

Physics

Section I – Part B (continued)

Marks

Question 24 (8 marks)

In terms of band structures and relative electrical resistance, describe the differences between a conductor, an insulator and a semiconductor.

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For a substance to conduct electricity, enough energy must be provided to move electrons from the valence energy band into the conduction energy band. In a conductor, these two bands overlap, and there is no 'energy gap' to overcome in order for an electron to ^{be available to} conduct. As a result, resistance of a conductor is low, and little, or no, energy is required for conduction. In an insulator however, there exists a large 'energy gap' between the valence and conduction bands, and a large amount of energy is required for an electron in the valence band to cross this 'forbidden gap' and move into the conduction band for conduction. As a result, insulators have a high resistance, although if enough energy is supplied it will conduct electricity. In a semiconductor, the energy gap between valence and conduction bands ~~is~~ is relatively small. Thus, electrons can be made available to conduct at even room temperatures. As temperature of a semiconductor increases, and hence the amount of energy, more and more electrons become available for conduction, crossing the small gap. Thus a semiconductor's resistance decreases as temperature increases.