7 X-rays are produced when electrons accelerated by a large electrical potential difference impinge upon a metal target. The X-ray spectrum of copper shown in Fig. 7.1 is produced by bombarding a copper target with high-energy electrons. The spectrum consists of two main components: a continuous spectrum (bremsstrahlung) and a line spectrum (characteristic X-rays).

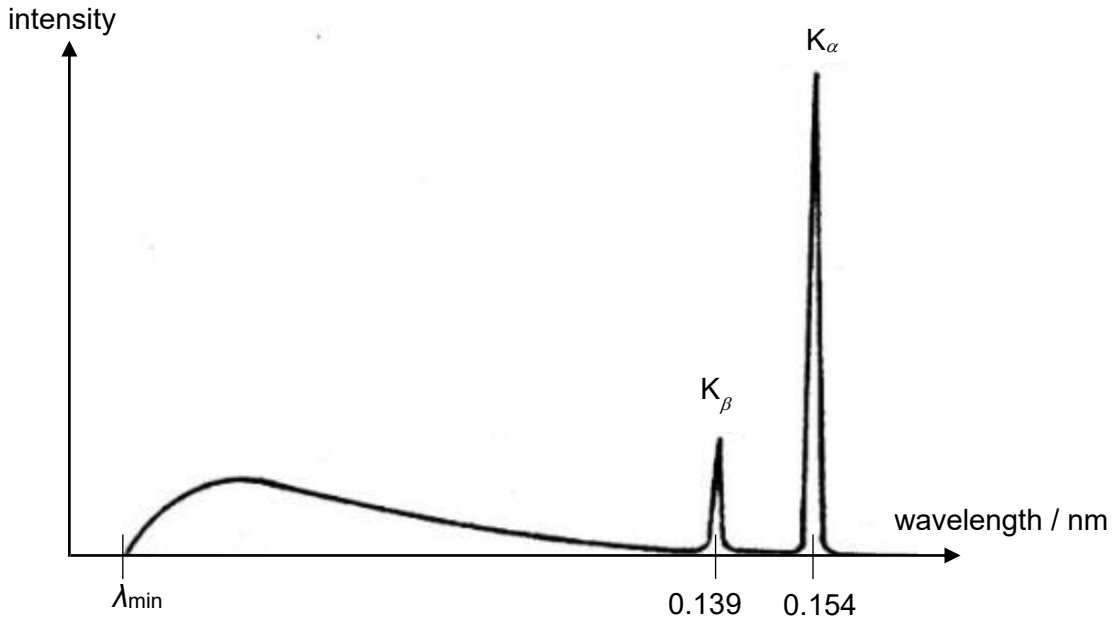

Fig. 7.1

(a) Explain the shape of:

(i) the continuous spectrum,

.....

.....

.....

.....[2]

(ii) the sharp peaks in the spectrum.

.....

.....

.....

.....

.....[2]

(b) **(i)** Calculate the energy of a K_α photon.

energy = ... eV [1]

(ii) L_α photons are emitted when inner shell electrons de-excite from the M shell to the L shell. Calculate the wavelength of the L_α photon.

wavelength = ... nm [2]

(c) The minimum wavelength λ_{min} observed in the continuous spectrum depends on the accelerating voltage V applied to the electrons. If the accelerating voltage is 30 kV, calculate λ_{min}.

Explain your working.

λ_{min} = ... nm [2]

(d) Explain why knowledge of the X-ray spectra of elements like copper can be used to identify the existence of these atoms in materials.

.....

.....

.....[1]

[Total: 10]