Interdisciplinary Energy Materials Science 2

Department Name

Insert an appropriate integer number in the respective □. (1 eV = 8065 cm^{-1} = 11605 K = 96 kJ/mol)

(a) The number of thermally excited electrons in silicon across the band gap of E_g = 1.1 eV is given by $n = n_0 \exp(-E_g/2k_BT)$, where $E_g/2k_BT$ at room temperature is about 2 x 10□.

$$\frac{(1.1\mathrm{eV})\times(11605\mathrm{K/eV})}{2\times 300\mathrm{K}} = \frac{1.1\mathrm{eV}}{2\times 0.026\mathrm{eV}} = 2\times 10^{1}$$

(b) Chemical reaction with the activation energy of E_a = 250 kJ/mol is excited with a probability of $P = \exp(-E_a/RT)$, where E_a/RT at room temperature is about 1 x 10□. (gas constant $R = k_BN$, where N is the Avogadro number)

$$\frac{(250\mathrm{kJ/mol})}{(96\mathrm{kJ/mol\cdot eV})}\frac{(11605\mathrm{K/eV})}{(300\mathrm{K})} = \frac{2.6\mathrm{eV}}{0.026\mathrm{eV}} = 1\times 10^{2}$$

(c) Energy spacing $h\nu$ coming from the molecular rotation is 22 cm^{-1}, where $h\nu/k_BT$ at room temperature is about 1 x 10□.

$$\frac{(22\mathrm{cm^{-1}})}{(8065\mathrm{cm^{-1}})}\frac{(11605\mathrm{K/eV})}{(300\mathrm{K})} = \frac{0.0027\mathrm{eV}}{0.026\mathrm{eV}} = 1\times 10^{-1}$$