7 **(a)** Briefly describe the concept of a photon.

.....

..... [1]

(b) Explain how line spectra of gases at low pressure provide evidence for discrete electron energy levels in atoms.

.....

.....

.....

..... [2]

(c) Fig. 7.1 shows the energy levels of hydrogen atoms.

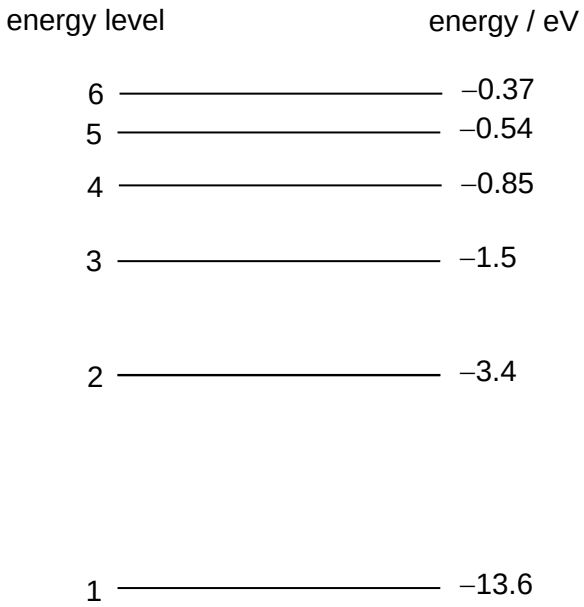

Fig. 7.1

Cool hydrogen atoms in a discharge tube are bombarded with electrons of energy 13.2 eV. Determine the frequency of the most energetic photons emitted during the subsequent transition between the energy levels.

highest frequency = ……..……..……..Hz [3]

(d) The hydrogen emission spectrum produced in **(c)** is used to illuminate the surface of Caesium metal by passing through a diffraction grating as shown in Fig. 7.2.

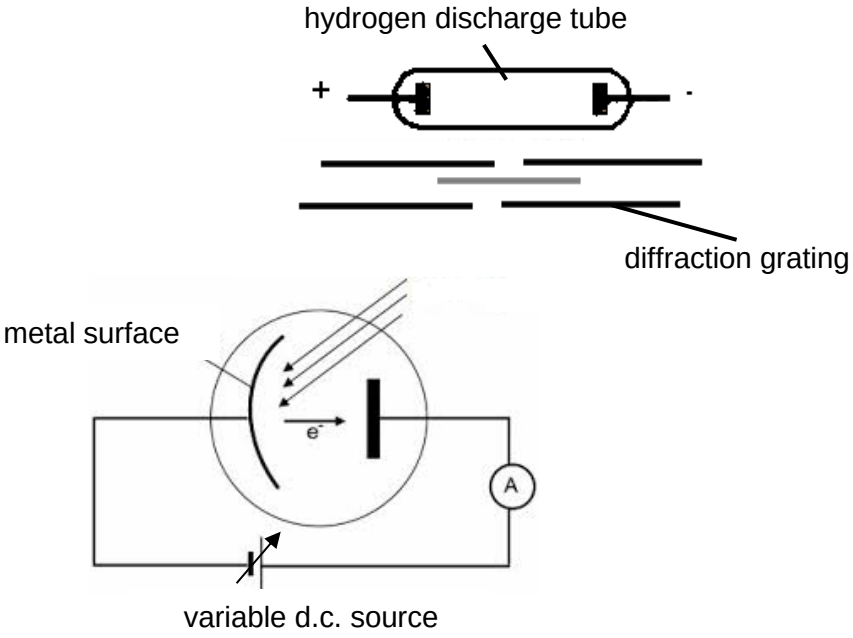

Fig. 7.2

When the Caesium metal surface is illuminated with visible light corresponding to the transition from level 5 to level 2, the minimum collector voltage required to reduce the ammeter reading to zero is –0.72 V.

(i) Explain why a minimum negative potential difference between the electrodes needs to be applied to reduce the current to zero.

……

…… [1]

(ii) Calculate the work function of the Caesium metal surface.

work function = …….……..…….. J [2]

(iii) When the magnitude of the collector voltage is decreased, the ammeter reading becomes 0.21 μA.

If on average one electron is emitted for every 10^5 incident photons, show that the estimated number of photons hitting the Caesium surface per second is 1.31×10^{17} s^{-1}.

[1]