7 **(a)** A beam of white light passes through a cloud of cool gas. The spectrum of the transmitted light is viewed and contains a number of dark lines.

Explain why these dark lines occur.

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..... [4]

(b) Some energy levels for the electron in an isolated hydrogen atom are illustrated in Fig. 7.1.

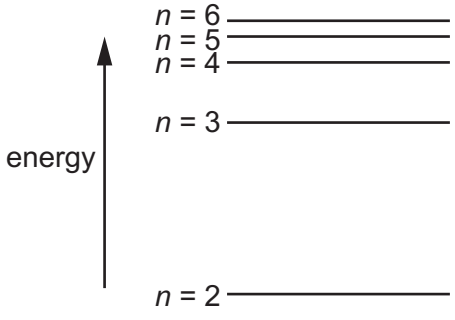

Fig. 7.1

Table 7.1 shows the wavelengths of photons that are emitted in the transitions to $n = 2$ from the other energy levels shown in Fig. 7.1.

Table 7.1

wavelength / nm
412
435
488
658

The energy associated with the energy level $n = 2$ is $-3.40\,\text{eV}$.

Calculate the energy, in J, of energy level $n = 3$.

energy = ... J [3]

[Total: 7]