12 **(a)** State what is meant by the *binding energy* of a nucleus.

.....

.....

.....[2]

(b) Some masses are shown in Fig. 12.1.

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

Fig. 12.1

Calculate the binding energy of a nucleus of lanthanum-141.

binding energy = ... J [4]

(c) The nuclide lanthanum-141 ($^{141}_{57}$La) has a half-life of 3.9 hours.

Initially, a radioactive source contains only lanthanum-141. The initial activity of the source is A_0.

(i) Calculate the time for the activity of the lanthanum-141 to be reduced to $0.40A_0$.

time = ... hours [3]

(ii) Suggest why the total activity of the radioactive source measured at the time calculated in **(i)** may be greater than $0.40A_0$.

.....

.....[1]

[Total: 10]

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