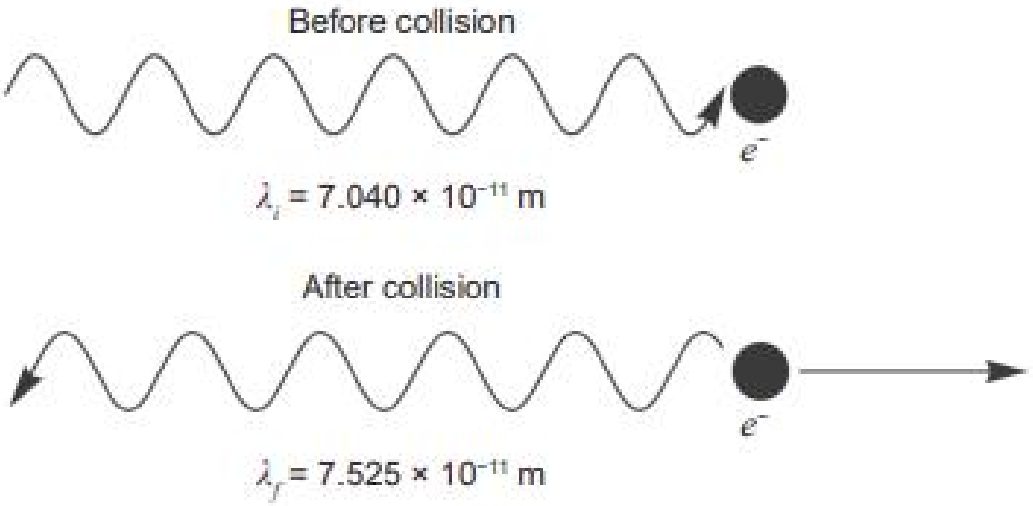
Question 13 **(14 marks)**



A stationary free electron and a photon collide. In such collisions, both momentum and energy are conserved. In one such collision, a photon of wavelength 7.040×10^{-11} m is travelling in the direction shown in the diagram above. After the collision, the photon returns in the direction it came from (i.e. 180°) with a new wavelength of 7.525×10^{-11} m and the electron is no longer stationary. No other particles or photons are produced in the collision.

(a) What is the original energy of the photon in eV? (3 marks)

Answer: _____ eV

(b) What is the momentum of the photon before the collision? (2 marks)

Answer: _____ N s

(c) Explain why the wavelength of the photon is greater after the collision. (3 marks)

(d) Calculate the speed of the electron after the collision. (Hint: use the principles of conservation of energy.) (6 marks)

Answer: _____ m s^{-1}