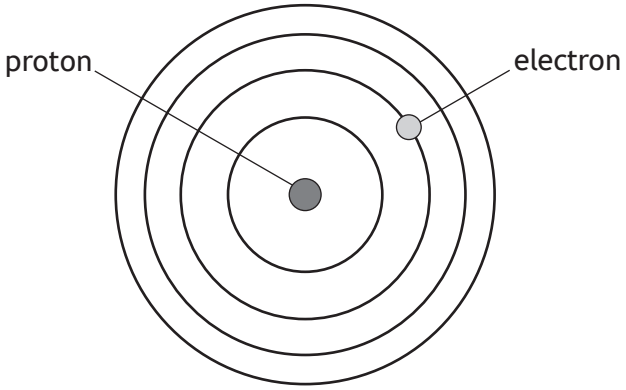
10. The Bohr model of the hydrogen atom can be represented by the diagram shown. **MARKS** DO NOT WRITE IN THIS MARGIN



(a) One of the features of the Bohr model of the hydrogen atom is that the electron can only occupy discrete energy levels.

State one other feature of the Bohr model of the hydrogen atom. **1**

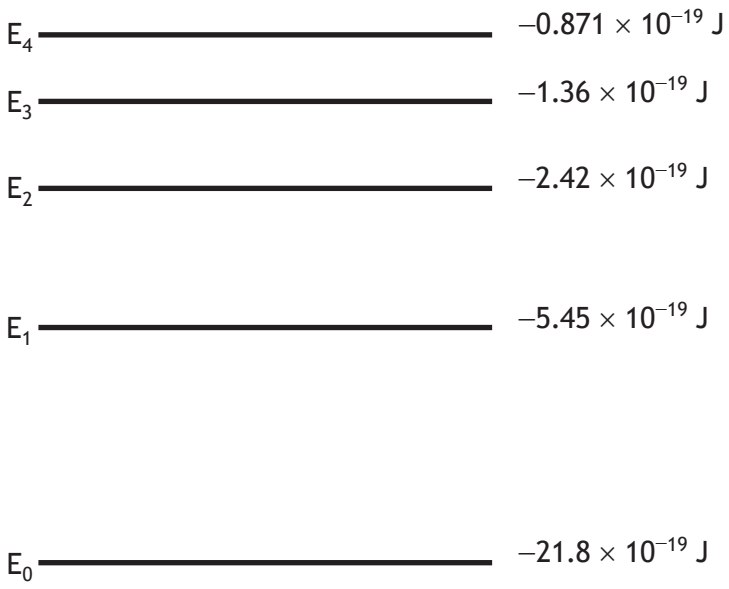
(b) The line emission spectrum from a hydrogen discharge lamp has four lines in the visible region of the electromagnetic spectrum, as shown.

(i) Explain how a line emission spectrum is produced. **2**

(ii) Explain why some of these lines appear brighter than others. **2**

10. (continued)

(c) Some of the energy levels of the hydrogen atom are shown.



(i) State the number of possible emission lines caused by the transition of electrons between the energy levels shown. **1**

(ii) (A) One of the emission lines produced is due to electron transitions from E_4 to E_1.

Calculate the frequency of the photon emitted when an electron makes this transition. **3**

Space for working and answer

10. (c) (ii) (continued)

(B) The photons produced by a different electron transition correspond to the blue-green spectral line in the hydrogen emission spectrum.

State the wavelength of these photons. **1**

(C) A distant galaxy has a recessional velocity of 4.52×10^6 m s^{-1}.

The hydrogen emission spectrum from the distant galaxy is viewed on Earth.

Determine the observed wavelength of the same spectral line as in (c) (ii) (B), when viewed on Earth. **5**

Space for working and answer