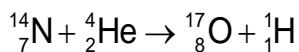


- 6 (a) When an α -particle bombards a stationary nitrogen-14 nucleus, the following nuclear reaction may occur.



The rest masses of the nuclei are

${}^{14}_7\text{N}$ 14.007525u

${}^4_2\text{He}$ 4.003860u

${}^{17}_8\text{O}$ 17.004507u

${}^1_1\text{H}$ 1.008142u

- (i) Deduce that the energy associated with the change in mass in this reaction is approximately 1.9×10^{-13} J.

[2]

- (ii) By reference to energy, suggest how it is possible for this reaction to occur.

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.....
.....

[2]

- (iii) The oxygen-17 nucleus and the hydrogen nucleus move apart after the reaction.

1. Explain why the oxygen-17 nucleus and the hydrogen nucleus move after the reaction.

.....
.....
.....

[1]

2. Describe the effect of this movement on your answer in (ii).

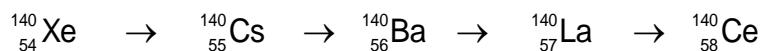
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[1]

- (b)** Products of a radioactive decay can be radioactive as well and give rise to a series of radioactive decay products. Each decay product has its own half-life, but eventually a stable nuclide is reached.

One such nuclide is xenon-140 ($^{140}_{54}\text{Xe}$), which eventually decays into cerium-140 ($^{140}_{58}\text{Ce}$), which is stable.

The series of decay products is as follow:



The half-lives of the radioactive nuclides are given in Fig. 6.1.

Nuclide	Half-life
xenon-140 $^{140}_{54}\text{Xe}$	16 s
caesium-140 $^{140}_{55}\text{Cs}$	1.1 minute
barium-140 $^{140}_{56}\text{Ba}$	13 days
lanthanum-140 $^{140}_{57}\text{La}$	40 hours

Fig. 6.1

- (i) Initially, the total mass of undecayed xenon-140 in a radioactive sample is 5.7×10^{-12} kg.

Calculate the activity of the undecayed xenon-140 in the sample after 60 s.

activity = Bq [3]

- (ii) The activity of the sample after 1 minute is higher than the value calculated in (b)(i). Suggest a reason for the difference using the given data.

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.....
.....

[1]

[Total: 10]