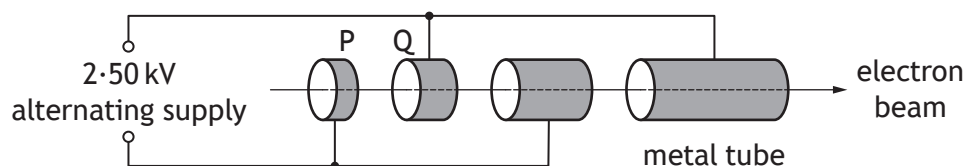


8. X-ray machines are used in hospitals.

An X-ray machine contains a linear accelerator that is used to accelerate electrons towards a metal target.

The linear accelerator consists of hollow metal tubes placed in a vacuum.



Electrons are accelerated across the gaps between the tubes by an alternating supply.

- (a) (i) Calculate the work done on an electron as it accelerates from P to Q. 3  
*Space for working and answer*

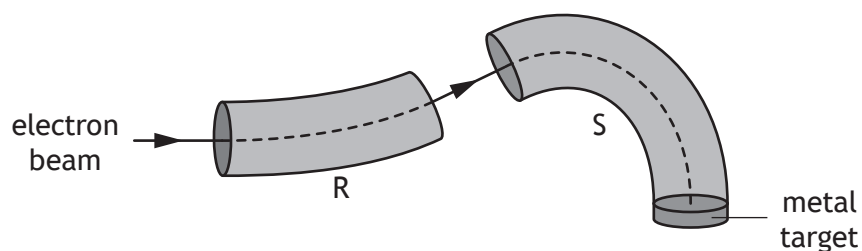
- (ii) Explain why an alternating supply is used in the linear accelerator. 1

8. (continued)

- (b) The electron beam is then passed into a “slalom magnet” beam guide. The function of the beam guide is to direct the electrons towards a metal target.

Inside the beam guides R and S, two different magnetic fields act on the electrons.

Electrons strike the metal target to produce high energy photons of radiation.



- (i) Determine the direction of the magnetic field inside beam guide R. 1
- (ii) State **two** differences between the magnetic fields inside beam guides R and S. 2
- (c) Calculate the minimum speed of an electron that will produce a photon of energy  $4.16 \times 10^{-17} \text{ J}$ . 3
- Space for working and answer*