

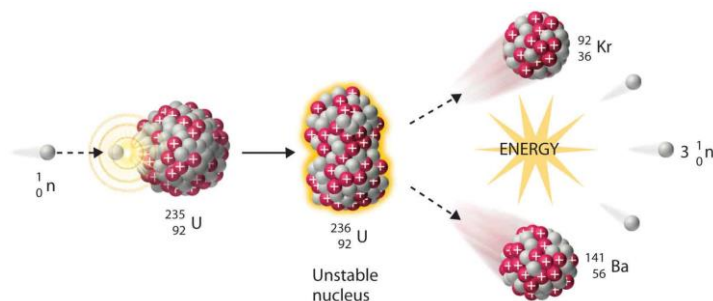
Nuclear – PHYSICS ONLY

Nuclear radiation in medicine

1. Radioactive isotopes are used in medicine for **medical imaging, treatment of cancer**, and as **tracers** to monitor organs.
2. How useful a radioactive isotope is depends on:
 - its half-life
 - the type of radiation it gives out.
3. Radioactive isotopes are used as medical tracers and for medical imaging; they emit gamma rays that can be detected outside the body. The half-life should long enough for the test to be done and short enough to decay almost completely in a few weeks.
4. A gamma beam or a radioactive implant (beta-emitters) can destroy cancer cells in a tumour.

Nuclear fission

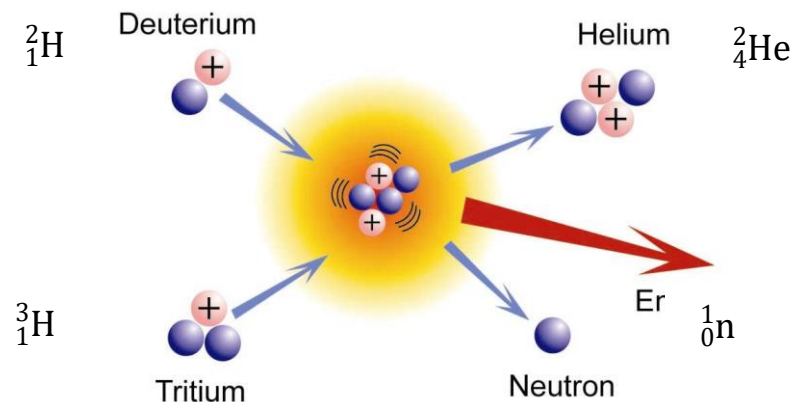
5. **Nuclear fission** is the splitting of an atom's nucleus into two smaller nuclei with the release of two or three neutrons and energy.
6. **Induced fission** occurs when a neutron is absorbed by a uranium-235 nucleus or a plutonium-239 nucleus causing the nucleus to split
7. Spontaneous fission occurs without a neutron being absorbed.



8. A **chain reaction** occurs in a nuclear reactor when each fission event causes further fission events.
9. In a nuclear reactor, **control rods** absorb fission neutrons to ensure that, on average, only one neutron per fission goes on to produce further fission.

Nuclear fusion

13. **Nuclear fusion** is the process of forcing the nuclei of two atoms close enough together so that they form a single larger nucleus.



14. Nuclear fusion can be brought about by making two light nuclei (e.g. ${}^2_1\text{H}$, ${}^3_1\text{H}$) collide at **very high speed**.
15. Energy is released when two light nuclei are fused together. Nuclear fusion in the Sun's core releases energy.
16. A fusion reactor needs to be at a **very high temperature** before nuclear fusion can take place. The nuclei to be fused are difficult to contain.

Nuclear issues

14. Radon gas is an α -emitting isotope that seeps into houses through the ground in some areas.
15. There are hundreds of fission reactors safely in use in the world. None of them are of the same type as the Chernobyl reactors that exploded in 1986.
16. Nuclear waste contains many different radioactive isotopes that emit nuclear radiation for many years. The radiation is dangerous because it can cause cancer.
17. Nuclear waste is stored in safe and secure conditions for many years after unused uranium and plutonium (for future use) are removed from it.