Oxford Cambridge and RSA

A Level Physics A

H556/01 Modelling physics

Question Set 9

1 (a) Fig. 21.1 shows some of the energy levels of electrons in hydrogen gas atoms. The energy levels are labelled **A**, **B**, **C** and **D**.

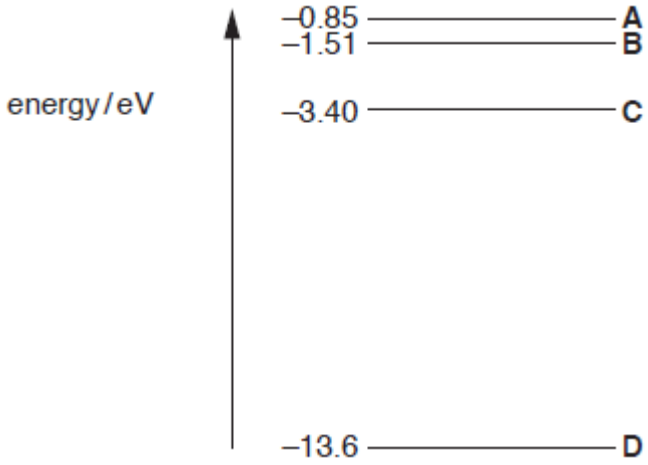

Fig. 21.1 (not to scale)

(i) Explain why the energy levels are negative. **[1]**

(ii) An electron makes a transition (jump) from level **C** to level **A**.

1 Calculate the energy gained by this electron.

energy = ... eV **[1]**

2 Calculate the wavelength in nm of the photon absorbed by this electron.

wavelength = ... nm **[3]**

(b) Light from a distant galaxy is passed through a diffraction grating. Fig. 21.2 shows the part of the spectrum of light that shows a strong hydrogen-alpha emission line.

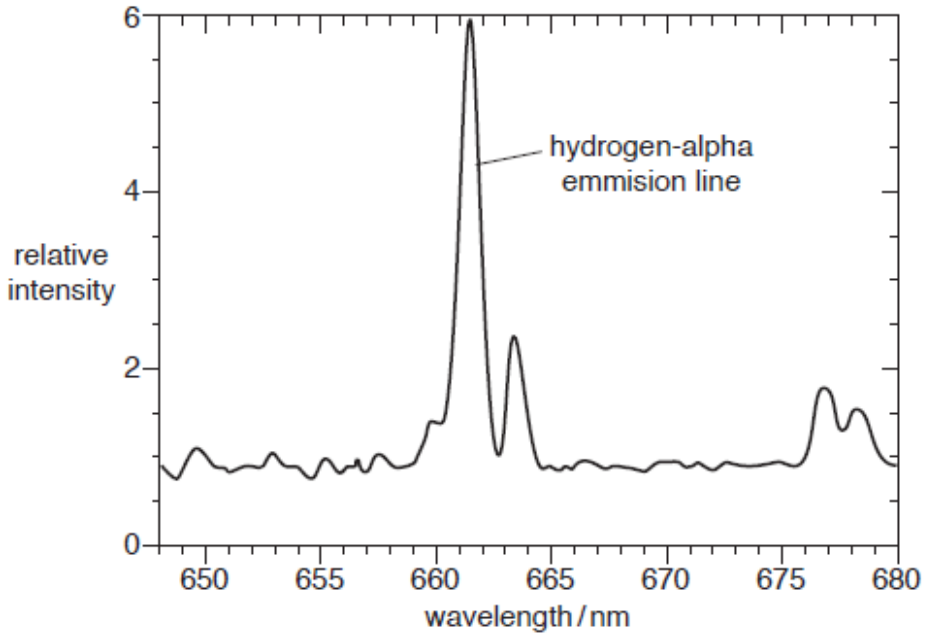

Fig. 21.2

(i) State how an emission line is produced. **[1]**

(ii) State an adjustment that could be made to the experimental arrangement that would space the emission lines more widely. **[1]**

(iii) In the laboratory, the wavelength of the hydrogen-alpha emission line is 656.3 nm. Use Fig. 21.2 to determine the recession velocity of the galaxy.

recession velocity = …….. $m\,s^{-1}$ **[3]**

(iv) Suggest why hydrogen spectral lines play an important role in determining red shift of galaxies. **[1]**

(c) Light from a similar star is viewed in a galaxy **further** away. The star is part of a pair of stars which orbit a common centre of mass.
Describe and explain how the equivalent spectrum might appear. **[3]**

Total Marks for Question Set 9: 14