6 **(a)** Fig. 6.1 shows some of the energy levels for an atom of hydrogen.

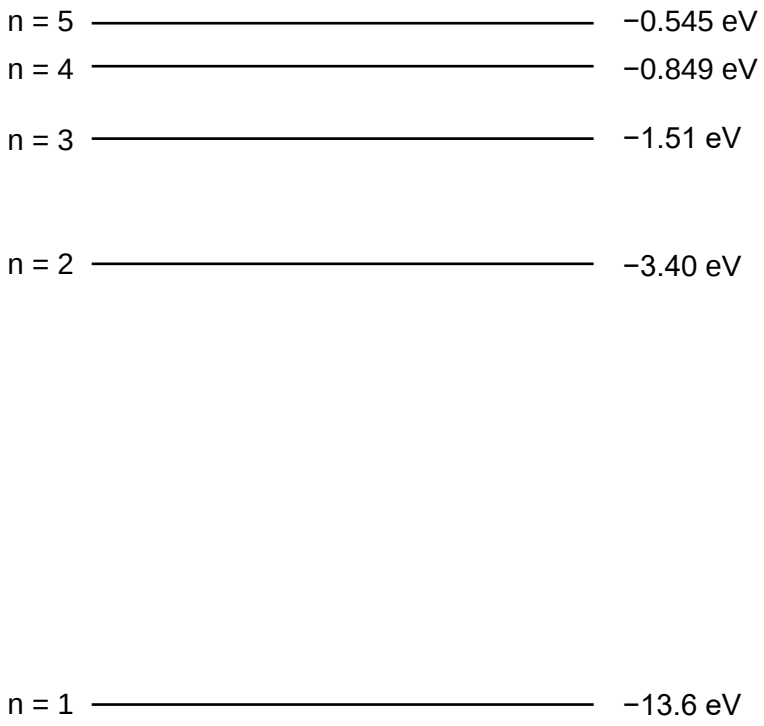

Fig. 6.1 (not to scale)

(i) An electron of the hydrogen atom is in the ground state.

1. Determine the amount of energy required to remove this electron from the atom.

energy = …… J [1]

Explain the possible result of the following interaction on the electron of the hydrogen atom.

2. An incident electron of 11.0 eV collides with the atom.

……...……..

……...……..

……...…… [1]

3. A photon of energy of 11.0 eV passes through the atom.

……..……..

……..……..

……..…… [1]

(ii) If an electron of the hydrogen atom at energy level n = 4 returns directly to the ground state, describe what will happen.
Show your working clearly.

……..……

……..……... [3]

(b) Fig. 6.2 shows how X-rays are produced inside an X-ray tube.
The electrons, emitted from the filament at the cathode, are accelerated from rest using an accelerating voltage *V* to strike a heavy metal target at the anode. As a result, X-rays are produced.

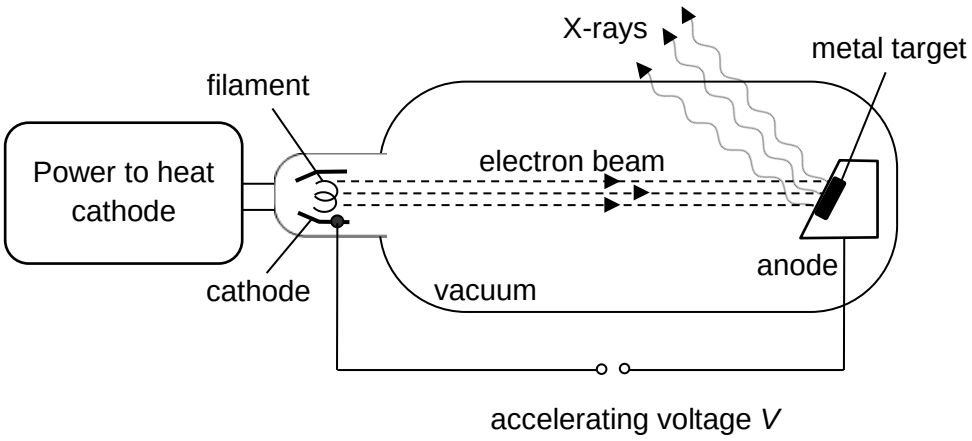

Fig. 6.2

Fig. 6.3 shows a graph of relative intensity I against wavelength λ of emitted radiation, featuring emission line spectrum superimposed on a continuous spectrum.

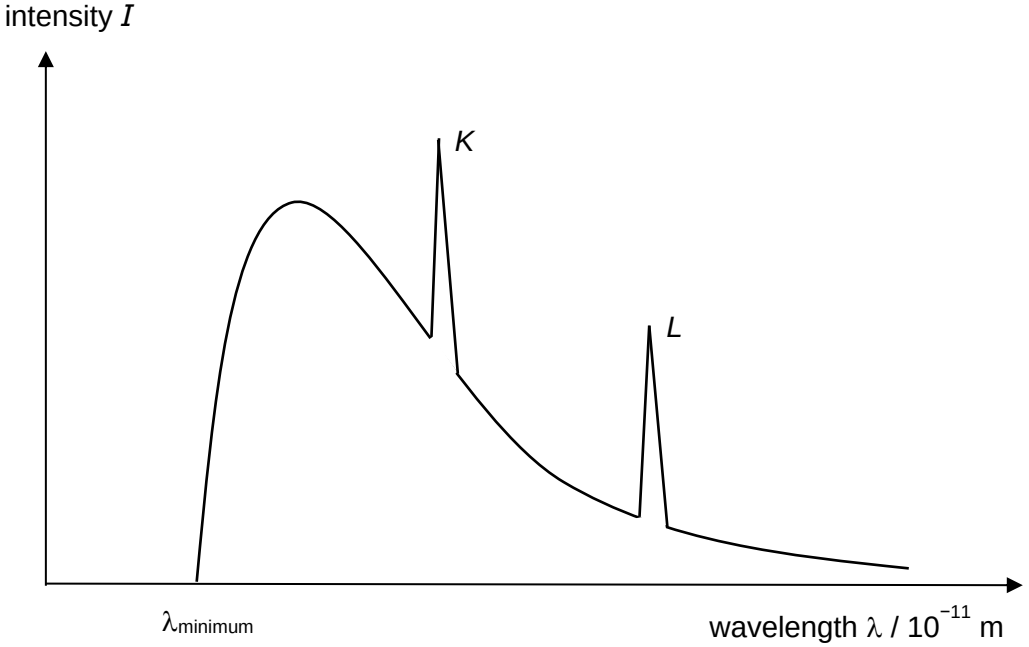

Fig. 6.3

(i) If the accelerating voltage V used is 105 kV, calculate the minimum wavelength $\lambda_{minimum}$.

$\lambda_{minimum}$ = ... m [3]

(ii) The target metal is replaced with another metal of higher atomic number and the current in the filament is reduced.

On Fig. 6.3, sketch a graph to show how intensity of the X-rays emitted varies with wavelength. Label your graph P.

[2]

End of Section A

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