WS 5.7 -- Effects & Applications of Nuclear Chemistry

Biological Effects

- acute (short term) damage
- chronic (long term) damage
- genetic damage

Application of Nuclear Chemistry

- preparation of artificial elements
- radioactive dating
- radioactive tracers (labels)
- cancer treatment
- medical diagnosis
- food preservation

Einstein's theory of special relativity

Use table 20.3 & Einstein's famous equation E=mc² to calculate the energy change (per mole) for the following nuclear reactions:

- 1. ${}^{2}_{1}H + {}^{3}_{2}He ---> {}^{4}_{2}He + {}^{1}_{1}H$
- 2. $^{238}_{92}$ ---> $^{234}_{90}$ Th + $^{4}_{2}$ He

 $J = kg \bullet (m/s)^2$ $\Delta E = \Delta m c^2$ Х $c = 3.00 \times 10^8 \text{ m/s}$

Table 20.3 Masses of Some Nuclei and Other Atomic Particles*

Symbol	Z	A	Mass (amu)	Symbol	Z	A	Mass (amu)
e ⁻	-1	0	0.000549	Co	27	59	58.9184
n	0	1	1.00867	Ni	28	58	57.9199
H or p	1 1 1	1 2 3	1.00728 2.01345 3.01550	Pb	82 82 82	206 207 208	205.9295 206.9309 207.9316
He	2 2	3 4	3.01493 4.00150	Ро	84 84	210 218	209.9368 217.9628
Li	3 3	6 7	6.01347 7.01435	Rn Ra	86 88	222 226	221.9703 225.9771
Be	4	9	9.00999	Th	90	230	229.9837
В	5 5	10 11	10.0102 11.0066	Pa	90 91	234 234	233.9942 233.9931
С	6 6	12 13	11.9967 13.0001	U	92 92	233 234	232.9890 233.9904
0	8	16	15.9905		92	235	234.9934
Cr	24	52	51.9273		92	238	238.0003
Fe	26	56	55.9206	Pu	94	239	239.0006

*The mass of an atom is obtained by adding the masses of the electrons to the nuclear mass given in this table. For example, the mass of the ${}^{12}_{2}C$ atom is 11.9967 + 6(0.000549) = 12.0000. (From R. C. Weast, ed., *CRC Handbook of Chemistry and Physics*, 59th ed. [Boca Raton, Fla.: CRC Press, Inc., 1978]. With permission of CRC Press, Inc.)

3. Plutonium-239 undergoing an alpha decay.



