9 **(a)** Explain what is meant by a *photon*.

……..……..…

……..……[2]

(b) An X-ray photon of wavelength 6.50 × 10^{-12} m is incident on an isolated stationary electron, as illustrated in Fig. 9.1.

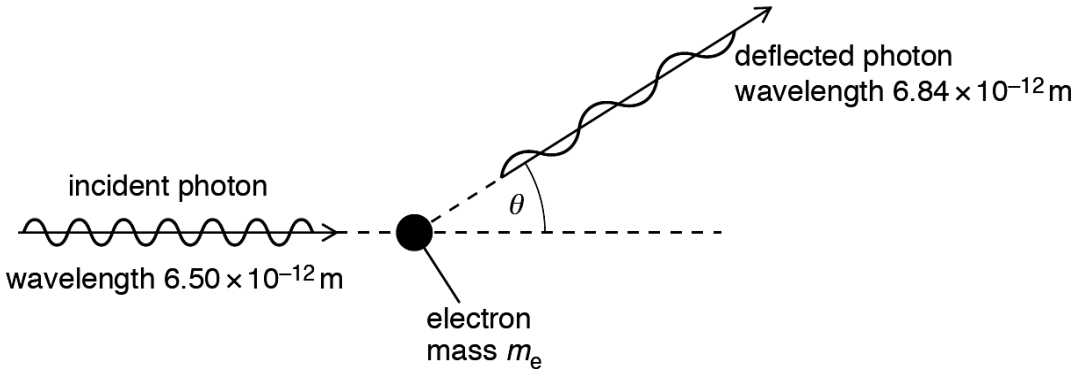

Fig. 9.1

The photon is deflected elastically by the electron of mass m_e. The wavelength of the deflected photon is 6.84 × 10^{-12} m.

(i) On Fig. 9.1, draw an arrow to indicate a possible initial direction of motion of the electron after the photon has been deflected.
[1]

(ii) Calculate

1. the change in energy of the deflected photon.

change in photon energy = …… J [2]

2. the speed of the electron after the photon has been deflected.

speed = …… m s^{-1} [2]

(iii) The electron is deflected at an angle of 70° to the horizontal.

Calculate the angle θ through which the photon is deflected.

θ = ... ° [3]

(c) The deflected photon in Fig. 9.1 falls on a metal surface of work function 180 keV. Photoelectrons are emitted.

(i) Calculate the maximum kinetic energy of the photoelectrons.

maximum kinetic energy = ... J [2]

(ii) Calculate the stopping potential of the photoelectrons

stopping potential = …… kV [2]

(iii) Explain why the kinetic energy of the photoelectrons is described as maximum.

…….....

…….[1]

(d) The electron in **(b)(ii)2** collided with an atom with the 5 lowest energy levels shown in Fig. 9.2.

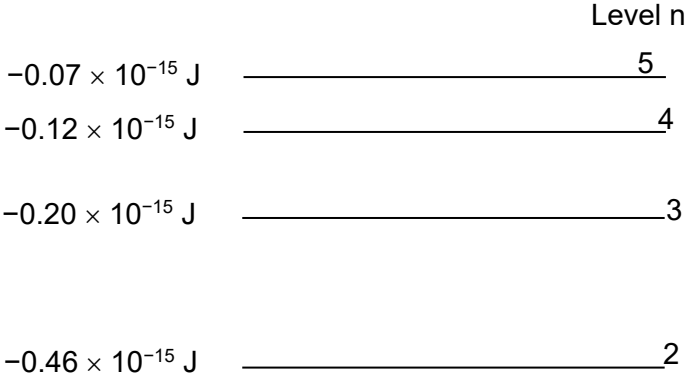

Fig. 9.2

The atom is initially at ground state. As a result of the collision, the atom transits to an excited state.

(i) Calculate the remaining energy of the recoiling electron after the collision.

energy = …… J [3]

(ii) State and explain whether the atom will transit to higher energy level if a photon of identical energy is incident on the atom.

……

……[2]

END OF PAPER