Chapter 34 Problem 68 [†]

Given
$\lambda = 25\ nm = 2.5 \times 10^{-8}\ m$
$E_1 = 40\ keV = 4.0 \times 10^4\ eV$
$E_2 = 100\ keV = 1.0 \times 10^5\ eV$
$m_e = 9.11 \times 10^{-31}\ kg$
$h = 6.63 \times 10^{-34}\ J \cdot s$

Solution
Is the less expensive electron microscope able to resolve the microtubules.

The energy of the less expensive electron microscope is

$$E_1 = (4.0 \times 10^4\ eV)\left(\frac{1.6 \times 10^{-19}\ J}{1.0\ eV}\right) = 6.4 \times 10^{-15}\ J$$

Converting this energy into a wavelength of the photons with this energy gives

$$E = \frac{hc}{\lambda}$$

$$\lambda = \frac{hc}{E} = \frac{(6.63 \times 10^{-34}\ J \cdot s)(3.0 \times 10^8\ m/s)}{6.4 \times 10^{-15}\ J} = 3.1 \times 10^{-11}\ m$$

This corresponds to 0.031 nm and is, therefore, able to resolve the microtubes.

[†]Problem from Essential University Physics, Wolfson