

Solutions and Explanations

Note: Each question is answered with the ****correct choice**** along with a short ****reason****.

Question 1. (1 point) *Which of the following bonds is the primary bond for ethylene or polyethylene molecules?*

- A) Covalent bond ✓
- B) Metallic bond
- C) Hydrogen bond
- D) Fluctuating dipole bond

Answer: A, Covalent bond. *Reason:* Polymers (like polyethylene) have strong covalent bonds along their carbon backbones.

Question 2. (1 point) *Which of the following bonds is the primary bond for NaCl?*

- A) Hydrogen bond
- B) Metallic bond
- C) Covalent bond
- D) Ionic bond ✓

Answer: D, Ionic bond. *Reason:* NaCl (table salt) is a classic example of an ionic crystal (Na^+ and Cl^-).

Question 3. (1 point) *Which of the following features belongs to metals and alloys?*

- A) Thermal and electric insulated
- B) Chain molecules
- C) Metallic bonding ✓
- D) Light weight

Answer: C, Metallic bonding. *Reason:* Metals/alloys have the characteristic metallic bond; they typically conduct heat and electricity well.

Question 4. (1 point) *Which of the following features belongs to Polymers?*

- A) Crystal structures
- B) Strong and stiff
- C) Corrosive
- D) Chain molecules ✓

Answer: D, Chain molecules. *Reason:* Polymers have long-chain molecular structures (e.g. polyethylene).

Question 5. (1 point) Which of the following bonding types are **primary** chemical bonds?

- A) Metallic, ionic, and covalent bonds ✓
- B) Covalent, hydrogen, and fluctuating bonds
- C) Metallic, permanent dipole, and hydrogen bonds
- D) Ionic, fluctuating dipole, and permanent dipole bonds

Answer: A, Metallic, ionic, and covalent bonds. *Reason:* Primary bonds are metallic, ionic, or covalent. (Hydrogen/dipole are secondary.)

Question 6. (1 point) Which of the following bonds is between water molecules?

- A) Fluctuating dipole bond
- B) Covalent bond
- C) Ionic bond
- D) Hydrogen bond ✓

Answer: D, Hydrogen bond. *Reason:* Inter-molecular bonding in H₂O is hydrogen bonding. (O–H inside a single water is covalent, but between molecules is hydrogen bond.)

Question 7. (1 point) Which of the three crystal structures are the most popular crystal structures of materials?

- A) Primitive cubic (PC), body-centered cubic (BCC), face-centered cubic (FCC)
- B) Hexagonal close-packed (HCP), face-centered cubic (FCC), body-centered cubic (BCC) ✓
- C) Primitive cubic (PC), HCP, FCC
- D) BCC, primitive cubic (PC), diamond cubic (DC)

Answer: B, HCP + FCC + BCC. *Reason:* The most common metal crystal structures are hcp, fcc, and bcc.

Question 8. (1 point) Which of the following defects are defects that are **not** closely related to the crystal structure?

- A) Low-angle boundaries, twin boundaries, surfaces, high-angle boundaries
- B) Pores, inclusions, cracks, and slip bands ✓
- C) Substitutional impurity, vacancy, self-interstitial, and interstitial impurity
- D) Edge dislocation, screw dislocation, combined dislocation

Answer: B, Pores/inclusions/cracks/slip bands. *Reason:* These are more like macroscopic or microstructural flaws, not strictly lattice defects.

Question 9. (1 point) *Which of the following bonds is the primary bond for diamond?*

- A) Covalent bond ✓
- B) Metallic bond
- C) Fluctuating dipole bond
- D) Hydrogen bond

Answer: A, Covalent bond. *Reason:* Diamond is purely covalent (each carbon is tetrahedrally bonded).

Question 10. (1 point) *Which of the following defects are line defects?*

- A) Low-angle boundaries, twin boundaries, surfaces, high-angle boundaries
- B) Edge dislocation, screw dislocation, combined dislocation ✓
- C) Pores, inclusions, cracks, slip bands
- D) Substitutional impurity, vacancy, self interstitial, interstitial impurity

Answer: B, Dislocations. *Reason:* Line defects in crystals are dislocations (edge, screw, or mixed).

Question 11. (1 point) *What are the four typical classes of engineering materials?*

- A) metals and alloys, polymers, ceramics and glasses, and composites ✓
- B) metals and alloys, superconductors, biomaterials, advanced materials
- C) superconductors, functional materials, advanced materials, etc.
- D) advanced materials, biomaterials, semiconductors, metals and alloys

Answer: A. *Reason:* Standard classification is metals/alloys, polymers, ceramics/glasses, composites.

Question 12. (1 point) *Which of the following defects are surface defects?*

- A) Substitutional impurity, vacancy, self interstitial, interstitial impurity
- B) Low-angle boundaries, twin boundaries, surfaces, high-angle boundaries ✓
- C) Pores, inclusions, cracks, slip bands
- D) Edge dislocation, screw dislocation, combined dislocation

Answer: B. *Reason:* Surfaces, grain boundaries (low or high angle), and twin boundaries are 2D (surface) defects.

Question 13. (1 point) *Which of the following bonds is the primary bond for H_2O (the molecule itself)?*

- A) Covalent bond ✓
- B) Metallic bond
- C) Permanent dipole bond
- D) Ionic bond

Answer: A, Covalent bond. *Reason:* O–H bonds inside a water molecule are primarily covalent (though polar).

Question 14. (1 point) *Which of the following defects are point defects?*

- A) low-angle boundaries, twin boundaries, surfaces, high-angle boundaries
- B) edge dislocation, screw dislocation, combined dislocation
- C) substitutional impurity, vacancy, self interstitial, interstitial impurity ✓
- D) pores, inclusions, cracks, slip bands

Answer: C. *Reason:* Point defects are 0D: vacancy, interstitial, or substitutional impurities.

Question 15. (1 point) *Which of the following statements is TRUE?*

- A) The theoretical shear strength of a material is approx. 1/10 of the elastic modulus.
- B) The actual strength of a material is approx. 1/10 of the elastic modulus.
- C) Strong primary chemical bonds result in stretching → low elastic modulus.
- D) The theoretical strength of a material is approx. 1/10 of the *elastic* modulus ✓

Answer: D. *Reason:* The so-called “ideal” or theoretical cohesive strength is on the order of $E/10$ (where E is the modulus).

Question 16. (1 point) *Which of the following features belongs to composites?*

- A) consisting matrix and reinforcement ✓
- B) metallic bonding
- C) crystal structure
- D) isotropic

Answer: A. *Reason:* Composites contain at least two distinct phases: a matrix plus a reinforcement (fiber, particle, etc.).

Question 17. (1 point) *Which of the following features belongs to Ceramics and Glasses?*

- A) ductile
- B) conductive
- C) strong, stiff, brittle, and hard ✓
- D) covalent and secondary bonding

Answer: C. *Reason:* Ceramics are typically stiff, hard, and brittle; they fail with little plastic deformation.