7 A beam of light consists of a continuous range of wavelengths from 430 to 600 nm. It passes through a cloud of cool hydrogen gas as shown in Fig. 7.1.

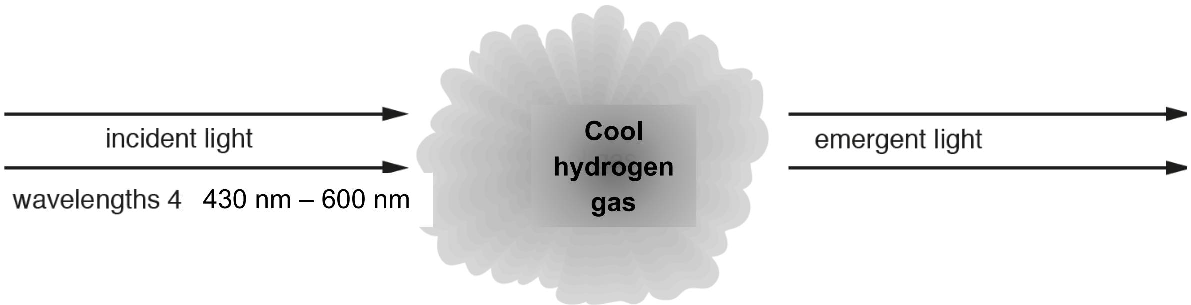

Fig. 7.1

(a) The spectrum of light emerging from the cloud of cool hydrogen gas is viewed with a spectrometer. Explain why this spectrum contains 2 dark lines.

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.... [4]

(b) The measured wavelengths, λ_m , of the selected lines in the hydrogen spectrum are given empirically by

$$\frac{1}{\lambda_m} = R\left(\frac{1}{4} - \frac{1}{m^2}\right)$$

where R is a constant of value 1.097×10^7 m s^{-1} and m is an integer taking the values 3, 4, 5… etc.

(i) Calculate the value of the wavelength when $m = 4$.

wavelength = ... m [2]

(ii) Determine the minimum wavelength given by the equation.

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

(iii) Some of the electron energy levels of the hydrogen atom in the gas are represented in Fig. 7.2.

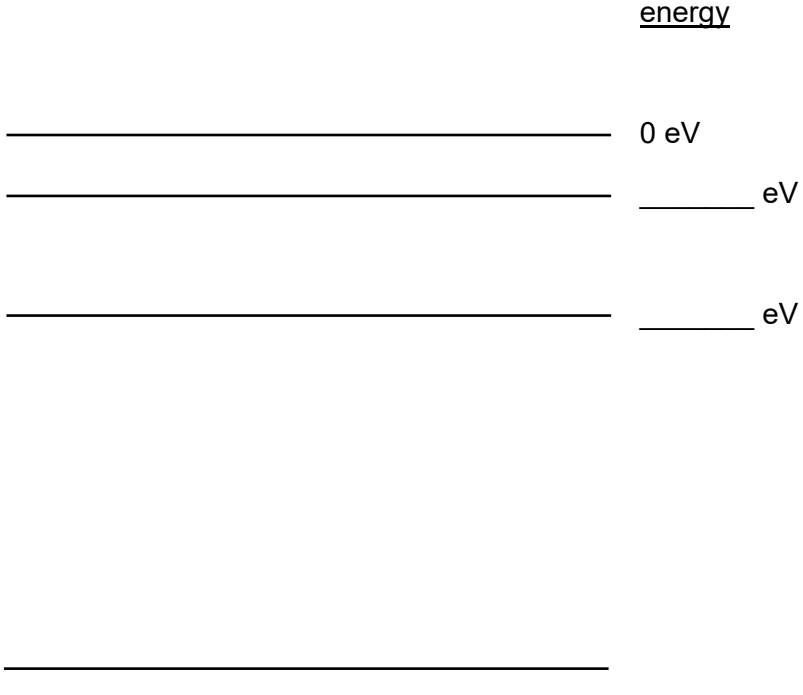

Fig. 7.2

1. Use your answers from **(b)(i)** and **(b)(ii)** to determine the energy of the 3 other electron energy levels in Fig. 7.2. Write your answer in the blanks in Fig. 7.2.

[2]

2. On Fig. 7.2, draw, and label with D, the transitions giving rise to the 2 darks lines from **(a)**. [2]

[Total: 12]

Section B

Answer **one** question from this Section in the spaces provided.