

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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In a conductor, the valence band overlaps the conduction band, hence there is no energy gap between the two and there is an abundance of free electrons to conduct a current. Hence resistance is very low to none.

In an insulator, there is a large energy gap between the valence and conduction bands, such that there are ~~only a~~ few electrons with sufficient energy to cross the gap and conduct ^{current}. Hence insulators have high resistance because current flows very slowly in them due to a lack of free electrons.

In semi-conductors there is a small ^{energy} gap between the valence and conduction bands, which can be overcome by heating the semiconductor and giving electrons in the valence band enough energy to jump the gap. When this occurs semiconductors become good conductors but their resistance is still higher than that of metals. In their original state they are poor conductors, although marginally better than insulators. When metals are heated however, the extra vibration in the crystal lattice impedes the current flow and increases the resistance.