

- 3.18** (a) The forbidden bandgap energy in GaAs is 1.42 eV. (i) Determine the minimum frequency of an incident photon that can interact with a valence electron and elevate the electron to the conduction band. (ii) What is the corresponding wavelength?
(b) Repeat part (a) for silicon with a bandgap energy of 1.12 eV.
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➤ Repeat part a) for Germanium.

c) From Table B.4, $E_g = 0.66$ eV for Germanium.

(i) Per section 2.1.1, $E = h\nu$.

$$\nu = E/h = 0.66 \text{ eV} (1.602176634 \times 10^{-19} \text{ J/1 eV}) / 6.62607015 \times 10^{-34} \text{ J/Hz}$$
$$\Rightarrow \underline{\nu = 1.59587 \times 10^{14} \text{ Hz} = 159.587 \text{ THz}}$$

(ii) From basic physics, $c = f\lambda = \nu\lambda$.

$$\lambda = c/\nu = 2.99792458 \times 10^8 / 1.59587 \times 10^{14}$$
$$\Rightarrow \underline{\lambda = 1.87855 \times 10^{-6} \text{ m} = 1.87855 \text{ }\mu\text{m} = 1878.55 \text{ nm.}}$$