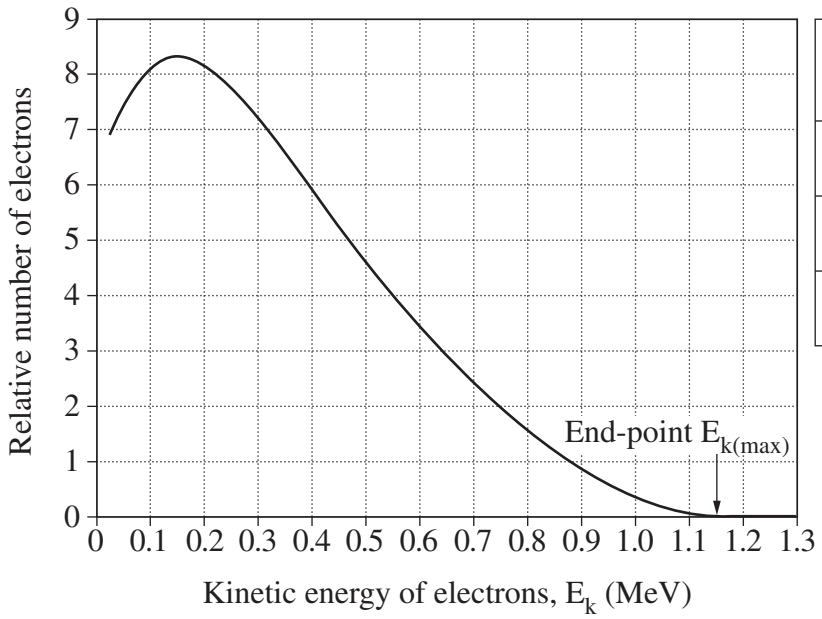
Marks

Question 31 — From Quanta to Quarks (25 marks)

(a) (i) Describe Davisson and Germer's experiment that confirmed the de Broglie hypothesis of wave-particle duality. **2**

(ii) Explain the stability of the electron orbits in the Bohr atom, using de Broglie's hypothesis. **4**

(b) The diagram shows the kinetic energy distribution of the electrons emitted in the β-decay of $^{210}_{83}$Bi into $^{210}_{84}$Po. The energy released during β-decay depends on the mass defect in the transmutation, as it does in nuclear fission.



Nucleus or particle	*Mass* (amu)
^{210}Bi	209.938 57
^{210}Po	209.936 78
e	0.000 55

(i) Identify the scientist who suggested that the existence of the neutrino relates to the need to account for the energy distribution of electrons emitted in β-decay. **1**

(ii) Use the data to calculate the mass defect in the β-decay of $^{210}_{83}$Bi. (Assume that the neutrino is a massless particle.) **2**

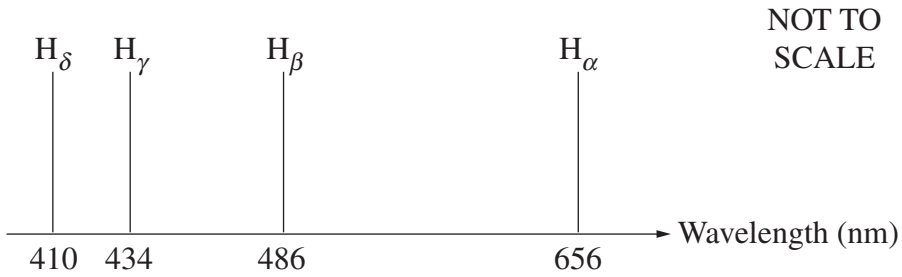
(iii) Account for the energy distribution of electrons emitted in this β-decay. **3**

Question 31 continues on page 35

Marks

Question 31 (continued)

(c) The diagram represents the four spectral lines in the visible region of the hydrogen spectrum known as the Balmer Series.



(i) Explain how the Balmer Series provides strong experimental evidence in support of Bohr's model of the hydrogen atom. **3**

(ii) Calculate the wavelength of the next line in the Balmer Series. **3**

(d) Discuss how neutron scattering and ONE other process have been used to increase our understanding of the structure of matter. **7**

End of Question 31