lattice consists of a cube formed by an anion at each corner, an anion in the center, and a cation at the center of each face. The unit cell contains a net:
   A) 5 anions and 6 cations
   B) 5 anions and 3 cations
   C) 2 anions and 3 cations
   D) 3 anions and 4 cations
   E) 2 anions and 2 cations

Answer Section

1. ANS: C
2. ANS: D
3. ANS: C
4. ANS: B
5. ANS: B
6. ANS: A
7. ANS: C
8. ANS: D
9. ANS: C