817.

Problem 53.49 (RHK)

The KCl *crystal has a band gap of* 7.6 eV *above the topmost occupied band, which is full. We have to answer whether this crystal is opaque or transparent to radiation of wavelength* 140 nm.

Solution:

We calculate the energy of a photon of wavelength 140 nm.

$$hv = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{140 \times 10^{-9}} \text{ J}$$

$$= 1.42 \times 10^{-18} \text{ J} = 1.42 \times 10^{-18} \times 6.242 \text{ eV}$$

$$= 8.86 \text{ eV}.$$

As the photon energy of the radiation of wavelength 140 nm is 8.86 eV and the gap between the filled band and the vacant band of the KCl crystal is 7.6 eV, the radiation will be able to push up electrons from the filled band to the vacant band. Therefore, the radiation will be absorbed by the KCl crystal and hence it will be opaque to this radiation.