Name _____ Period _____

Types of Nuclear Radiation

- **Unstable atoms** emit excess energy from their nuclei to become more stable. The energy released is called **nuclear radiation**.
- There are *three main types of radiation* released by radioactive atoms: **Alpha**, **Beta**, and **Gamma radiation.**

α

$^{4}_{2}He$

- **Alpha Particles** are identical to **helium nuclei**.
- Because they are large, **alpha particles** have the least penetrating power.
- **Least** dangerous radiation. Can be stopped by a piece of paper. Particles cannot penetrate skin.

- **Beta Particles** are **electrons** that are emitted as **nuclear radiation**.
- Because they are much smaller, **beta particles** travel faster and can **penetrate skin**.
- Can be stopped by thin sheet of **metal** or **wood**.

β

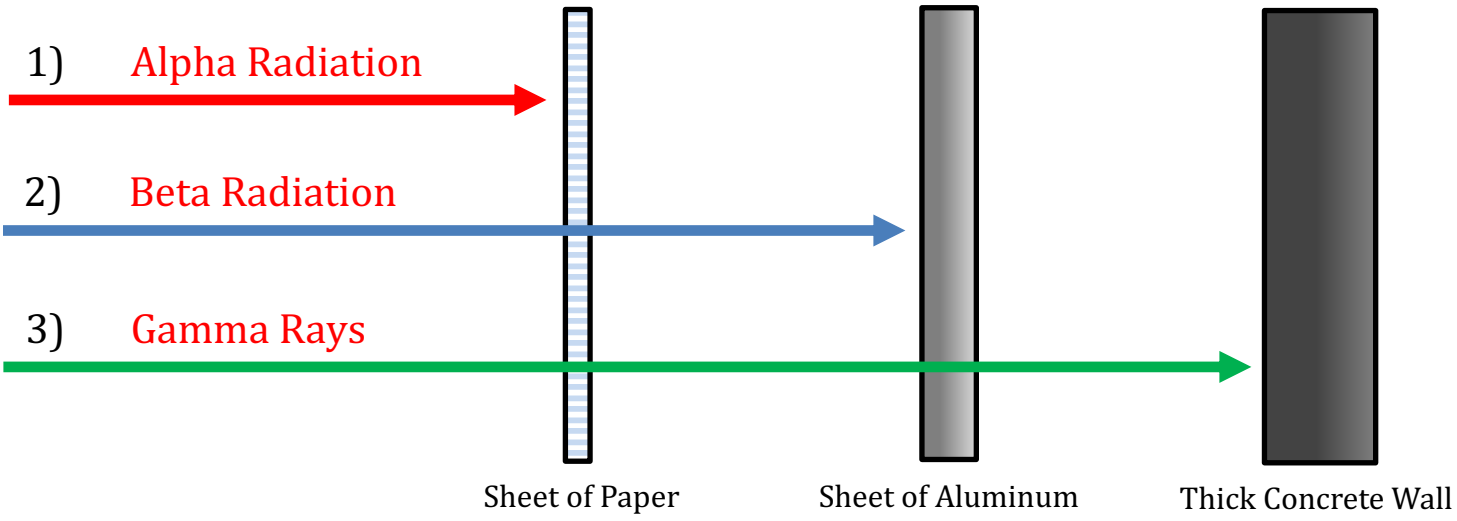
$^{0}_{-1}e$

$^{0}_{0}\gamma$

- **Gamma Rays** are emitted in the form of **waves**.
- Gamma rays have **no mass** and high penetrating power. This makes them **extremely dangerous**.
- Can be stopped by thick layers of **concrete**.

Example 1:

Label alpha, beta, and gamma radiation in the diagram below.



Example 2:

An isotope of Uranium-238 emits an alpha particle. Write the equation below.

$$^{238}_{92}U \longrightarrow \underline{^{234}_{90}Th} + \underline{^{4}_{2}He}$$

Example 3:

An isotope of Carbon-14 emits a beta particle. Write the equation below.

$$^{14}_{6}C \longrightarrow \underline{^{14}_{7}C} + \underline{^{0}_{-1}e}$$

Example 4:

An isotope of Technetium-99 emits a gamma ray. Write the equation below.

$$^{99}_{43}Tc^{*} \longrightarrow \underline{^{99}_{43}Tc} + \underline{^{0}_{0}\gamma}$$

Name _____ Period _____

Types of Nuclear Radiation – Practice

Instructions: Write the particle (Alpha, Beta, or Gamma) that completes the equation below.

1) $^{54}_{27}Co \rightarrow {}^{50}_{25}Mn + {}^{4}_{2}He$

2) $^{8}_{3}Li \rightarrow {}^{8}_{4}Be + {}^{0}_{-1}e$

3) $^{222}_{88}Ra \rightarrow {}^{218}_{86}Rn + {}^{4}_{2}He$

4) $^{236}_{94}Pu \rightarrow {}^{232}_{92}U + {}^{4}_{2}He$

5) $^{60}_{27}Co^{*} \rightarrow {}^{60}_{27}Co + {}^{0}_{0}\gamma$

6) $^{234}_{90}Th \rightarrow {}^{234}_{91}Pa + {}^{0}_{-1}e$

Instructions: Complete the following *alpha decay* equations.

7) $^{263}_{106}Sg \rightarrow {}^{259}_{104}Rf + {}^{4}_{2}He$

8) $^{256}_{103}Lr \rightarrow {}^{252}_{101}Md + {}^{4}_{2}He$

9) $^{149}_{64}Gd \rightarrow {}^{145}_{62}Sm + {}^{4}_{2}He$

10) $^{237}_{93}Np \rightarrow {}^{233}_{91}Pa + {}^{4}_{2}He$

Instructions: Complete the following *beta decay* equations.

11) $^{52}_{26}Fe \rightarrow {}^{52}_{27}Co + {}^{0}_{-1}e$

12) $^{45}_{20}Ca \rightarrow {}^{45}_{21}Sc + {}^{0}_{-1}e$

13) $^{24}_{11}N \rightarrow {}^{24}_{12}Mg + {}^{0}_{-1}e$

14) $^{35}_{16}S \rightarrow {}^{35}_{17}Cl + {}^{0}_{-1}e$

Name _____ Period _____

Types of Nuclear Radiation – Questions

Instructions: Identify the following descriptions as alpha, beta, or gamma:

1) This radiation can only be stopped by **thick concrete or lead**. Gamma
2) This particle can be stopped by **clothing** alone. Alpha
3) During this decay, no protons, neutrons, or electrons are lost. Gamma
4) During this type of decay, **two protons** are lost. Alpha
5) This particle has a -1 charge. Beta
6) This particle has a mass of 4. Alpha
7) This type of radiation is identical to an **electron**. Beta
8) This form of radiation has **no mass** and **no charge**. Gamma
9) This particle is represented as a **helium** atom. Alpha
10) This particle is emitted as in the form of **waves**. Gamma
11) This particle can be stopped by a **piece of paper**. Alpha
12) This particle has average (medium) penetrating power. Beta
13) This is the **least dangerous** type of radiation. Alpha
14) This is the **most dangerous** type of radiation. Gamma

Instructions: Use the nuclear equation below to answer the following questions:

$$^{32}_{15}\mathrm{P} \longrightarrow {}^{32}_{16}\mathrm{S} + {}^{0}_{-1}\mathrm{e}$$

15) The picture above represents **what type** of nuclear decay? Beta Decay
16) What is the mass of the starting **phosphorus (P)** atom? 32
17) What is the **mass of the particle released** above? 0
18) Which decay would have caused a **larger change in mass**? Alpha Decay

Name _____ Period _____

Types of Nuclear Radiation

- _____ emit excess energy from their nuclei to become more stable. The energy released is called _____.
- There are *three main types of radiation* released by radioactive atoms: **Alpha**, **Beta**, and **Gamma radiation.**

α

$^{4}_{2}He$

- _____ are identical to **helium nuclei**.
- Because they are large, **alpha particles** have the least penetrating power.
- _____ dangerous radiation. Can be stopped by a piece of paper. Particles cannot penetrate skin.

β

$^{0}_{-1}e$

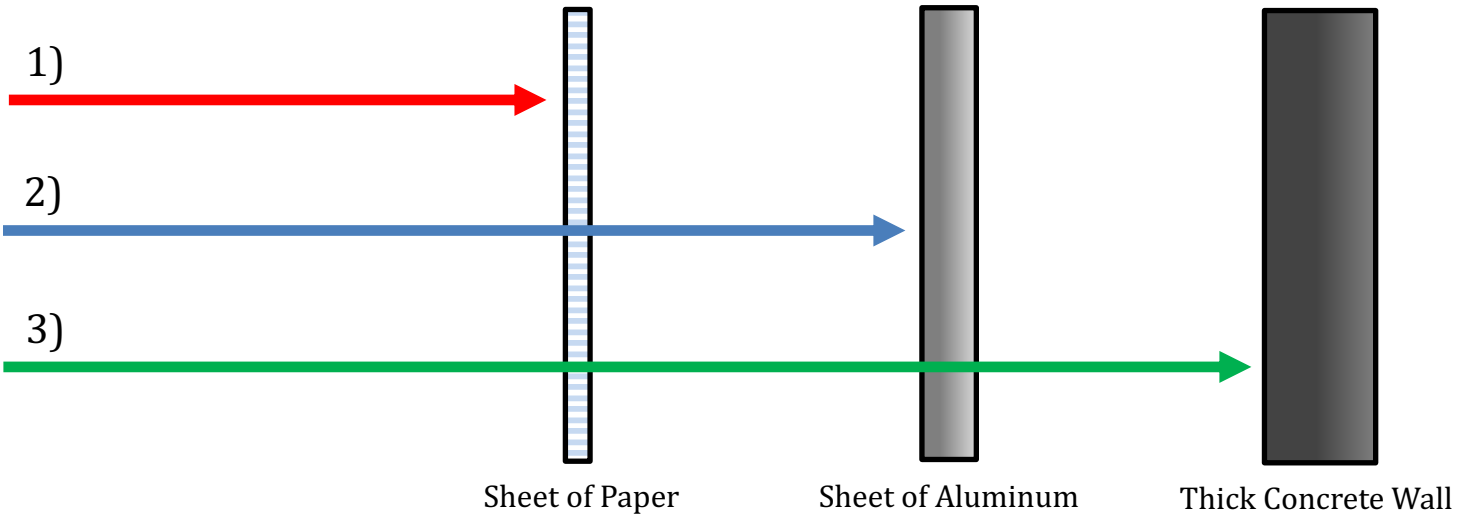
- _____ are **electrons** that are emitted as **nuclear radiation**.
- Because they are much smaller, **beta particles** travel faster and can **penetrate skin**.
- Can be stopped by thin sheet of _____ or _____.

$^{0}_{0}\gamma$

- _____ are emitted in the form of **waves**.
- Gamma rays have **no mass** and high penetrating power. This makes them **extremely dangerous**.
- Can be stopped by thick layers of _____.

Example 1:

Label alpha, beta, and gamma radiation in the diagram below.



Example 2:

An isotope of Uranium-238 emits an alpha particle. Write the equation below.

$$^{238}_{92}U \longrightarrow \_\_\_\_ + \_\_\_\_$$

Example 3:

An isotope of Carbon-14 emits a beta particle. Write the equation below.

$$^{14}_{6}C \longrightarrow \_\_\_\_ + \_\_\_\_$$

Example 4:

An isotope of Technetium-99 emits a gamma ray. Write the equation below.

$$^{99}_{43}Tc^{*} \longrightarrow \_\_\_\_ + \_\_\_\_$$

Name _____ Period _____

Types of Nuclear Radiation – Practice

Instructions: Write the particle (Alpha, Beta, or Gamma) that completes the equation below.

1) $^{54}_{27}\text{Co} \rightarrow {}^{50}_{25}\text{Mn} + \_\_\_\_\_$

2) $^{8}_{3}\text{Li} \rightarrow {}^{8}_{4}\text{Be} + \_\_\_\_\_$

3) $^{222}_{88}\text{Ra} \rightarrow {}^{218}_{86}\text{Rn} + \_\_\_\_\_$

4) $^{236}_{94}\text{Pu} \rightarrow {}^{232}_{92}\text{U} + \_\_\_\_\_$

5) $^{60}_{27}\text{Co}^{*} \rightarrow {}^{60}_{27}\text{Co} + \_\_\_\_\_$

6) $^{234}_{90}\text{Th} \rightarrow {}^{234}_{91}\text{Pa} + \_\_\_\_\_$

Instructions: Complete the following *alpha decay* equations.

7) $^{263}_{106}\text{Sg} \rightarrow \_\_\_\_\_ + \_\_\_\_\_$

8) $^{256}_{103}\text{Lr} \rightarrow \_\_\_\_\_ + \_\_\_\_\_$

9) $^{149}_{64}\text{Gd} \rightarrow \_\_\_\_\_ + \_\_\_\_\_$

10) $^{237}_{93}\text{Np} \rightarrow \_\_\_\_\_ + \_\_\_\_\_$

Instructions: Complete the following *beta decay* equations.

11) $^{52}_{26}\text{Fe} \rightarrow \_\_\_\_\_ + \_\_\_\_\_$

12) $^{45}_{20}\text{Ca} \rightarrow \_\_\_\_\_ + \_\_\_\_\_$

13) $^{24}_{11}\text{N} \rightarrow \_\_\_\_\_ + \_\_\_\_\_$

14) $^{35}_{16}\text{S} \rightarrow \_\_\_\_\_ + \_\_\_\_\_$

Name _____ Period _____

Types of Nuclear Radiation – Questions

Instructions: Identify the following descriptions as alpha, beta, or gamma:

1) This radiation can only be stopped by **thick concrete or lead**. _____
2) This particle can be stopped by **clothing** alone. _____
3) During this decay, no protons, neutrons, or electrons are lost. _____
4) During this type of decay, **two protons** are lost. _____
5) This particle has a -1 charge. _____
6) This particle has a mass of 4. _____
7) This type of radiation is identical to an **electron**. _____
8) This form of radiation has **no mass** and **no charge**. _____
9) This particle is represented as a **helium** atom. _____
10) This particle is emitted as in the form of **waves**. _____
11) This particle can be stopped by a **piece of paper**. _____
12) This particle has average (medium) penetrating power. _____
13) This is the **least dangerous** type of radiation. _____
14) This is the **most dangerous** type of radiation. _____

Instructions: Use the nuclear equation below to answer the following questions:

$$^{32}_{15}P \longrightarrow {}^{32}_{16}S + {}^{0}_{-1}e$$

15) The picture above represents **what type** of nuclear decay? _____
16) What is the mass of the starting **phosphorus (P)** atom? _____
17) What is the **mass of the particle released** above? _____
18) Which decay would have caused a **larger change in mass**? _____