

Ionising Radiation and Nuclear Reactions

Set 5: Nuclei and Radiation Solutions

5.1

		Protons	Neutrons	Element
A	$^{17}\text{O}_8$	8	9	Oxygen
B	$^{40}\text{K}_{19}$	19	21	Potassium
C	$^{234}\text{U}_{92}$	92	142	Uranium
D	$^{241}\text{Am}_{95}$	95	146	Americium

5.2

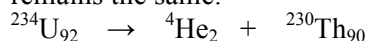
	Balancing Number of Nucleons/Protons	Particle
A	27 nucleons on left, 26 nucleons on right 13 protons on left, 12 protons on right Proton emitted.	1 Proton: $^1\text{H}_1$
B	Beta particle emitted, Neutron changing into a proton and emitting an electron. Parent particle increases by one proton. Mass number does not change.	$^{239}\text{Pu}_{94}$
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.	$^0\text{e}_{+1}$ Positron
D	Gamma particle emitted. Require excited parent nuclei	$^{131}\text{I}_{53}^*$
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	$^4\text{He}_2$

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	$^{10}\text{B}_5 + ^1\text{n}_0 \rightarrow ^4\text{He}_2 + ^7\text{Li}_3$
B	Element	Lithium-7 Helium-4

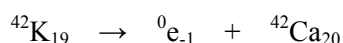
5.4

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



5.5

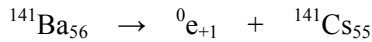
With Beta the number of protons will increase by 1 proton. The number of nucleons will still remain the same. Remember 1 neutron is changing into a proton and emitting an electron.



Ionising Radiation and Nuclear Reactions

5.6

Parent	Nucleons/Protons	Daughter	
$^{141}\text{Ba}_{56}$	141 Nucleons 56 Protons 85 Neutrons	$^{141}\text{Cs}_{55}$	141 Nucleons 55 Protons 86 Neutrons

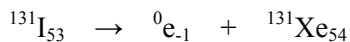


With positron decay the number of protons will decrease as a proton changes into a neutron and then emits a positron. A positron is an anti-matter particle.

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.

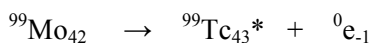
Parent	Nucleons/Protons	Daughter	Nucleons/Protons
$^{131}\text{I}_{53}$	131 Nucleons 53 Protons 78 Neutrons	$^{131}\text{Xe}_{54}$	131 Nucleons 54 Protons 77 Neutrons



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.

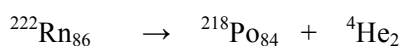
Parent	Nucleons/Protons	Daughter	Nucleons/Protons
Molybdenum-99 $^{99}\text{Mo}_{42}$	99 Nucleons 42 Protons 57 Neutrons	Technetium $^{99}\text{Tc}_{43}^*$	99 Nucleons 43 Protons 56 Neutrons



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 $^{222}\text{Rn}_{86}$	222 Nucleons 86 Protons 136 Neutrons	Polonium-218 $^{218}\text{Po}_{84}$ Helium-4 (Alpha) $^4\text{He}_2$	218 Nucleons 84 Protons 134 Neutrons 4 Nucleons 2 Protons 2 Neutrons

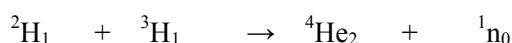


Ionising Radiation and Nuclear Reactions

5.10

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

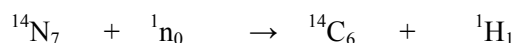
Parents	Nucleons/Protons	Daughter	Nucleons/Protons
Deuterium ${}^2\text{H}_1$	2 Nucleons 1 Protons 1 Neutrons	Helium-4 ${}^4\text{He}_2$	4 Nucleons 2 Protons 2 Neutrons
Tritium ${}^3\text{H}_1$	2 Nucleons 1 Protons 2 Neutrons		1 Neutron



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 ${}^{14}\text{N}_7$	14 Nucleons 7 Protons 7 Neutrons	Carbon-14 ${}^{14}\text{C}_6$	14 Nucleons 6 Protons 8 Neutrons
Cosmic Particle ${}^1_0\text{n}$	1 Neutrons	Proton ${}^1_1\text{H}$	1 Proton



5.12

Alpha Decay of Pu-239	${}^{239}\text{Pu}_{94} \rightarrow {}^4\text{He}_2 + {}^{235}\text{U}_{92}$
Beta Decay of U-235	${}^{235}\text{U}_{92} \rightarrow {}^{235}\text{Np}_{93} + {}^0_{-1}\text{e}$

5.13

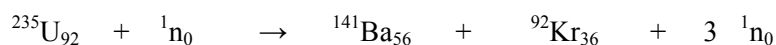
Alpha Decay of Th-232	${}^{232}\text{Th}_{90} \rightarrow {}^4\text{He}_2 + {}^{228}\text{Ra}_{88}$
Beta Decay of Ra-228	${}^{228}\text{Ra}_{88} \rightarrow {}^{228}\text{Ac}_{89} + {}^0_{-1}\text{e}$
Beta Decay of Ac-228	${}^{228}\text{Ac}_{89} \rightarrow {}^{228}\text{Th}_{90} + {}^0_{-1}\text{e}$
Alpha Decay of Th-228	${}^{228}\text{Th}_{90} \rightarrow {}^4\text{He}_2 + {}^{224}\text{Ra}_{88}$
Alpha Decay of Ra-224	${}^{224}\text{Ra}_{88} \rightarrow {}^4\text{He}_2 + {}^{220}\text{Rn}_{86}$

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5.14

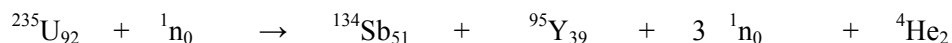
With fusion and fission events ensure the sum of nucleons are conserved and that the number of protons/neutrons remains the same.

Parents	Nucleons/Protons	Daughters	Nucleons/Protons
Uranium-235 $^{235}\text{U}_{92}$ Neutron ^1_0n	235 Nucleons 92 Protons 143 Neutrons + 1	To be made up of: 236 Nucleons 92 Protons 144 Neutrons Barium-141 $^{141}\text{Ba}_{56}$ Krypton-92 $^{92}\text{Kr}_{36}$	141 Nucleons 56 Protons 85 Neutrons 92 Nucleons 36 Protons 56 Neutrons 3 Neutrons required to make number of nucleons conserved.



5.15

Parents	Nucleons/Protons	Daughters	Nucleons/Protons
Uranium-235 $^{235}\text{U}_{92}$ Neutron ^1_0n	235 Nucleons 92 Protons 143 Neutrons + 1	To be made up of: 236 Nucleons 92 Protons 144 Neutrons Antimony-134 $^{134}\text{Sb}_{51}$ Yttrium-95 $^{95}\text{Y}_{39}$	134 Nucleons 51 Protons 83 Neutrons 95 Nucleons 39 Protons 56 Neutrons 2 Protons and 5 Neutrons required to make number of nucleons conserved. Likely to be Alpha as well



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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 $^{11}\text{B}_5$ Alpha $^4\text{He}_2$	15 Nucleons 7 Protons 8 Neutrons	To be made up of: 15 Nucleons 7 Protons 8 Neutrons Nitrogen-14 $^{14}\text{N}_7$	14 Nucleons 7 Protons 7 Neutrons 1 Neutron required to make number of nucleons conserved.

