**6** **(a)** **(i)** Distinguish between the appearance of a visible line emission spectrum and a visible line absorption spectrum.

……

……

……

…….. [2]

**(ii)** A hot gas emits light that, when passed through a prism, forms a line emission spectrum on a screen, as shown in Fig. 6.1.

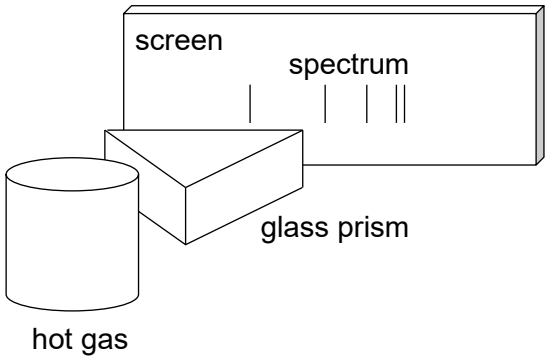


**Fig. 6.1**

Using Fig. 6.1, explain how a line emission spectrum is formed.

……

……

……

……

……

…….. [3]

**(iii)** Some electron energy levels of the hydrogen atom are illustrated in Fig. 6.2.

The heat supplied to the hot gas is reduced, such that electrons cannot be excited above −1.0 eV.

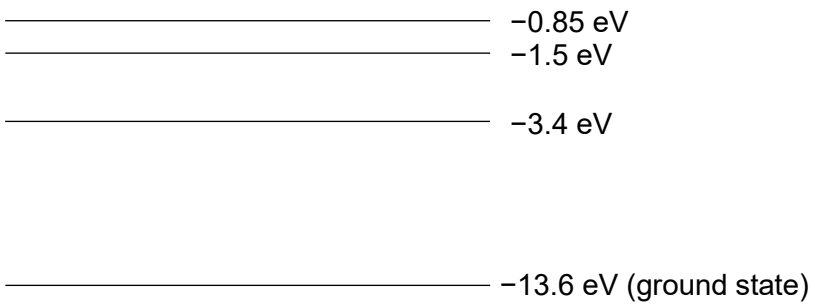


**Fig. 6.2**

On Fig. 6.2, sketch the possible transitions for an excited electron. [1]

**(iv)** On Fig. 6.3, sketch the resulting line emission spectrum.

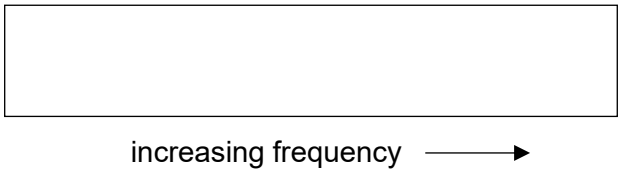


**Fig. 6.3**

[1]

**(b)** Fig. 6.4 shows the setup of an X-ray tube. Electrons, emitted from the cathode, are accelerated to hit the metal target at a high speed, producing X-ray as a result.

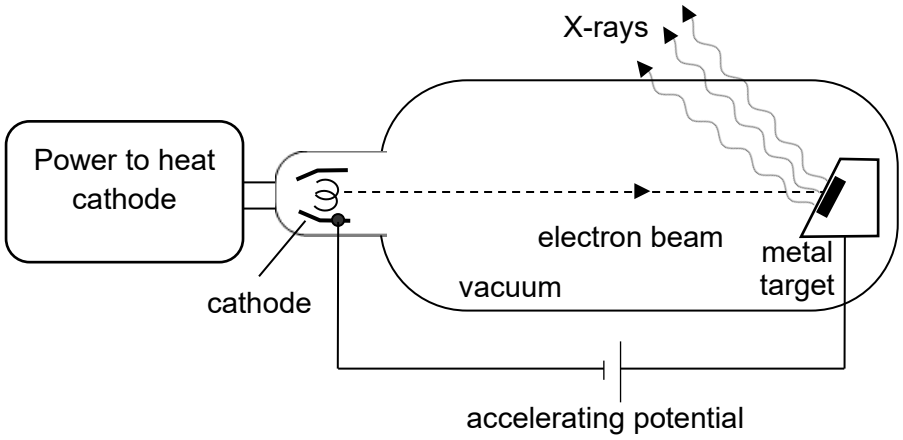


**Fig. 6.4**

Fig. 6.5 shows the resulting X-ray spectrum, with characteristic X-ray wavelengths A, B, C, D and E.

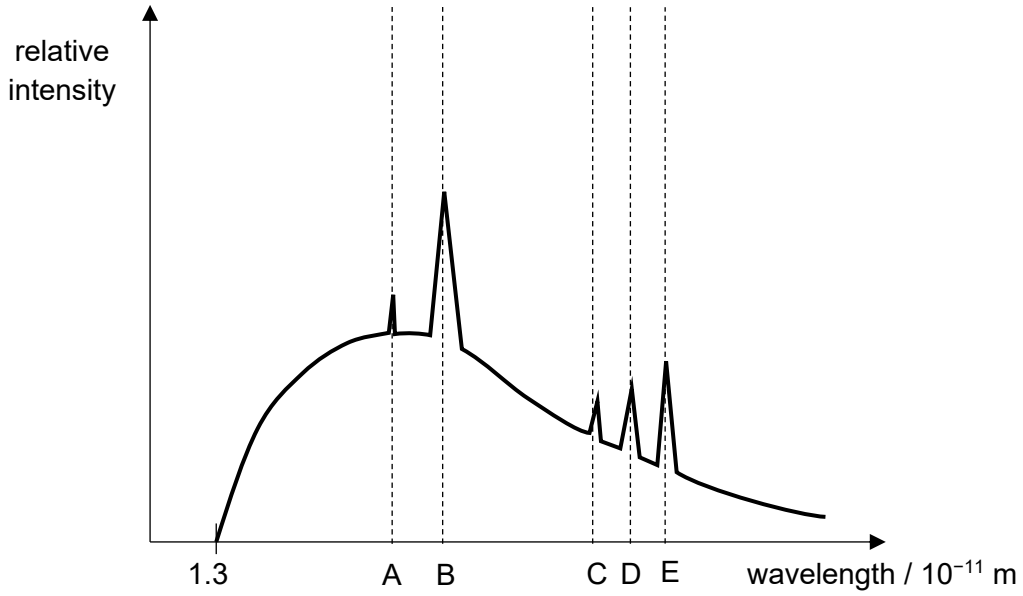


**Fig. 6.5**

**(i)** Show that the maximum energy of the X-ray photons emitted is $1.5 \times 10^{-14}$ J.

[1]

**(ii)** Calculate the momentum of the electrons striking the metal X-ray source.

momentum = …….. kg m $s^{-1}$ [2]

**(iii)** Calculate the de Broglie wavelengths of the electrons striking the metal X-ray source.

wavelength = …… m [2]

**(iv)** State which characteristic wavelength has the highest probability of occuring.

…….. [1]

**(v)** The power used to heat the cathode is increased.

On Fig. 6.5, sketch the resulting X-ray spectrum. [2]

## End of Section A

## Section B

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