**Additional Multiple-Choice Questions for Instructor Use**

**Atomic Structure and the Elements**

1. The element with the lowest density and smallest atomic weight is which one of the following: (a) aluminum, (b) argon, (c) helium, (d) hydrogen, or (e) magnesium?

**Answer**. (d).

1. In the planetary model of atomic structure, the electrons in the outermost shell are called which one of the following: (a) atomic electrons, (b) orbital electrons, (c) quantum electrons, or (d) valence electrons?

**Answer**. (d).

**Bonding between Atoms and Molecules**

1. Which two of the following bond types are called intramolecular bonds: (a) covalent bonding, (b) electronic bonding, (c) hydrogen bonding, (d) ionic bonding, (e) metallic bonding, and (f) van der Waals forces?

**Answer**. (a) and (d).

**Crystalline Structures**

1. How many atoms are there in the hexagonal close-packed (HCP) unit cell: (a) 8, (b) 9, (c) 10, (d) 12, (e) 14, or (f) 17?

**Answer**. (f).

1. Which one of the following metals has a body-centered cubic crystal structure at room temperature: (a) aluminum, (b) copper, (c) iron, (d) nickel, and (e) zinc?

**Answer**. (c).

1. Twinning can be described as which three of the following: (a) elastic deformation, (b) more likely at high deformation rates, (c) more likely in metals with HCP structure, (d) plastic deformation, (e) slip mechanism, and (f) type of dislocation?
2. **Answer**. (b), (c), and (d).
3. Grain boundaries in metals interfere with dislocation movement, which contributes to which one of the following properties that are characteristic of metals: (a) crystal structure, (b) ductility, (c) electrical conductivity, (d) strain hardening, or (e) thermal conductivity?

**Answer**. (d).

**Noncrystalline (Amorphous) Structures**

1. As an amorphous material such as glass cools from the molten (liquid) state, it transforms into the solid state gradually, first going through a transition phase which is called which one of the following: (a) mushy zone, (b) passing phase, (c) supercooled liquid, (d) superheated solid, or (e) transformation phase?

**Answer**. (c).

**Engineering Materials**

1. Polymers are characterized by which two of the following bonding types: (a) adhesive, (b) covalent, (c) hydrogen, (d) ionic, (e) metallic, and (f) van der Waals?

**Answer**. (b) and (f).

1. In general, ceramics are characterized by which four of the following properties: (a) brittleness, (b) chemical inertness, (c) electrically insulating, (d) high electrical conductivity, (e) high hardness, (f) high thermal conductivity, and (g) low density?

**Answer**. (a), (b), (c), and (e).

**Additional Review Questions for Instructor Use**

1. Describe how ionic bonding works?

**Answer**. In ionic bonding, atoms of one element give up their outer electron(s) to the atoms of another element to form complete outer shells.

1. Among the common point defects in a crystal lattice structure, what is a Frenkel defect?

**Answer**. A Frenkel defect in a crystal lattice structure is an ion that is removed from a regular position in the lattice and inserted into an interstitial position not normally occupied by such an ion.

1. How do grain boundaries contribute to the strain hardening phenomenon in metals?

**Answer**. Grain boundaries block the continued movement of dislocations in the metal during straining. As more dislocations become blocked, the metal becomes more difficult to deform; in effect it becomes stronger.