Set 5: Nuclei and Radiation Solutions

5.1

		Protons	Neutrons	Element
A	$^{17}O_8$	8	9	Oxygen
B	$^{40}K_{19}$	19	21	Potassium
C	$^{234}U_{92}$	92	142	Uranium
D	$^{241}Am_{95}$	95	146	Americium

5.2

	Balancing Number of Nucleons/Protons	Particle
A	27 nucleons on left, 26 nucleons on right 13 protons on left, 12 protons on right Proton emitted.	1 Proton: $^1H_1$
B	Beta particle emitted, Neutron changing into a proton and emitting an electron. Parent particle increases by one proton. Mass number does not change.	$^{239}Pu_{94}$
C	22 nucleons on left, 22 nucleons on right. Likely to be beta or positron decay Parent decrease by one proton. Mass number does not change. Opposite of Beta.	$^0e_{+1}$ Positron
D	Gamma particle emitted. Require excited parent nuclei	$^{131}I_{53}$*
E	8 nucleons on left, required 8 nucleons on right. 4 protons on left, require 4 protons on left. 2 in front means two nuclei the same	$^4He_2$

5.3

	Balancing Number of Nucleons/Protons	Equation
A	All decays are Alpha/Absorption therefore must have number of nucleons balancing 11 nucleons on left, required 11 nucleons on right. Alpha will be present in products	$^{10}B_5 + {}^1n_0 \rightarrow {}^4He_2 + {}^7Li_3$
B	Element	Lithium-7 Helium-4

5.4

With Alpha decay ensure the sum of nucleons are conserved and that the number of protons remains the same.

$^{234}U_{92} \rightarrow {}^4He_2 + {}^{230}Th_{90}$

5.5

With Beta the number of protons will increase by 1 proton. The number of nucleons will still remain the same. Remember 1 neutron is changing into a proton and emitting an electron.

$^{42}K_{19} \rightarrow {}^0e_{-1} + {}^{42}Ca_{20}$

5.6

Parent	Nucleons/Protons	Daughter	
$^{141}Ba_{56}$	141 Nucleons 56 Protons 85 Neutrons	$^{141}Cs_{55}$	141 Nucleons 55 Protons 86 Neutrons

$$^{141}Ba_{56} \rightarrow {}^{0}e_{+1} + {}^{141}Cs_{55}$$

With positron decay the number of protons will decrease as a proton changes into a neutron and then emits a positron. A positron is an anti-matter particle.

5.7

With Beta the number of protons will increase by 1 proton. The number of nucleons will still remain the same. Remember 1 neutron is changing into a proton and emitting an electron.

Parent	Nucleons/Protons	Daughter	Nucleons/Protons
$^{131}I_{53}$	131 Nucleons 53 Protons 78 Neutrons	$^{131}Xe_{54}$	131 Nucleons 54 Protons 77 Neutrons

$$^{131}I_{53} \rightarrow {}^{0}e_{-1} + {}^{131}Xe_{54}$$

5.8

This is a Beta decay system. With Beta the number of protons will increase by 1 proton. The number of nucleons will still remain the same. Remember 1 neutron is changing into a proton and emitting an electron.

Parent	Nucleons/Protons	Daughter	Nucleons/Protons
Molybdenum-99 $^{99}Mo_{42}$	99 Nucleons 42 Protons 57 Neutrons	Technetium $^{99}Tc_{43}*$	99 Nucleons 43 Protons 56 Neutrons

$$^{99}Mo_{42} \rightarrow {}^{99}Tc_{43}* + {}^{0}e_{-1}$$

5.9

This is an Alpha decay system. With Alpha decay ensure the sum of nucleons are conserved and that the number of protons remains the same. A Helium nuclei is emitted.

Parent	Nucleons/Protons	Daughter	Nucleons/Protons
Radon-222 $^{222}Rn_{86}$	222 Nucleons 86 Protons 136 Neutrons	Polonium-218 $^{218}Po_{84}$ Helium-4 (Alpha) $^{4}He_{2}$	218 Nucleons 84 Protons 134 Neutrons 4 Nucleons 2 Protons 2 Neutrons

$$^{222}Rn_{86} \rightarrow {}^{218}Po_{84} + {}^{4}He_{2}$$

5.10

With fusion and fission events ensure the sum of nucleons are conserved and that the number of protons/neutrons remains the same.

Parents	Nucleons/Protons	Daughter	Nucleons/Protons
Deuterium $^{2}H_{1}$	2 Nucleons 1 Protons 1 Neutrons	Helium-4 $^{4}He_{2}$	4 Nucleons 2 Protons 2 Neutrons
Tritium $^{3}H_{1}$	2 Nucleons 1 Protons 2 Neutrons		 1 Neutron

$$^{2}H_{1} \quad + \quad ^{3}H_{1} \quad \rightarrow \quad ^{4}He_{2} \quad + \quad ^{1}n_{0}$$

5.11

Ensure the sum of nucleons are conserved and that the number of protons/neutrons remains the same.

Parents	Nucleons/Protons	Daughters	Nucleons/Protons
Nitrogen-14 $^{14}N_{7}$	14 Nucleons 7 Protons 7 Neutrons	Carbon-14 $^{14}C_{6}$	14 Nucleons 6 Protons 8 Neutrons
Cosmic Particle $^{1}n_{0}$	 1 Neutrons	Proton $^{1}H_{1}$	 1 Proton

$$^{14}N_{7} \quad + \quad ^{1}n_{0} \quad \rightarrow \quad ^{14}C_{6} \quad + \quad ^{1}H_{1}$$

5.12

Alpha Decay of Pu-239	$^{239}Pu_{94} \rightarrow {}^{4}He_{2} + {}^{235}U_{92}$
Beta Decay of U-235	$^{235}U_{92} \rightarrow {}^{235}Np_{93} + {}^{0}e_{-1}$

5.13

Alpha Decay of Th-232	$^{232}Th_{90} \rightarrow {}^{4}He_{2} + {}^{228}Ra_{88}$
Beta Decay of Ra-228	$^{228}Ra_{88} \rightarrow {}^{228}Ac_{89} + {}^{0}e_{-1}$
Beta Decay of Ac-228	$^{228}Ac_{89} \rightarrow {}^{228}Th_{90} + {}^{0}e_{-1}$
Alpha Decay of Th-228	$^{228}Th_{90} \rightarrow {}^{4}He_{2} + {}^{224}Ra_{88}$
Alpha Decay of Ra-224	$^{224}Ra_{88} \rightarrow {}^{4}He_{2} + {}^{220}Rn_{86}$

5.14

With fusion and fission events ensure the sum of nucleons are conserved and that the number of protons/neutrons remains the same.

Parents	Nucleons/Protons	Daughters	Nucleons/Protons
Uranium-235 $^{235}U_{92}$ Neutron $^{1}n_{0}$	235 Nucleons 92 Protons 143 Neutrons + 1	To be made up of: 236 Nucleons 92 Protons 144 Neutrons	
		Barium-141 $^{141}Ba_{56}$	141 Nucleons 56 Protons 85 Neutrons
		Krypton-92 $^{92}Kr_{36}$	92 Nucleons 36 Protons 56 Neutrons
			3 Neutrons required to make number of nucleons conserved.

$$^{235}U_{92} \quad + \quad ^{1}n_{0} \quad \rightarrow \quad ^{141}Ba_{56} \quad + \quad ^{92}Kr_{36} \quad + \quad 3 \quad ^{1}n_{0}$$

5.15

Parents	Nucleons/Protons	Daughters	Nucleons/Protons
Uranium-235 $^{235}U_{92}$ Neutron $^{1}n_{0}$	235 Nucleons 92 Protons 143 Neutrons + 1	To be made up of: 236 Nucleons 92 Protons 144 Neutrons	
		Antimony-134 $^{141}Sb_{51}$	134 Nucleons 51 Protons 83 Neutrons
		Yttrium-95 $^{95}Y_{39}$	95 Nucleons 39 Protons 56 Neutrons
			2 Protons and 5 Neutrons required to make number of nucleons conserved. Likely to be Alpha as well

$$^{235}U_{92} \quad + \quad ^{1}n_{0} \quad \rightarrow \quad ^{134}Sb_{51} \quad + \quad ^{95}Y_{39} \quad + \quad 3 \quad ^{1}n_{0} \quad + \quad ^{4}He_{2}$$

5.17

Assuming with alpha bombardment that no beta/positron occurs at the same time thus conservation of nucleons.

Parents	Nucleons/Protons	Daughters	Nucleons/Protons
Boron-11 $^{11}B_5$ Alpha $^4He_2$	15 Nucleons 7 Protons 8 Neutrons	To be made up of: 15 Nucleons 7 Protons 8 Neutrons Nitrogen-14 $^{14}N_7$	 14 Nucleons 7 Protons 7 Neutrons 1 Neutron required to make number of nucleons conserved.

$$^{11}B_5 \quad + \quad ^4He_2 \quad \rightarrow \quad ^1n_0 \quad + \quad ^{14}N_7$$