

1) Explain in 15 lines what it means to dope a semiconductor and how this affects the electrical conductivity of the material.

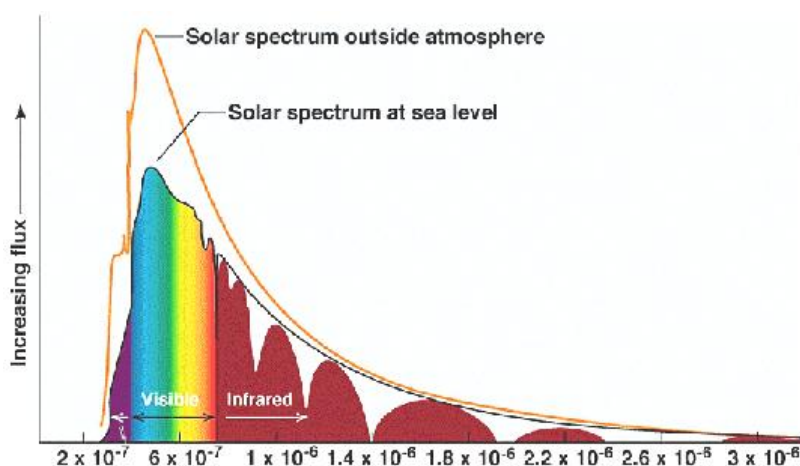
2) In the following table the values of the *energy gap* of certain materials are reported

a) Explain what the *energy gap* is.

b) Calculate, by showing the formal passages, the energy (in Joule) and the wavelength of a photon that is able to produce an electron-hole pair in these materials. Complete the table.

Material	Symbol	Energy Gap (eV) at 300 K	Energy Gap (J)	Wavelength λ ()
Silicon	Si	1.12		
Diamond	C	5.5		
Germanium	Ge	0.67		

c) The following figure shows the spectrum of solar radiation on the Earth (the x axis shows the wavelength expressed in m; the y axis indicates the flow in arbitrary units). By using the data reported in the previous table, indicate on the figure which photons are able to produce photoelectrons in germanium and diamond.



- d) Describe how the photoelectric conversion in a pn junction takes place. Explain why the illuminated junction delivers an electrical current when connected to a load (maximum 15 lines).
 - e) Explain why a pn junction is needed (instead of an intrinsic semiconductor) in a photovoltaic cell.
- 3) Report and briefly explain the reactions occurring within a Graetzel cell illuminated by sunlight.