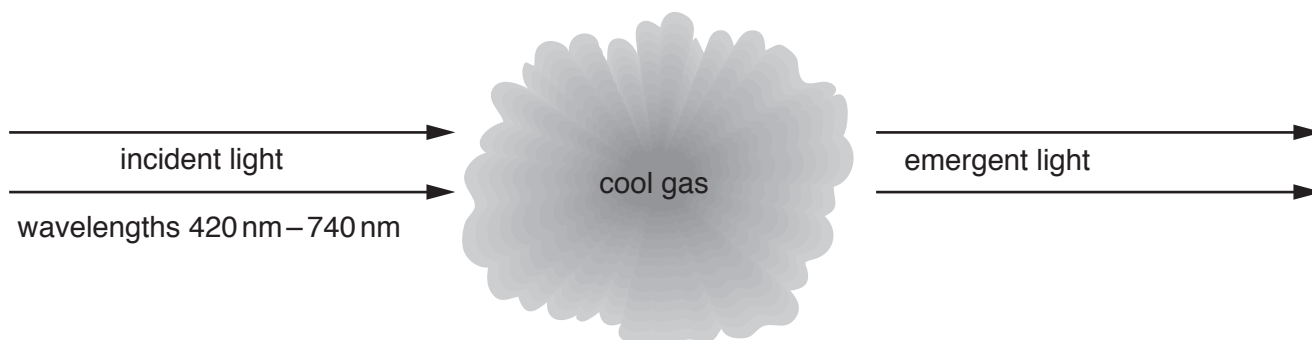**11** A beam of light consists of a continuous range of wavelengths from 420 nm to 740 nm. The light passes through a cloud of cool gas, as shown in Fig. 11.1.

incident light

wavelengths 420 nm – 740 nm

cool gas

emergent light

Fig. 11.1

(a) The spectrum of the light emerging from the cloud of cool gas is viewed using a diffraction grating.
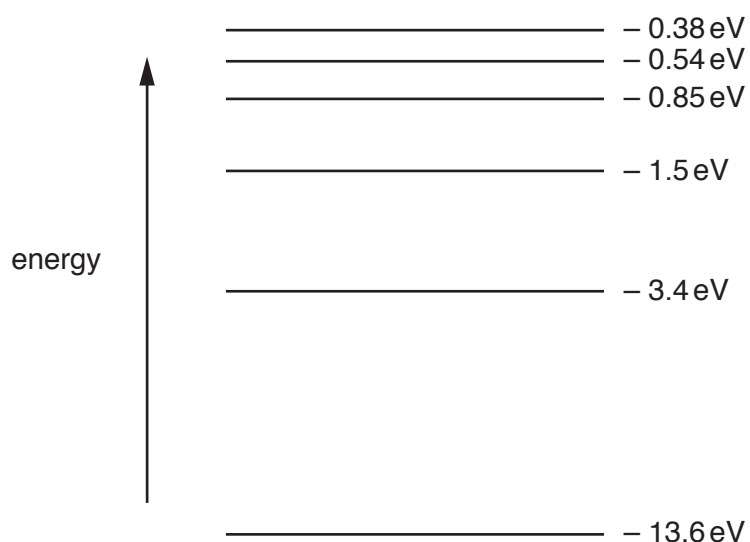Explain why this spectrum contains a number of dark lines.

....

....

....

....

....

....[4]

(b) Some of the electron energy levels of the atoms in the cloud of gas are represented in Fig. 11.2.

energy

− 0.38 eV
− 0.54 eV
− 0.85 eV

− 1.5 eV

− 3.4 eV

− 13.6 eV

Fig. 11.2 (not to scale)

(i) Light of wavelength 420 nm has a photon energy of 2.96 eV.
Calculate the photon energy, in eV, of light of wavelength 740 nm.

photon energy = ... eV [2]

(ii) Use data from **(i)** and your answer in **(i)** to show, on Fig. 11.2, the changes in energy
levels giving rise to the dark lines in **(a)**. [2]

[Total: 8]