

CHEM 245 PROBLEM SET IV

1. Cadmium sulphide, CdS, is used as a photoconductor in light meters. The band gap is about 2.4 eV. What is the greatest wavelength of light that can promote an electron from the valence band to the conduction band in CdS?
2. Conductivity, σ , of a semiconductor shows an Arrhenius-like temperature dependence:

$$\sigma = \sigma_0 e^{-E_a / kT}$$

where;

$$\begin{array}{ll} E_a = \text{activation energy} & T = \text{absolute temperature} \\ E_a \sim 1/2E_{\text{gap}}, & k = \text{Boltzmann constant} \end{array}$$

- The band gap of silicon is 1.12 eV. Calculate the ratio of conductivities at 373 and 273 K.
3. N-type semiconductors can also be formed by increasing the amount of metal in ZnO or TiO₂ and *p*-type semiconductors can be formed by increasing the amount of nonmetal in Cu₂S, CuI or ZnO. Explain how this is possible.
 4. Decide whether the following are likely to be *n*-type or *p*-type semiconductors:
 - a) arsenic-doped germanium
 - b) gallium doped germanium
 - b) silicon-doped germanium