At what speed would people, each of mass 60 kg, passing though a door of width 1.0 m diffract? Comment on the value of this speed. [3]

Electrons in outer space can travel at very high speeds. One particular electron has KE of 0.010 MeV.
(a) Determine the KE in joules. [1]
(b) Determine the de Broglie wavelength of this electron. [2]
(c) State and explain whether a proton moving at the same speed as an electron would have a smaller, same or larger wavelength than that calculated in (b). [1]

54 eV electrons passing through a nickel crystal are diffracted.
(a) What causes the diffraction of the electrons? [2]
(b) Analysis of the experimental results shows that the wavelength of these electrons is 1.65×10^{-10} m. Show that this agrees with the theoretical value of the wavelength of these electrons. [3]
(c) Explain why the diffraction pattern formed by the electrons of wavelength 2.5×10^{-11} m cannot be due to the atomic nuclei of nickel. [3]

Calculate the accelerating p.d. that gives an electron a de Broglie wavelength of 4.0×10^{-11} m. [3]