Balancing Nuclear Equations

Name: _____

There are two types of nuclear reactions: Fission, where a nucleus breaks into two or more fragments, and fusion where two or more nuclei combine to form a new element. In nuclear reactions, only the nucleus is involved. Orbital 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	Penetrating ability
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	Aluminium foil
Beta+ e^- capture	β^+ positron	+1	0	Decrease by 1	0	Aluminium foil
Gamma	γ	None	none	None	none	Lead

The net result of α, β- or β+ decay is a new element. In β- decay, a neutron decays into a p+ and an e^- which is then emitted. 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.
NB: an 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: $^{2}_{1}H + {}^{3}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n$

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. $^{144}_{58}Ce \rightarrow {}^{144}_{59}Pr$ + _____ _____

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

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

6. ${}^{7m}_{4}Be \rightarrow {}^{7}_{4}Be +$ _____ _____

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

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 an 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. ${}^{7}_{4}Be + {}^{1}_{0}n \rightarrow$ __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?