12 One possible nuclear reaction that takes place is

$$^{235}_{92}\text{U} + ^{1}_{0}\text{n} \rightarrow ^{95}_{42}\text{Mo} + ^{139}_{57}\text{La} + 2^{1}_{0}\text{n} + 7^{0}_{-1}\text{e}$$

Data for nuclei in this reaction are given in Fig. 12.1.

nucleus	mass / u	total mass of separate nucleons / u	mass defect / u	binding energy per nucleon / MeV
$^{95}_{42}$Mo	94.906	95.765	0.859	8.443
$^{139}_{57}$La	138.906	140.125	1.219	8.189
$^{235}_{92}$U	235.044	236.909	1.865	.....

Fig. 12.1

(a) Show that the energy equivalent to a mass of 1.00 u is 934 MeV.

[2]

(b) **(i)** Use data from Fig. 12.1 to calculate the binding energy per nucleon of a nucleus of uranium-235 ($^{235}_{92}$U). Complete Fig. 12.1.

[2]

(ii) The nucleon number of an isotope of the element rutherfordium is 267.

State whether the binding energy per nucleon of this isotope will be greater than, equal to or less than the binding energy per nucleon of uranium-235.

..... [1]

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(c) Calculate the total energy, in MeV, released in this nuclear reaction.

energy = ... MeV [2]

(d) The nuclei in 1.2×10^{-7} mol of uranium-235 all undergo this reaction in a time of 25 ms.

Calculate the average power release during the time of 25 ms.

power = ... W [3]

[Total: 10]

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