774.

Problem 52.8 (RHK)

We have to find the minimum potential difference that must be applied to an x-ray tube to produce x rays with a wavelength equal to the Compton wavelength of the electron.

Solution:

The electron Compton wavelength

$$\mathrm{D}_e = \frac{h}{m_e c} = 3.861\times10^{-13}\ \mathrm{m} = 0.3861\ \mathrm{pm}.$$

The applied minimum potential difference V in kV required for producing radiation of wavelength λ pm in an x ray tube is given by the relation

$$V = \frac{1240\ \mathrm{pm}}{\lambda\ \mathrm{pm}}\ \mathrm{kV}.$$

Therefore, the minimum potential difference required for producing x rays of wavelength equal to the Compton wavelength of the electron is

$$V = \frac{1240}{0.3861}\ \mathrm{kV} = 3.21\ \mathrm{MV}.$$