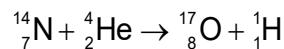


- 7 The discovery of the proton was credited to Ernest Rutherford. In 1917, he fired a beam of α particles into pure nitrogen gas which resulted in the production of oxygen and protons. The nuclear reaction is given by the equation



- (a) State what is meant by the binding energy of a nucleus and how it is related to the mass defect.

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[2]

- (b) Data for some masses are given in Table 7.1.

		mass / u
proton	${}_{1}^{1}\text{H}$	1.007 276
neutron	${}_{0}^{1}\text{n}$	1.008 665
nitrogen-14	${}_{7}^{14}\text{N}$	14.003 074

Table 7.1

- (i) Show that the energy equivalent of 1.00 u is 934 MeV.

[2]

- (ii) Using data from Table 7.1, show that the binding energy per nucleon of nitrogen-14 is 7.24 MeV.

[2]

- (c) The binding energy per nucleon for the other nuclides is shown in Table 7.2.

		binding energy per nucleon / MeV
helium	${}_2^4\text{He}$	6.836
oxygen-17	${}_8^{17}\text{O}$	7.530

Table 7.2

- (i) Use data from Table 7.2 to determine, to three significant figures, the energy released in this reaction associated with the change in mass.

energy released = MeV [2]

- (ii) State and explain whether the reaction will take place if the incident α -particle has a kinetic energy of 0.300 MeV. You may assume that the nitrogen-14 nucleus is at rest.

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[2]