6(a) The graph in Fig 6.1 shows the spectrum of the visible light coming from a bright star. These lines correspond to the Balmer series for hydrogen gas which are transitions from higher energy levels to level $n = 2$.

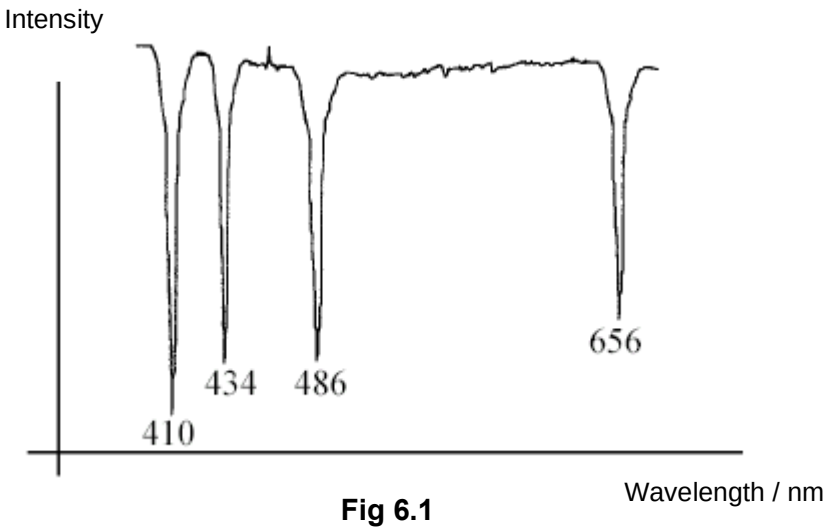

Fig 6.1

(i) State and explain the type of spectrum shown in Fig. 6.1 [2]

……

……

(ii) Given that the energy of level $n = 2$ is -5.44×10^{-19} J, calculate the energy in eV of level $n = 3$, E_3. [3]

E_3 = …… eV

(b) Ultra-violet radiation of wavelength 184 nm is shone on a cathode within a vacuum tube as shown in Fig 6.2 and photoelectrons are observed to be emitted.

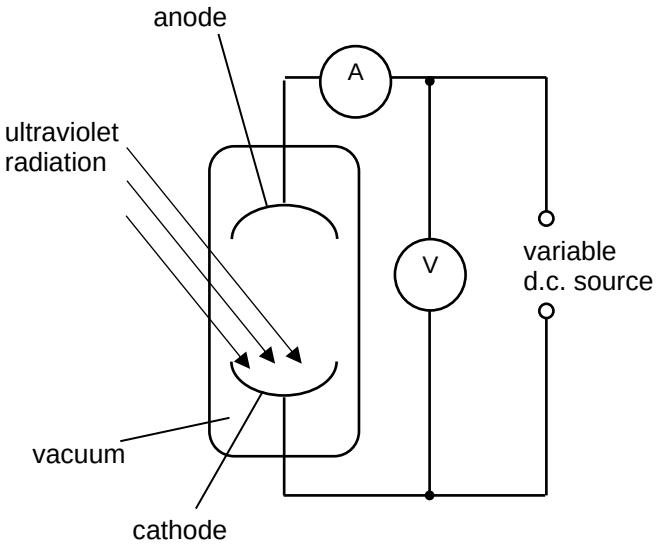

Fig 6.2

The potential difference across the cathode and anode is varied and the corresponding value of the current is measured with the ammeter. Fig 6.3 shows the relationship between these two quantities.

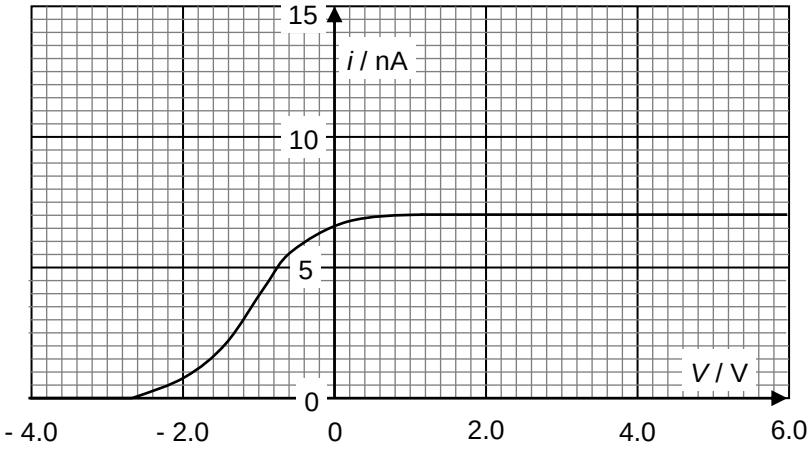

Fig 6.3

(i) The presence of a threshold frequency is an evidence for the particulate nature of electromagnetic radiation.

Explain why the wave nature of electromagnetic radiation does not support this observation. [2]

……

……

……

……

(ii) Determine the work function in joules of the cathode. [3]

Work function = …….. J

(iii) The cathode is replaced with a metal with **lower** work function.
Sketch, on Fig. 6.3, the new *i-V* graph. [1]