

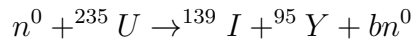
## Chapter 38 Problem 35 <sup>†</sup>

### Given

### Solution

Find the number of neutrons released in the neutron-induced fission of  $^{235}\text{U}$ .

The nuclear reaction of this process is as follows:



where  $b$  is the number of neutrons released in the process. This reaction needs to be neutron-induced because the half-life for  $^{235}\text{U}$  is  $7.04 \times 10^8$  yrs. However, if a neutron is absorbed it makes the nucleus unstable and it breaks into two nuclei,  $^{139}\text{I}$  and  $^{95}\text{Y}$ .

Since Uranium has 92 protons, the number of neutrons in  $^{235}\text{U}$  is

$$n_U = 235 - 92 = 143$$

Iodine has 53 protons. Therefore, the number of neutrons in  $^{139}\text{I}$  is

$$n_I = 139 - 53 = 86$$

Yttrium has 39 and, therefore,  $^{95}\text{Y}$  has

$$n_Y = 95 - 39 = 56$$

Therefore, the number of neutrons unaccounted for in the fission process is

$$n_{n^0} + n_U - n_I - n_Y = 1 + 143 - 86 - 56 = 2$$

The neutron-induced fission of  $^{235}\text{U}$  releases 2 neutrons. If one out of the two neutrons is used to initiate another reaction, the nuclear reaction will be self-sustaining. The mass that achieves this threshold is called the critical mass.

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<sup>†</sup>Problem from Essential University Physics, Wolfson