**5** **(a)** Describe and explain the appearance of an emission line spectrum.

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**(b)** Fig. 5.1 shows some of the electron energy levels in a hydrogen atom.
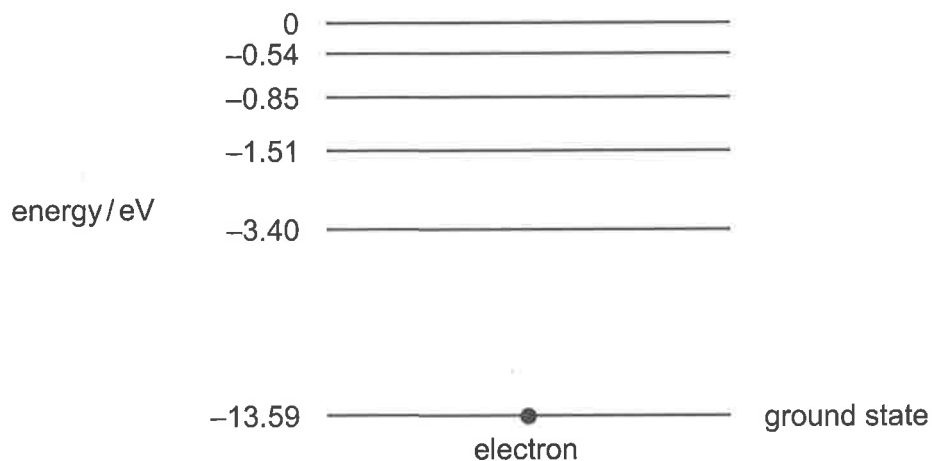


**Fig. 5.1**

An electron travelling at a speed of $1.93 \times 10^6 \, \text{m s}^{-1}$ collides with an electron in the ground state of the atom.

This causes the incoming electron to deflect and the atom to emit electromagnetic radiation.

**(i)** Calculate the maximum energy, in eV, that can be absorbed by the electron in the ground state from the incoming electron. Explain your working.

maximum energy = .................................................. eV [4]

**(ii)** Calculate the wavelength of the electromagnetic radiation emitted.

wavelength = .......................................................m [2]

**(iii)** Calculate the de Broglie wavelength of the deflected electron after the collision.

de Broglie wavelength = .......................................................m [4]