7 **(a)** The masses of some nuclei are shown in Fig. 7.1.

	mass / u
proton ($^{1}_{1}\mathrm{p}$)	1.007
neutron ($^{1}_{0}\mathrm{n}$)	1.009
lanthanum-141 ($^{141}_{57}\mathrm{La}$) nucleus	140.911

Fig. 7.1

(i) Determine the number of neutrons in the lanthanum-141 nucleus.

number of neutrons = …… [1]

(ii) Use data from Fig. 7.1 to show that the binding energy of a nucleus of lanthanum-141 is 1162 MeV.

[3]

(iii) A plutonium-239 ($^{239}_{94}\mathrm{Pu}$) nucleus has binding energy of 1807 MeV.

By comparing the binding energy per nucleon of lanthanum-141 and plutonium-239, state and explain whether lanthanum-141 or plutonium-239 is more likely to undergo nuclear fission.

……..

……..

…… [3]

(b) Lanthanum-141 ($^{141}_{57}\text{La}$) undergoes radioactive decay to form cerium-141 ($^{141}_{58}\text{Ce}$) and a particle X. Particle X deflects as it moves through a magnetic field.

The decay can be represented by the equation

$$^{141}_{57}\text{La} \rightarrow {}^{141}_{58}\text{Ce} + \text{X}$$

(i) State what particle X is.

……. [1]

(ii) According to conservation laws of energy and momentum, when lanthanum-141 nuclide of fixed initial energy undergoes decay, the emitted particle X should have a specific energy value. However, experimental observations show that particle X are emitted with a range of energies from different lanthanum-141 nuclides.

Explain the experimental observations.

……..

……..

……. [2]