7 **(a)** An electron is moving with a kinetic energy of 4.96×10^{-24} J.

(i) Show that its momentum is 3.0×10^{-27} kg m s^{-1}.

[1]

(ii) Hence, determine the wavelength of ultraviolet light with the same momentum as that calculated in **(a) (i)**.

wavelength = ... m [2]

(b) A heated filament at one end of a fluorescent tube emits electrons through a process known as thermionic emission. These electrons are then accelerated by a potential difference applied between the two ends of the tube.

The accelerated electrons collide with the atoms of mercury vapour contained within the tube as shown in Fig. 7.1 to emit UV light.

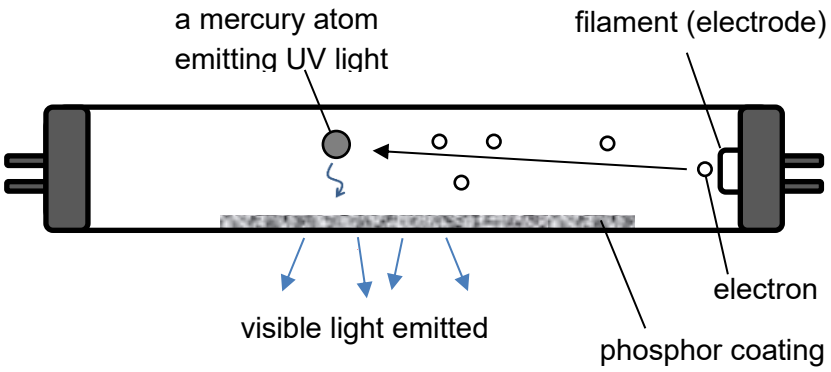
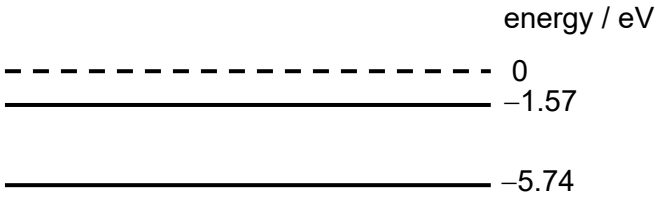


Fig. 7.1

Some of the energy levels of a mercury atom are represented in Fig. 7.2.



(i) Explain why the energy of each energy level is negative.

.....

.....

[1]

(ii) In one particular interaction, an electron with kinetic energy 9.0 eV collides with a mercury atom at ground state.

Use Fig. 7.2 to determine the longest wavelength of UV radiation that can be emitted due to this interaction.

wavelength = ... m [3]

(iii) The UV photons emitted by the mercury atoms strike the phosphor coating on the inside of the fluorescent tube. The phosphor absorbs the UV photons and emits visible light by “fluorescence”. Some amount of infrared radiation is also emitted.

Fig. 7.3 shows three energy levels E_1, E_2 and E_3 of an atom in the phosphor that are involved in the absorption of UV and emission of infrared and visible light.

On Fig. 7.3, draw arrows to indicate the following transitions:

(1) absorption of a UV photon
(2) emission of an infrared photon
(3) emission of a red light photon

Label the transitions clearly.

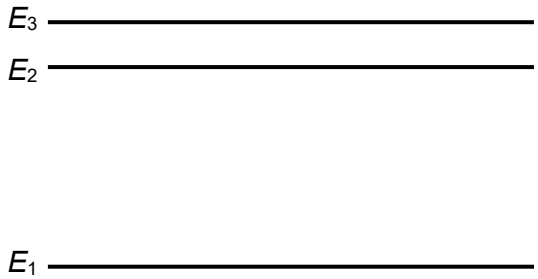


Fig. 7.3

[1]

Section B

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

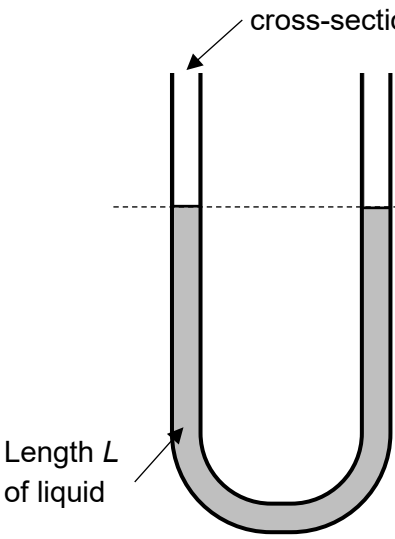


Fig. 8.1

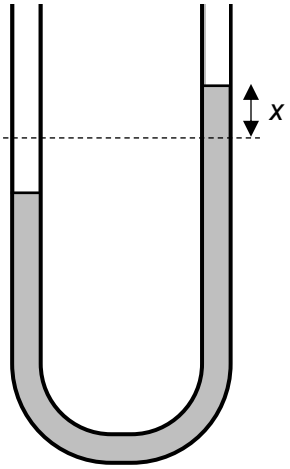


Fig. 8.2