Balancing Nuclear Equations

Name: ________________________ Period: ________________________

There are two types of nuclear reactions: Fission, where a nucleus breaks into two or more pieces, and fusion where two or more nuclei combine to form a new element. In nuclear reactions, only the nucleus is involved. Electrons are ignored. Some atomic nuclei are inherently unstable and spontaneously change or "decay". There are four types of decay:

Type	Symbol	Charge of particle	Mass(AMU)	Effect on Atomic #	Effect on Atomic Mass	Strength
Alpha	α	+2 (He nucleus)	4	decrease by 2	decrease by 4	Stopped by paper
Beta- e- emission	β- electron	-1	0	increase by 1	0	Aluminum Foil
Beta+ e- capture	β+ Positron	+1	0	decrease by 1	0	Aluminum Foil
Gamma	γ	none	none	none	none	Lead

The net result of α, β- or β+ decay is a new element. In b- decay, a neutron decays into a p+ and an e- which is then ejected. In β+ decay a p+ captures an e- and transforms into a neutron. But despite the nature of the reaction the law of conservation of matter still applies and the equations are balanced the same way. Note α particle is a helium nucleus!

Another type of reaction occurs when something impacts a nucleus. These reactions result either in the nucleus splitting (fission) or the combination of two or more nuclei to form a third, different nucleus (fusion).

Balancing Nuclear Equations: Matter must be conserved including all p+ & n°. Example:

Decay reaction (α decay) $^{219}_{86}Rn \rightarrow ^{4}_{2}He + ^{215}_{84}Po$

Fission Reaction $^{1}_{0}n + ^{235}_{92}U \rightarrow ^{92}_{36}Kr + ^{141}_{56}Ba + 3^{1}_{0}n$

Fusion Reaction: $^{35}_{17}Cl + ^{1}_{1}H \rightarrow ^{36}_{18}Ar$ another example $^{2}_{1}H + ^{3}_{1}H \rightarrow ^{4}_{2}He + n^{\circ}$

Practice

Fill in the missing symbol and name the reaction:

1. $^{3}_{1}H \rightarrow$ ______________ $+ ^{0}_{-1}e$ ______________________

2. $^{232}_{92}U \rightarrow ^{228}_{90}Th +$ ______________ ______________________

3. $^{144}_{58}Ce \rightarrow ^{144}_{59}\mathrm{Pr} +$ ______________ ______________________

4. $^{65}_{30}Zn \rightarrow$ ______________ $+ ^{0}_{+1}e$ ______________________

5. $^{40}_{19}K \rightarrow ^{40}_{18}Ar +$ ____________ ______________________

6. $^{7}_{4}Be \rightarrow ^{7}_{4}Be +$ __________ __________________________

7. $^{1}_{0}n + ^{235}_{92}U \rightarrow$ _____________ $\rightarrow ^{141}_{55}Cs + ^{92}_{37}Rb +$ _______________ _____________

8. $^{222}_{86}Rn \rightarrow$ _________ $+ ^{4}_{2}He$ __________________________

9. $^{129}_{53}I \rightarrow ^{129}_{54}Xe +$ _____________ __________________________

10. $^{239}_{94}Pu \rightarrow$ _____________ $+ ^{4}_{2}He$ __________________________

11 $^{15}_{8}O \rightarrow ^{15}_{7}N +$ _____________ __________________________

12. Write a balanced nuclear equation for each decay process indicated.

a. The isotope Th-234 decays by an alpha emission.

b. The isotope Fe-59 decays by a beta emission.

c. The isotope Tc-99 decays by a gamma emission.

d. The isotope C-11 decays by a electron capture.

Balance these equations: Note $^{4}_{2}He$ is the only stable isotope of helium.

13. $^{1}_{1}H + ^{7}_{3}Li \rightarrow$ ________________

14. $^{7}_{4}Be + n^{\circ} \rightarrow$ ________ H + _________ He

15. What is the balanced nuclear equation for the reaction of curium-246 with carbon-12 to produce nobelium-254 and four neutrons?

16. What is the balanced nuclear equation for the reaction of californium-250 with boron-10 to produce lawrencium-258 and two neutrons?

1. $^{3}_{1}H \rightarrow ^{3}_{2}He + ^{0}_{-1}e$ β- decay

2. $^{232}_{92}U \rightarrow ^{228}_{90}Th + ^{4}_{2}He$ α decay

3. $^{144}_{58}Ce \rightarrow ^{144}_{59}\mathrm{Pr} + ^{0}_{-1}e$ β- decay

4. $^{65}_{30}Zn \rightarrow ^{65}_{29}Cu + ^{0}_{+1}e$ β+ decay

5. $^{40}_{19}K \rightarrow ^{40}_{18}Ar + ^{0}_{+1}e$ β+ decay

6. $^{7}_{4}Be \rightarrow ^{7}_{4}Be + \gamma$ γ decay

7. $^{1}_{0}n + ^{235}_{92}U \rightarrow ^{236}_{92}U \rightarrow ^{141}_{55}Cs + ^{92}_{37}Rb + 3^{1}_{0}n$ Fission

8. $^{222}_{86}Rn \rightarrow ^{218}_{84}Po + ^{4}_{2}He$ α decay

9. $^{129}_{53}I \rightarrow ^{129}_{54}Xe + ^{0}_{-1}e$ β- decay

10. $^{239}_{94}Pu \rightarrow ^{235}_{92}U + ^{4}_{2}He$ α decay

11. $^{15}_{8}O \rightarrow ^{15}_{7}N + ^{0}_{+1}e$ β+ decay

12.

a. $^{234}_{90}Th \rightarrow ^{230}_{88}Ra + ^{4}_{2}He$

b. $^{59}_{26}Fe \rightarrow ^{59}_{27}Co + ^{0}_{-1}e$

c. $^{99}_{43}Tc \rightarrow ^{99}_{43}Tc + \gamma$

d. $^{11}_{6}C + ^{0}_{-1}e \rightarrow ^{11}_{5}B$

13. $^{1}_{1}\mathrm{H} + ^{7}_{3}\mathrm{Li} \rightarrow 2^{4}_{2}\mathrm{He}$ or $^{8}_{4}\mathrm{Be}$

14. $^{7}_{4}\mathrm{Be} + ^{1}_{0}\mathrm{n} \rightarrow 2^{2}_{1}\mathrm{H} + ^{4}_{2}\mathrm{He}$ or $^{1}_{1}\mathrm{H} + ^{3}_{1}\mathrm{H} + ^{4}_{2}\mathrm{He}$

15. $^{246}_{96}Cm + ^{12}_{6}C \rightarrow ^{254}_{102}No + 4^{1}_{0}n$

16. $^{250}_{98}Cf + ^{10}_{5}B \rightarrow ^{258}_{103}Lr + 2^{1}_{0}n$