Find the wavelengths in a hydrogen spectrum between the range 500 nm to 700 nm.

olution : The energy of a photon of wavelength 500 nm is

$$\frac{hc}{\lambda} = \frac{1242 \text{ eV nm}}{500 \text{ nm}} = 2{\cdot}44 \text{ eV}.$$

The energy of a photon of wavelength 700 nm is

$$\frac{hc}{\lambda} = \frac{1242 \text{ eV nm}}{700 \text{ nm}} = 1{\cdot}77 \text{ eV}.$$

The energy difference between the states involved in the transition should, therefore, be between 1·77 eV and 2·44 eV.

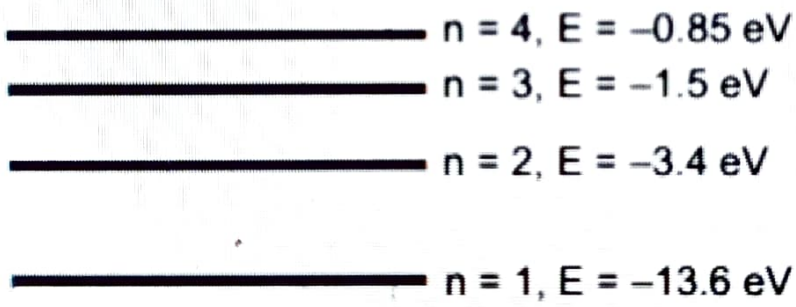

Figure 43-W1

Figure (43-W1) shows some of the energies of hydrogen states. It is clear that only those transitions which end at $n = 2$ may emit photons of energy between 1·77 eV and 2·44 eV. Out of these only $n = 3 \rightarrow n = 2$ falls in the proper range. The energy of the photon emitted in the transition $n = 3$ to $n = 2$ is $\Delta E = (3{\cdot}4 - 1{\cdot}5)$ eV $= 1{\cdot}9$ eV. The wavelength is

$$\lambda = \frac{hc}{\Delta E}$$

$$= \frac{1242 \text{ eV nm}}{1{\cdot}9 \text{ eV}} = 654 \text{ nm}.$$