

In the following multiple-choice questions, indicate the single and best answer.

1. Metals have a high electrical conductivity, because:
 - a) metal atoms are small and can diffuse quickly;
 - b) electrons in metals are tightly bound to the atomic nuclei;
 - c) the valence band is unfilled;
 - d) the valence band is filled;
 - e) none of the above.

2. Polymers are poor electrical conductors, because:
 - a) carbon atoms have only six electrons;
 - b) the filled valence band and empty conduction band are separated by a large energy gap;
 - c) different polymer molecules are bonded to each by weak secondary bonds;
 - d) they exhibit thermoplastic behavior;
 - e) none of the above.

3. Ceramic materials are often made by sintering of green powder compacts, because
 - a) ceramics melt at very high temperatures;
 - b) ceramics are generally too brittle to form by deformation processing;
 - c) ceramics usually involve ionic-covalent bonding;
 - d) all of the above;
 - e) a and c.

4. An amorphous solid:
 - a) has a very high viscosity;
 - b) has the atomic/molecular structure of a liquid but the mechanical properties of a solid;
 - c) is also referred to as a “glass;”
 - d) is made by cooling a liquid quickly below the so-called glass-transition temperature, T_g .
 - e) all of the above.

5. Metals and alloys can be formed by:

- a) extrusion;
- b) stamping;
- c) casting;
- d) the sintering of metal powder;
- e) all of the above.

6. A ceramic made by sintering a cast and dried slurry:

- a) is 100% dense;
- b) is easy to machine into its final shape;
- c) can be easily melted;
- d) is a good electrical conductor because of residual water;
- e) none of the above.

7. Cement:

- a) is a ceramic material;
- b) forms when water evaporates from a hydrated mixture of CaO and SiO₂-based powders;
- c) forms by a chemical reaction between water, CaO powder, and SiO₂-based powder;
- d) is a good electrical conductor;
- e) a and c;
- f) b and d.

8. Using well-labeled energy-band diagrams to describe why a metal is a good electrical conductor and an insulator like a ceramic or a polymer is a poor electrical conductor.

9. The average molecular weight of a solid 1 gram sample of poly(ethylene) is 400,000. Calculate the average degree of polymerization. Estimate the end-to-end length of the average molecule in this sample. In the solid, with (roughly) what probability do you expect that the ends of this molecule will be this distance apart? Briefly justify your answer.

10. Ohring problem 4-12

11. Ohring problem 8-20

12. Ohring problem 8-25 b.