Example 2.5 Calculate the ionization energy for shallow donors and acceptors in germanium and silicon using the hydrogen-like model.

Solution Using the effective mass for conductivity calculations (Appendix 3) one finds the ionization energy for shallow donors in germanium to be:

$$E_c - E_d = 13.6 \frac{m^*_{cond}}{m_0 e_r^2} \text{eV} = 13.6 \frac{0.12}{16^2} \text{eV} = 6.4 \text{ meV}$$

The calculated ionization energies for donors and acceptors in germanium and silicon are provided below.

	Germanium	Silicon
donors	6.4 meV	13.8 meV
acceptors	11.2 meV	20.5 meV

Note that the actual ionization energies differ from this value and depend on the actual donor atom.