13 In the early part of the 20th century, Rutherford made the first observation of an element being changed into a different element.

Alpha particles were fired at nitrogen atoms.

The nuclear equation for this reaction is:

$$^{4}_{2}\mathrm{He} + {}^{14}_{7}\mathrm{N} \rightarrow {}^{17}_{8}\mathrm{O} + {}^{1}_{1}\mathrm{H}$$

(a) Calculate the minimum energy, in MeV, required for the reaction to take place.

(4)

Nuclide	Mass / 10^{-27} kg
^{17}O	28.2185
^{14}N	23.2451
^{4}He	6.64432
^{1}H	1.67299

Minimum energy = ... MeV

(b) Explain why the alpha particle must have an energy greater than the minimum energy for the reaction to take place.

(2)

(Total for Question 13 = 6 marks)