6 The energy E, in eV, of the electron energy levels in a hydrogen atom may be determined using the expression

$$E = -\frac{13.6}{n^2}$$

where n is the energy level.

(a) **(i)** Calculate the energy, in eV, of energy level $n = 2$.

energy = ... eV [1]

(ii) Explain why the energy of each energy level is negative.

.....

..... [1]

(b) A sample of low-pressure cool hydrogen gas is illuminated with monochromatic electromagnetic radiation of 103 nm. Some of the atoms are excited from the $n = 1$ level to the $n = 3$ level.

A spectrometer is placed near the sample of hydrogen gas, as shown in Fig. 6.1.

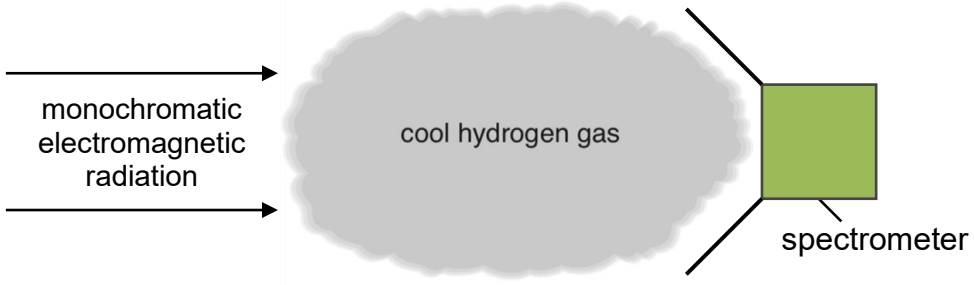

Fig. 6.1

Three wavelengths are detected by the spectrometer. One of the wavelengths is the incident radiation.

(i) The hydrogen glows faintly. Only transitions from $n = 3$ level to the $n = 2$ level lead to emission of visible light photons.

Determine the wavelength of the visible light photons and state the colour of the glow.

wavelength = ... m

colour: ..... [2]

(ii) Determine the third wavelength detected.

wavelength = ... m [2]

(iii) Explain why the number of photons measured over a duration for the wavelengths in **(i)** and **(ii)** is equal.

.....

.....

..... [1]

(iv) On Fig. 6.2, sketch the number of photons against wavelength graph of the spectrum detected over a duration.

Fig. 6.2

[3]

[Total: 10]