PHYSICS 6 HOMEWORK 5 SPRING 2006

due Tuesday Apr.25

generation	number of fissions in the generation
1	$2^0 = 1$
2	$2^1 = 2$
3	$2^2 = 2x2 = 4$
4	$2^3 = 4x2 = 8$
5	$2^4 = 8x2 = 16$
.	.
.	.
.	.
.	.
79	$2^{78} = 3.0x10^{23}$
80	$2^{79} = 6.0x10^{23}$
81	$2^{80} = 1.2x10^{24}$
82	$2^{81} = 2.4x10^{24}$

I. The fission process

$$n + {}^{235}_{92}U \rightarrow {}^{90}_{37}Rb + {}^{143}_{?}Cs + ?\ n + \text{Energy}$$

releases energy that you will calculate below.

a. How many neutrons are released?

b. What is Z for Cs (cesium)?

c. The masses of the nuclei are given below. What is the amount of mass that disappears (i.e. gets converted to other forms of energy) in the reaction? (Don't forget the neutrons.)

$M({}^{235}U) = 3.9184x10^{-25}$ Kg
$M({}^{90}Rb) = 1.4925x10^{-25}$ Kg
$M({}^{143}Cs) = 2.3892x10^{-25}$ Kg
$M(n) = 0.0167x10^{-25}$ Kg

d. The mass that disappears is converted to how much energy? (Express in MeV units.)

For the remainder, suppose 2.35 Kg of ^{235}U undergo fission in a bomb.

e. How many moles of the Uranium undergo fission?

f. How many nuclei undergo fission?

g. If each fission releases the energy you calculated in part (d), how much energy is released by the bomb (convert from MeV to Joules to kiloTons)?

h. How many generations were involved in the chain reaction?

i. If the <u>average</u> time for a neutron to reach a U nucleus and subsequently to induce fission in a critical mass is 10^{-8} sec, how long will it take to "burn" all the U nuclei that underwent fission in the bomb?

II. A single short-range missile is accidentally launched vertically from a launching tube. Its initial velocity upward as it leaves the tube is 400 m/s.

a. What is its Kinetic Energy when it reaches its highest point?

b. How high does it go (ignoring air resistance)?

c. After it reaches that highest point, how far does it fall in 10 sec.?

d. What is the missile's speed at that time (10 sec after the highest point was reached)?