

The terms “nuclear weapon” and “nuclear explosive device” mean any device designed to produce an instantaneous release of an amount of nuclear energy from special nuclear material that is greater than the amount of energy that would be released from the detonation of one pound of trinitrotoluene (TNT).

What is an isotope and Give any three applications of isotopes

Isotopes: Isotopes are atoms of the same element having the same atomic number but different mass numbers.

Isotopes can also be defined as the variants of chemical elements that possess the same number of protons and electrons, but a different number of neutrons.

The chemical properties of all the isotopes of an element are the same.

For Ex: Isotopes of Hydrogen are $^1\text{H}_1$, $^1\text{H}_2$, $^1\text{H}_3$.

Application of Isotopes

- 1) An isotope of Uranium (i.e. Uranium-235) is used as a fuel in a nuclear reactor.
- 2) An isotope of cobalt (i.e. cobalt-60) is used in the treatment of cancer.
- 3) An isotope of iodine (i.e. iodine-131) is used in the treatment of goiter.
- 4) An isotope of carbon (i.e. carbon-14) is used in the carbon dating technique (through which the age of fossils can be determined)

Table of Uses of some Radioactive Isotopes

Isotope	Uses
Americum-241	Many smoke detectors for homes and businesses use this material to assess toxic lead levels in dried paint samples to ensure uniform thickness in rolling processes such as steel and paper manufacturing as well as to assist in determining where oil wells should be drilled.
Cadmium-109	Analyzes metal alloys for stock control and scrap sorting.
Calcium-47	Biomedical researchers studying cellular functions and bone formation in mammals will benefit greatly from this discovery.
Californium-252	Used to inspect airline luggage for hidden explosives, to determine the moisture content of soil in the road and building industries, and to measure the moisture of materials stored in soils.
Carbon-14	Important research tool. Aids in research by ensuring that potential new drugs are metabolised without the formation of harmful by-products. Biological research, agriculture, pollution control, and archaeology all use it.
Caesium-137	Used to treat cancerous tumours, to measure correct patient doses of radioactive pharmaceuticals, to measure and control liquid flow in oil pipelines, to tell researchers whether oil wells are plugged by sand, and to ensure the proper fill level for packages of food, drugs, and other products.

Chromium-51	Used in studies of red blood cell survival.
Cobalt-57	As a tracer, it is used to diagnose pernicious anaemia.
Cobalt-60	Sterilizes surgical instruments as well as improves the safety and reliability of industrial fuel oil burners. Cancer treatment, food irradiation, gauges, and radiography all use it.
Copper-67	When monoclonal antibodies are injected into a cancer patient, it aids the antibodies in binding to and destroying the tumour.
Curium-244	In mining, it is used to analyse material excavated from pits as well as slurries from drilling operations.
Gallium-67	Used to make medical diagnoses
Iodine-123	It is commonly used to diagnose Thyroid disorders and other metabolic disorders, including brain function.
Iodine-125	A significant diagnostic tool used in clinical tests and to diagnose thyroid disorders. This term is also used in biomedical research.
Iodine-131	Thyroid disorders are treated with this medication. (Disease of Graves)
Iridium-192	It is used to test the integrity of pipeline welds, boilers, and aircraft parts, as well as in brachy therapy/tumour irradiation.
Iron-55	Detects the presence of sulphur in the air and analyses electroplating solutions. It is used in metabolic research.
Krypton-85	Indicator lights in appliances such as clothes washers and dryers, stereos, and coffeemakers are used to determine the thickness of thin plastics and sheet metal, rubber, textiles, and paper, as well as to measure dust and pollutant levels. Used in explosive detection, voltage regulators and current surge protectors in electronic devices, and electron capture detectors in gas chromatographs.
Nickel-63	Used in explosive detection, voltage regulators and current surge protectors in electronic devices, and electron capture detectors in gas chromatographs.
Phosphorus-32	This term is used in molecular biology and genetics research.
Phosphorus-33	Since 1972, it has powered more than 20 NASA spacecraft.
Plutonium-238	Reduces static charge in the manufacture of photographic film and other materials.

Polonium-210	Used to measure the thickness of thin plastics, thin sheet metal, rubber, textiles, and paper in electric blanket thermostats.
Promethium-147	Used to measure the thickness of thin plastics, thin sheet metal, rubber, textiles, and paper in electric blanket thermostats.
Radium-226	Increases the effectiveness of lighting rods
Selenium-75	In life science research, it is used in protein studies.
Sodium-24	Leak detection in industrial pipe lines and oil well studies.
Strontium-85	It is used to research bone formation and metabolism.
Strontium-90	Survey metres are used in schools, the military, and emergency management authorities. Sensors and medical treatment are also applications for this material.
Sulphur-35	This term is used in genetics and molecular biology research.
Technetium-99m	The most commonly used radioactive pharmaceutical in nuclear medicine diagnostic studies. For brain, bone, liver, spleen, and kidney imaging, as well as blood flow studies, various chemical forms are used.
Thallium-201	In nuclear medicine, it is used for nuclear cardiology and tumour detection.
Thallium-204	Dust and pollutant levels on filter paper are measured, and the thickness of plastics, sheet metal, rubber, textiles, and paper is gauged.
Thoriated Tungsten	Electric arc welding rods are used in the construction, aircraft, petrochemical, and food processing industries. They result in easier starting, improved arc stability, and reduced metal contamination.
Thorium-229	It extends the life of fluorescent lights.
Thorium-230	Colour and fluorescence are provided in coloured glazes and glassware.
Tritium	A vital tool in biomedical research. Used in life science and drug metabolism research to ensure the safety of potential new drugs for self-illuminating aircraft and commercial exit signs for luminous dials, gauges, and wrist watches, as well as geological prospecting and hydrology.
Uranium-234	Used to provide a natural colour and brightness in dental fixtures such as crowns and dentures.
Uranium-235	It is used to make fluorescent glassware, a variety of coloured glazes, and wall tiles, as well as fuel for nuclear power plants and naval nuclear propulsion systems.
Xenon-133	In nuclear medicine, it is used to study lung ventilation and blood flow.