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CLASS 11th

# Nuclear Chemistry

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## 01. Radioactivity

Radioactivity is a process in which nuclei of certain elements undergo spontaneous disintegration without excitation by any external means.

All those substances which have the tendency to emit these radiations are termed radioactive materials. Radioactivity is a nuclear phenomenon.

## 02. Analysis of Radioactive Radiations

Property	$\alpha$ -rays	$\beta$ -rays	$\gamma$ -rays
(i) Nature	These consist of small positively charged particles which are merely nuclei of helium atoms, each consisting of 2 protons and 2 neutrons. These are represented as ${}^4_2\text{He}$ .	These consist of negatively charged particles which have the same $e/m$ value as the cathode rays. $\beta$ -rays are merely electrons. The $\beta$ -rays are represented as ${}^0_{-1}\beta$ or ${}^0_{-1}e$ .	$\gamma$ -rays are similar to X-rays. These are neutral in nature. They have very small wavelengths of the order of $10^{-10}$ to $10^{-13}$ m.
(ii) Velocity	The $\alpha$ -rays are ejected with high velocities ranging from $1.4 \times 10^9$ to $1.7 \times 10^9$ to cm/sec. The velocity of $\alpha$ -rays depends upon the kind of nucleus from which they are emitted.	The $\beta$ -rays are much faster than $\alpha$ -rays. They have generally different velocities sometimes approaching the velocity of light.	They travel with the velocity of light.
(iii) Penetrating power	$\alpha$ -particles have small penetrating power due to relatively larger size. They are stopped by a piece of aluminium foil of 0.1 mm thickness.	$\beta$ -rays are more penetrating than $\alpha$ -particles. This is due to small size and high velocity. These are stopped by a 1 cm thick sheet of aluminium.	Due to high velocity and non-material character, $\gamma$ -rays are $10^{10}$ times more penetrating than $\alpha$ -rays.

(iv) Ionising power	$\alpha$ -particles produce intense ionisation in gases, Ionising power is 100 times greater than $\beta$ -rays and 10,000 times greater than $\gamma$ -rays. This is due to high kinetic energy.	Due to low value of kinetic energy ionising power is less than $\alpha$ -particles but 100 times greater than $\gamma$ -rays.	$\gamma$ -rays produce minimum ionisation or no ionisation.
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### 03. Cause of Radioactivity

The stable nuclei lie within the shaded area which is called the **region** or **zone of stability**. All the nuclei falling outside this zone are invariably radioactive and unstable in nature. **Nuclei that fall above the stability zone have an excess of neutrons while those lying below have more protons.** Both of these cause instability. These nuclei attain stability by making adjustment in the  $n/p$  ratio.

