

2.20 (a) Draw a simple band picture to distinguish a metallic conductor from a semiconductor. (b) Explain how the temperature dependence of the electrical conductivity can be used to distinguish a metallic conductor from a semiconductor. (c) Compare and contrast the expected temperature-dependence of the conductivity for a *semiconductor* and an *insulator*.

2.21 Decide whether the following systems are likely to be n-type or p-type semiconductors: (a) arsenic-doped germanium, (b) gallium-doped germanium, (c) silicon-doped germanium. For this last one, you need to think about the actual energies of the states that will be introduced by the dopant.