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

.....

.....

..... [2]

(b) The following nuclear reaction takes place:

$$^{235}_{92}U + {}^{1}_{0}n \longrightarrow {}^{144}_{55}Cs + {}^{90}_{x}Rb + y\,{}^{1}_{0}n$$

(i) Determine the values of x and y.

x = ...

y = ...
[1]

(ii) State the name of this type of nuclear reaction.

..... [1]

(iii) Compare the binding energy per nucleon of uranium-235 with the binding energy per nucleon of caesium-144.

.....

..... [1]

(c) Yttrium-90 decays into zirconium-90, a stable isotope.

A sample initially consists of pure yttrium-90.

Calculate the time, in days, when the ratio of the number of yttrium-90 nuclei to the number of zirconium-90 nuclei would be 2.0.

The half-life of yttrium-90 is 2.7 days.

time = ... days [3]

[Total: 8]

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