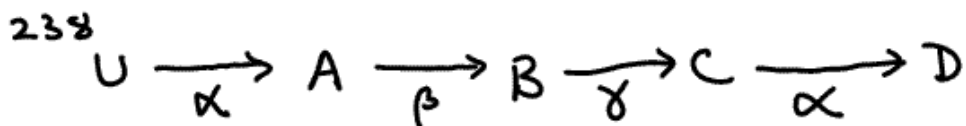


Physics 100 - Spring 2007 - Recitation 8

- ① Determine the nuclear product remaining after
- β^- decay of ^{211}Pb
 - α decay of ^{247}Cm
 - γ decay of ^{131}I
- ② Which is safer overall - a coal power plant or a nuclear power plant? what do you mean by "safe"? what are all the factors you should consider?
- ③ Sometimes radioactive isotopes decay to other isotopes that are also radioactive ... which decay to other isotopes that are radioactive, etc. This is called a "decay series". Here is the beginning of one such series:



What are nuclei A, B, C, D? (Z , A and symbol)

④ What fraction of a sample of ^{68}Ge will remain after 3 years?
($t_{1/2}$ of ^{68}Ge is ~ 9 months)

⑤ A small sample of charcoal from an archaeological site is measured to have an activity of 38000 decays/second
Approximately how many ^{14}C nuclei remain in the sample?
($t_{1/2}$ for ^{14}C = 5730 years)

6

When the atomic (fission) bomb was being developed, one of the scientists on the Manhattan project suggested that the detonation of the bomb might trigger fusion reactions in the atmosphere, causing a fusion chain reaction that could burn up the entire atmosphere of the earth. Other scientists calculated that under worst-case scenario assumptions the temperature needed to ignite fusion reactions in the atmosphere was a factor of 100 higher than that expected to occur in the midst of the fission explosion. So, these scientists were confident that the atmosphere would not be destroyed. This issue and the potential risk was not made public at the time.

What do you think about this?

Was the risk justified?

How certain should the science be to make you comfortable with such a risk?

What would you have done in such a situation if you were one of the scientists?

... what would you have done if you were the President at the time?

⑦ Each member of the class should wad up 3 sheets of paper.

All the students should bunch together in the center of the room holding their paper wads. Whenever a student is hit by a wad of paper they are to toss all three of their paper wads up into the air.

The TA now tosses one wad of paper into the center of the group of students.

→ Watch the "chain reaction"

Next, have $\sim\frac{2}{3}$ of the students carry 3 wads of paper while $\sim\frac{1}{3}$ of the students remain without wads of paper. These folks act as "control rods" in a nuclear reactor.

Now the TA tosses a wad of paper into the center of the group. . . . can you see the difference in the "chain reaction"?

8 An α -particle fuses with ${}^{16}_8\text{O}$. What is the nuclear product of this reaction?

Is energy released or absorbed when this reaction occurs? Is it easier or harder to remove a nucleon from the product nucleus than from the ${}^{16}_8\text{O}$ before the reaction takes place?

9 When an atom of uranium undergoes fission, approximately 1% of the mass is lost (converted to energy). In a uranium bomb similar to that dropped on Hiroshima, suppose that 10 kg of uranium undergoes fission. How much energy is released?

Express your answer in equivalent tons of TNT, where one ton of TNT releases 4.2×10^9 J when it explodes.

Los Alamos National Laboratory Chemistry Division

Periodic Table of the Elements

1A	1 H Hydrogen 1.008	2A	4 Be Beryllium 9.012	3B	21 Sc Scandium 44.96	4B	22 Ti Titanium 47.88	5B	23 V Vanadium 50.94	6B	24 Cr Chromium 52.00	7B	25 Mn Manganese 54.94	8B	26 Fe Iron 55.85	27 Co Cobalt 58.93	28 Ni Nickel 58.69	11B	29 Cu Copper 63.55	12B	30 Zn Zinc 65.38	3A	5 B Boron 10.81	4A	6 C Carbon 12.01	5A	7 N Nitrogen 14.01	6A	8 O Oxygen 16.00	7A	9 F Fluorine 18.99	8A	2 He Helium 4.003		
	3 Li Lithium 6.941		12 Mg Magnesium 24.31		39 Y Yttrium 88.91		40 Zr Zirconium 91.22		41 Nb Niobium 92.91		42 Mo Molybdenum 95.94		43 Tc Technetium (97)		44 Ru Ruthenium 101.1		46 Pd Palladium 106.4		47 Ag Silver 107.9		48 Cd Cadmium 112.4		13 Al Aluminum 26.98		14 Si Silicon 28.09		15 P Phosphorus 30.97		16 S Sulfur 32.07		17 Cl Chlorine 35.45		18 Ar Argon 39.95		
	19 K Potassium 39.10		20 Ca Calcium 40.08		38 Sr Strontium 87.62		40 Zr Zirconium 91.22		41 Nb Niobium 92.91		42 Mo Molybdenum 95.94		43 Tc Technetium (97)		44 Ru Ruthenium 101.1		46 Pd Palladium 106.4		47 Ag Silver 107.9		48 Cd Cadmium 112.4		31 Ga Gallium 69.72		32 Ge Germanium 72.64		33 As Arsenic 74.92		34 Se Selenium 78.96		35 Br Bromine 79.90		36 Kr Krypton 83.80		
	37 Rb Rubidium 85.47		38 Sr Strontium 87.62		57 La* Lanthanum 138.91		72 Hf Hafnium 178.5		73 Ta Tantalum 180.9		74 W Tungsten 183.8		75 Re Rhenium 186.2		76 Os Osmium 190.2		77 Ir Iridium 192.2		78 Pt Platinum 195.1		79 Au Gold 197.0		80 Hg Mercury 200.6		81 Tl Thallium 204.4		82 Pb Lead 207.2		83 Bi Bismuth 208.9		84 Po Polonium (209)		85 At Astatine (210)		86 Rn Radon 222.0
	55 Cs Cesium 132.9		56 Ba Barium 137.3		89 Ac~ Actinium (227)		104 Rf Rutherfordium (261)		105 Db Dubnium (262)		106 Sg Seaborgium (263)		107 Bh Bohrium (264)		108 Hs Hassium (265)		109 Mt Meitnerium (266)		110 Ds Darmstadtium (271)		111 Uuu Ununundium (272)		112 Uub Unbibium (277)		114 Uuq Ununquadium (284)		116 Uuh Unhexium (289)		118 Uuo Ununoctium (294)		119 Uu Unennium (295)		120 Uu Unbinilium (296)		121 Uu Untrium (297)

Lanthanide Series*

Actinide Series~

58 Ce Cerium 140.1	59 Pr Praseodymium 140.9	60 Nd Neodymium 144.2	61 Pm Promethium (145)	62 Sm Samarium 150.4	63 Eu Europium 152.0	64 Gd Gadolinium 157.3	65 Tb Terbium 158.9	66 Dy Dysprosium 162.5	67 Ho Holmium 164.9	68 Er Erbium 167.3	69 Tm Thulium 168.9	70 Yb Ytterbium 173.0	71 Lu Lutetium 174.9
90 Th Thorium 232.0	91 Pa Protactinium 231.0	92 U Uranium 238.0	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (260)

element names in **blue** are liquids at room temperature
 element names in **red** are gases at room temperature
 element names in **black** are solids at room temperature