

LEARNING OBJECTIVES

CHAPTER 3 - THE STRUCTURE OF CRYSTALLINE SOLIDS

1. Give a definition of a crystalline solid.
2. Describe the difference between crystalline and noncrystalline materials.
3. Give a brief definition of a unit cell.
4. Schematically diagram face-centered cubic, body-centered cubic, and hexagonal close-packed unit cells.
5. Given the atomic radius of an atom that forms into a face-centered cubic crystal structure as well as the metal's atomic weight, compute its density.
6. Given the atomic radius of an atom that forms into a body-centered cubic crystal structure as well as the metal's atomic weight, compute its density.
7. (a) Explain what is meant by coordination number and atomic packing factor.
(b) Cite the atomic packing factors and coordination numbers for body-centered cubic, face-centered cubic, and hexagonal close-packed crystal structures.
8. Briefly define polymorphism (or allotropy).
9. Distinguish between crystal system and crystal structure.
10. Recognize and also give the lattice parameter relationships for all seven crystal systems--i.e., cubic, hexagonal, tetragonal, rhombohedral, orthorhombic, monoclinic, and triclinic.
11. Given a unit cell and three point coordinates, locate the point represented by these indices within the unit cell.
12. Given the location of a point within a unit cell, specify its point coordinates
13. Given a unit cell and three direction indices, draw the direction represented by these indices referenced to this unit cell.
14. Given a direction that has been drawn referenced to a unit cell, specify its direction indices.
15. Given a unit cell and the Miller indices for a plane, draw the plane represented by these indices referenced to this unit cell.
16. Given a plane that has been drawn referenced to a unit cell, specify its Miller indices.
17. For hexagonal crystals, be able to convert both directional and planar indices from the three-axes scheme to the four-axes (Miller Bravais) scheme.

18. Given the unit cell for some crystal structure, be able to draw the atomic packing arrangement for a specific crystallographic plane.
19. Define both linear and planar atomic densities.
20. For a given crystal structure, be able to determine the linear density for a specified crystallographic direction.
21. For a given crystal structure, be able to determine the planar density for a specified crystallographic plane.
22. (a) Draw the packing of a close-packed plane of spheres (atoms).
(b) Describe how both hexagonal close-packed and face-centered cubic crystal structures may be generated by the stacking of close-packed planes.
(c) Cite which planes in both hexagonal close-packed and face-centered cubic structures are close-packed.
23. Briefly cite the difference between single crystals and polycrystalline materials.
24. Define *grain boundary*.
25. Give definitions for *isotropy* and *anisotropy*.
- 26W. Briefly describe the phenomenon of diffraction.
- 27W. Given the angle at which an x-ray diffraction peak occurs, as well as the x-ray wavelength and order of reflection, compute the interplanar spacing for the crystallographic planes that are responsible for the diffraction peak.
- 28W. For crystals having cubic symmetry, given the lattice parameter (i.e., unit cell edge length), compute the interplanar spacing for a set of crystallographic planes of specified Miller indices.