

## Balancing Nuclear Equations

Name: \_\_\_\_\_

Period: \_\_\_\_\_

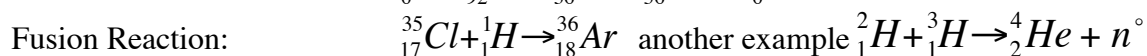
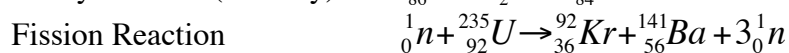
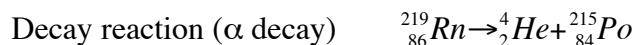
There are two types of nuclear reactions: Fission, where a nucleus breaks into two or more pieces, and fusion where two or more nuclei combine to form a new element. In nuclear reactions, only the nucleus is involved. Electrons are ignored. Some atomic nuclei are inherently unstable and spontaneously 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            | $\alpha$           | +2 (He nucleus)    | 4         | decrease by 2      | decrease by 4         | Stopped by paper |
| Beta-e- emission | $\beta^-$ electron | -1                 | 0         | increase by 1      | 0                     | Aluminum Foil    |
| Beta+ e- capture | $\beta^+$ Positron | +1                 | 0         | decrease by 1      | 0                     | Aluminum Foil    |
| Gamma            | $\gamma$           | none               | none      | none               | none                  | Lead             |

The net result of  $\alpha$ ,  $\beta^-$  or  $\beta^+$  decay is a new element. In  $\beta^-$  decay, a neutron decays into a  $p^+$  and an  $e^-$  which is then ejected. In  $\beta^+$  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  $\alpha$  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).

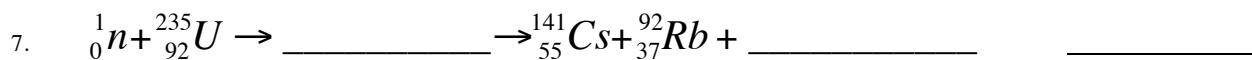
Balancing Nuclear Equations: Matter must be conserved including all  $p^+$  &  $n^0$ . Example:



## Practice

Fill in the missing symbol and name the reaction:





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

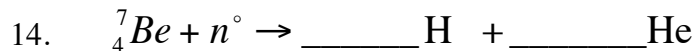
a. The isotope Th-234 decays by an alpha emission.

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  ${}_2^4\text{He}$  is the only stable isotope of helium.



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.  ${}^3_1\text{H} \rightarrow {}^3_2\text{He} + {}^0_{-1}\text{e}$        $\beta^-$  decay
2.  ${}^{232}_{92}\text{U} \rightarrow {}^{228}_{90}\text{Th} + {}^4_2\text{He}$        $\alpha$  decay
3.  ${}^{144}_{58}\text{Ce} \rightarrow {}^{144}_{59}\text{Pr} + {}^0_{-1}\text{e}$        $\beta^-$  decay
4.  ${}^{65}_{30}\text{Zn} \rightarrow {}^{65}_{29}\text{Cu} + {}^0_{+1}\text{e}$        $\beta^+$  decay
5.  ${}^{40}_{19}\text{K} \rightarrow {}^{40}_{18}\text{Ar} + {}^0_{+1}\text{e}$        $\beta^+$  decay
6.  ${}^7_4\text{Be} \rightarrow {}^7_4\text{Be} + \gamma$        $\gamma$  decay
7.  ${}^1_0\text{n} + {}^{235}_{92}\text{U} \rightarrow {}^{236}_{92}\text{U} \rightarrow {}^{141}_{55}\text{Cs} + {}^{92}_{37}\text{Rb} + 3{}^1_0\text{n}$       Fission
8.  ${}^{222}_{86}\text{Rn} \rightarrow {}^{218}_{84}\text{Po} + {}^4_2\text{He}$        $\alpha$  decay
9.  ${}^{129}_{53}\text{I} \rightarrow {}^{129}_{54}\text{Xe} + {}^0_{-1}\text{e}$        $\beta^-$  decay
10.  ${}^{239}_{94}\text{Pu} \rightarrow {}^{235}_{92}\text{U} + {}^4_2\text{He}$        $\alpha$  decay
11.  ${}^{15}_8\text{O} \rightarrow {}^{15}_7\text{N} + {}^0_{+1}\text{e}$        $\beta^+$  decay
12.
  - a.  ${}^{234}_{90}\text{Th} \rightarrow {}^{230}_{88}\text{Ra} + {}^4_2\text{He}$
  - b.  ${}^{59}_{26}\text{Fe} \rightarrow {}^{59}_{27}\text{Co} + {}^0_{-1}\text{e}$
  - c.  ${}^{99}_{43}\text{Tc} \rightarrow {}^{99}_{43}\text{Tc} + \gamma$
  - d.  ${}^{11}_6\text{C} + {}^0_{-1}\text{e} \rightarrow {}^{11}_5\text{B}$
13.  ${}^1_1\text{H} + {}^7_3\text{Li} \rightarrow 2{}^4_2\text{He}$  or  ${}^8_4\text{Be}$
14.  ${}^7_4\text{Be} + {}^1_0\text{n} \rightarrow 2{}^2_1\text{H} + {}^4_2\text{He}$  or  ${}^1_1\text{H} + {}^3_1\text{H} + {}^4_2\text{He}$
15.  ${}^{246}_{96}\text{Cm} + {}^{12}_6\text{C} \rightarrow {}^{254}_{102}\text{No} + 4{}^1_0\text{n}$
16.  ${}^{250}_{98}\text{Cf} + {}^{10}_5\text{B} \rightarrow {}^{258}_{103}\text{Lr} + 2{}^1_0\text{n}$