15 A series of experiments was carried out in the 1970s to investigate the structure of protons using the linac at Stanford, USA.

*(a) Explain how an electron is accelerated in a linac.

(6)

(b) The electron leaves the accelerator with a high energy.

Explain why electrons need high energies to investigate the structure of a proton.

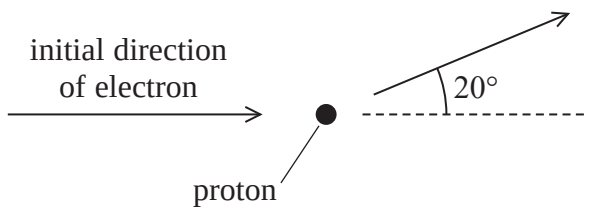
(2)

(c) An electron leaves the accelerator with a momentum of 20 GeV/c.

(i) Explain, with reference to base units, why GeV/c can be used as a unit of momentum.

(2)

(ii) An electron with initial momentum 20 GeV/c collides with a stationary proton. After the collision the electron is deflected by an angle of 20° as shown and its momentum is 9.1 GeV/c. The momentum of the proton after the collision is 11.9 GeV/c.



Deduce whether the law of conservation of momentum is obeyed.

(3)

(iii) The collisions between electrons and the protons in these experiments are sometimes inelastic.

State what is meant by an inelastic collision.

(1)

(Total for Question 15 = 14 marks)