2002 HIGHER SCHOOL CERTIFICATE EXAMINATION

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. **8**

In a conductor such as a metal, there are free electrons or delocalised electrons in the valence shell. These electrons are able to move freely under the influence of an electric field. Therefore, it is also said that the electrons are conduction electrons. In terms of band structure, the valence & conduction band are very close together in a conductor. Not much thermal energy is required to initiate electric current ∴ conductors have low electrical resistance. Insulators, however do not have any free electrons in the valence band. Therefore they have high electrical resistance because of the large gap between the valence & conduction band.(*) The valence band in semiconductors are only very partially filled by free electrons. Thus when an electric field is applied of reasonable strength, it is possible for an electron to jump the small into the conduction band.

(*) A very high electric field strength is required to provide electrons with sufficient energy to jump this gap.