

a change in the nucleus so 1 type of element becomes a different type
 high energy particles

NATURAL AND ARTIFICIAL TRANSMUTATIONS

NATURAL TRANSMUTATION	ARTIFICIAL TRANSMUTATION
EXAMPLES $^{238}_{92}\text{U} \rightarrow ^4_2\text{He} + ^{234}_{90}\text{Th}$ $^{14}_6\text{C} \rightarrow ^{14}_7\text{N} + ^0_{-1}\text{e}$ $^{226}_{88}\text{Ra} \rightarrow ^4_2\text{He} + ^{222}_{86}\text{Rn}$	EXAMPLES $^{27}_{13}\text{Al} + ^4_2\text{He} \rightarrow ^{30}_{15}\text{P} + ^1_0\text{n}$ ex) fission $^{238}_{92}\text{U} + ^1_0\text{n} \rightarrow ^{239}_{94}\text{Pu} + 2^0_{-1}\text{e}$ + fusion $^{239}_{94}\text{Pu} + ^1_0\text{n} \rightarrow ^{147}_{56}\text{Ba} + ^{90}_{38}\text{Sr} + 3^1_0\text{n}$
What do you notice about the examples? 1 reactant \rightarrow 2 products ↳ 1 isotope ↳ 1 emission	What do you notice about the examples? 2 reacts \rightarrow multiple products

- natural + spontaneous decay of radioactive isotopes
 ↳ alpha
 ↳ beta
 ↳ gamma
 ↳ positron

- nonspontaneous
 - stable nucleus is bombarded w/ a high energy particle

PRACTICE Identify whether the following reactions is a natural transmutation or an artificial transmutation.

- $^{14}_6\text{C} \rightarrow ^{14}_7\text{N} + ^0_{-1}\text{e}$ nat.
- $^{87}_{37}\text{Rb} \rightarrow ^0_{-1}\text{e} + ^{87}_{38}\text{Sr}$ nat.
- $^{232}_{90}\text{U} \rightarrow ^{228}_{88}\text{Th} + ^4_2\text{He}$ nat.
- $^{27}_{13}\text{Al} + ^4_2\text{He} \rightarrow ^{30}_{15}\text{P} + ^1_0\text{n}$ art.
- $^{12}_6\text{C} \rightarrow ^{12}_7\text{N} + ^0_{-1}\text{e}$ nat.
- $^{238}_{92}\text{U} + ^1_0\text{n} \rightarrow ^{239}_{94}\text{Pu} + 2^0_{-1}\text{e}$ art.
- $^{239}_{94}\text{Pu} + ^1_0\text{n} \rightarrow ^{147}_{56}\text{Ba} + ^{90}_{38}\text{Sr} + 3^1_0\text{n}$ art.

Completing the equations for an artificial transmutation is the same as that for a natural transmutation; the sum of the mass numbers on the left side of the equation must equal the sum of the mass numbers on the right and the sum of the protons on the left side must equal the sum of the protons on the right.

1. $^{48}_{22}\text{Ti} + ^4_2\text{He} \rightarrow ^1_1\text{H} + ^{51}_{23}\text{V}$

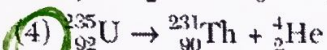
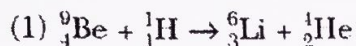
2. $^{63}_{29}\text{Cu} + ^1_0\text{n} \rightarrow ^{60}_{27}\text{Co} + ^4_2\text{He}$

3. $^{44}_{20}\text{Ca} + ^4_2\text{He} \rightarrow ^{47}_{21}\text{Sc} + ^1_1\text{H}$

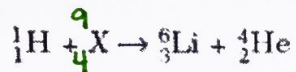
4. $^{14}_7\text{N} + ^4_2\text{He} \rightarrow ^{17}_8\text{O} + ^1_1\text{H}$
 ↳ atomic #

Directions: Answer the following using your knowledge of Chemistry.

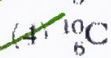
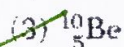
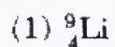
1. Which nuclear equation represents a natural transmutation?



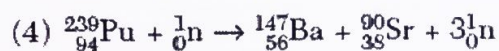
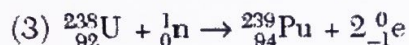
2. Given the nuclear equation:



The particle represented by X is



3. Which reaction is an example of natural transmutation?



4. Radioactive cobalt-60 is used in radiation therapy treatment. Cobalt-60 undergoes beta decay. This type of nuclear reaction is called

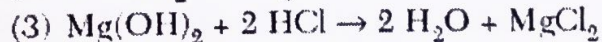
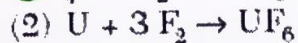
(1) natural transmutation

(2) artificial transmutation

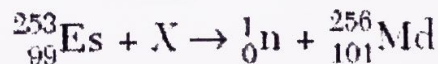
(3) nuclear fusion

(4) nuclear fission

5. Which equation is an example of artificial transmutation?



6. Given the following nuclear equation, which particle is represented by X?



7. The change that is undergone by an atom of an element made radioactive by bombardment with high-energy protons is called

(1) natural transmutation

(2) artificial transmutation

(3) natural decay

(4) radioactive decay