6 In a photoelectric experiment, a beam of radiation of wavelength 620 nm from a laser of intensity 400 W m^{-2} is used to irradiate a silver surface of area 100 mm^2 in an evacuated photocell as shown in Fig. 6.1. The experiment is then repeated with another radiation of the same intensity but of unknown wavelength.

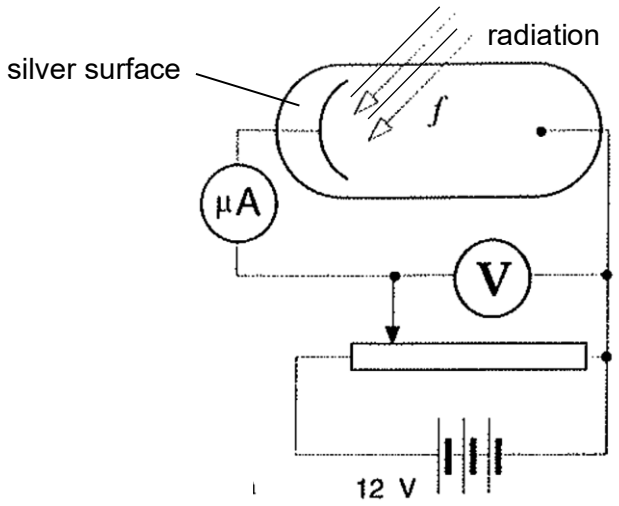

Fig. 6.1

Fig 6.2 shows the variation with voltage *V* across the electrodes of the photocurrent *I* for the two radiations used.

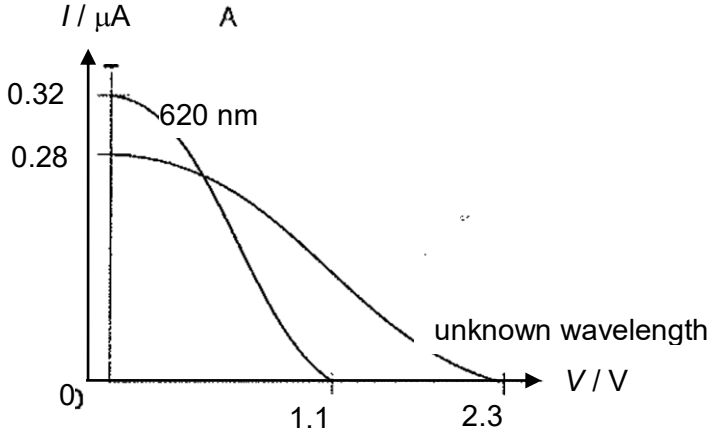

Fig. 6.2

(a) (i) Using Fig. 6.2, determine the wavelength of the unknown radiation.

wavelength = …….. m [3]

(ii) Hence explain why this unknown radiation produces a lower saturation current as compared to the radiation with a wavelength of 620 nm.

……...

……...

……...

…….. [2]

(b) In the Coolidge tube (also called a hot cathode tube), electrons are produced from a filament heated by an electric current as shown in Fig. 6.2. A large accelerating potential difference is set up between the filament and the target material. The electrons are accelerated from the filament and hit the target material to emit x-ray photons.

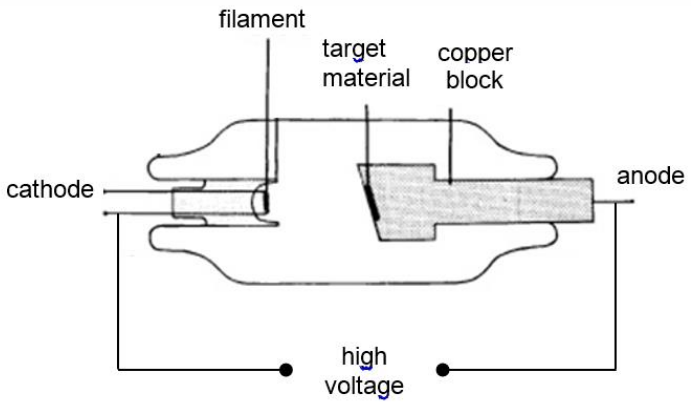

Fig. 6.2

A graph of intensity against frequency of the emitted radiation is plotted as shown in Fig 6.3.

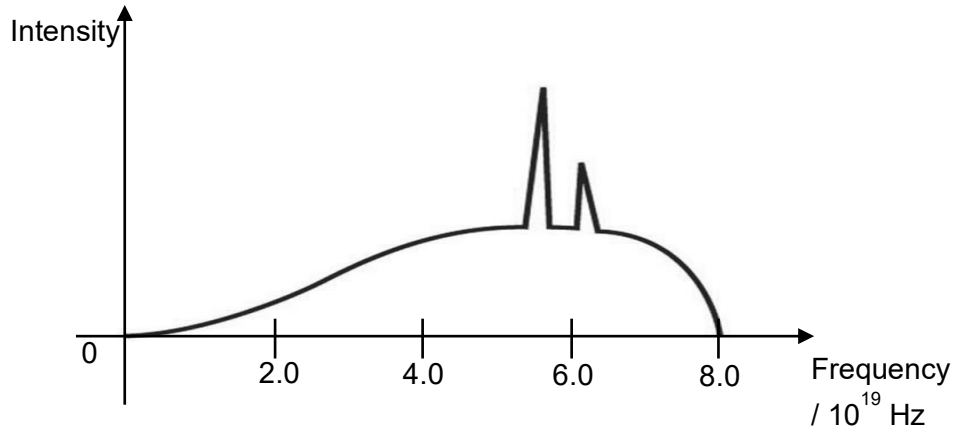

Fig. 6.3

(i) Explain why there is a maximum frequency as shown in Fig. 6.3

……

…… [1]

(ii) Determine the maximum energy of the X-ray photons emitted.

maximum energy = …….. MeV [1]

(iii) Sketch on Fig. 6.3, a graph to show the intensity variation with frequency if the current in the filament increases. Label this graph P. [1]

(iv) Sketch on Fig. 6.3, a graph to show the intensity variation with frequency if the accelerating potential is reduced to one half of its original value. Label this graph Q. [1]

(c) Fig. 6.4 shows the lowest five energy levels for a hydrogen atom.

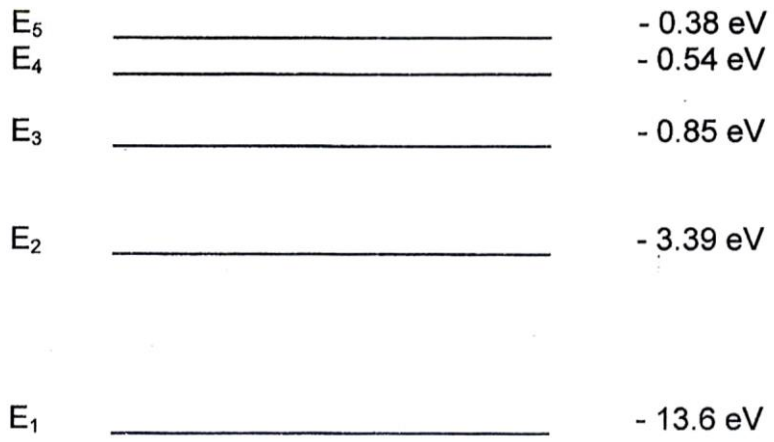

Fig. 6.4

Hydrogen atoms are contained in a low pressure vapour lamp. Electrons in the vapour are accelerated from rest by a potential difference *V* and subsequently bombard the hydrogen atoms. A line corresponding to a wavelength of 436 nm is observed in the line spectrum.

(i) Deduce the energy levels involved in the transition to produce this wavelength.

the transition is from …….. to …….. [2]

(ii) State and explain the minimum value of *V* used to give rise to the transition in **(i)**.

……

……

……

…… [1]

Section B

Answer **one** question from this section in the spaces provided.