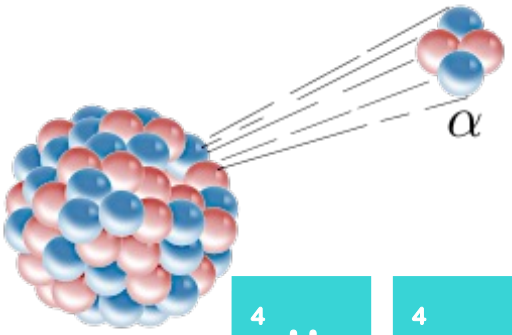
What is an alpha particle?



$^{4}_{2}He$ $^{4}_{2}\alpha$

Radioactive decay is unpredictable and can happen in 4 forms. Rutherford isolated alpha decay in his alpha scattering experiment. Due to the trace lines of the particle, he was able to identify the alpha α particle as helium with an atomic mass of 4 and 2 protons. When a nucleus decays through alpha α it loses 2 protons, which mean that its atomic number decreases by 2 and its atomic mass by 4:-

$$^{219}_{86}Rn \rightarrow {}^{215}_{84}Po + {}^{4}_{2}\alpha$$

This can also be written like this:-

$$^{219}_{86}Rn \rightarrow {}^{215}_{84}Po + {}^{4}_{2}He$$

When radon-219 becomes polonium-215 it loses 2 protons and its atomic number is reduced by 4.

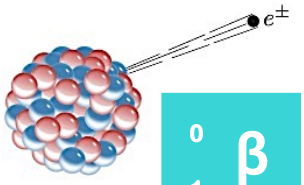
Beta decay

When a nucleus decays through beta β decay, a neutron changes to a proton that is kept by a nucleus and an electron is emitted at high speed from the atom to balance the charge of the atom. This means that the atomic number increases by 1 and the atomic mass remains unchanged. The decay of carbon-14 to nitrogen-14 can be written :-

$$^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{0}_{-1}\beta$$

Or like this:-

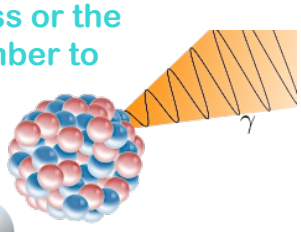
$$^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{0}_{-1}e$$

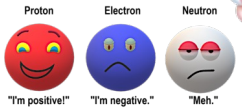


$^{0}_{-1}\beta$ $^{0}_{-}e$

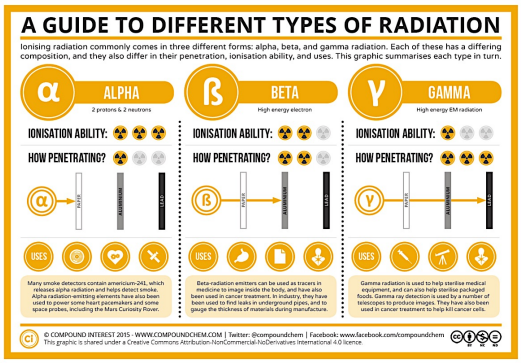
Neutron emission can happen when nuclear fission occurs; a neutron is released from the parent atom when it splits. The mass number decreases by 1 and the atomic number stays the same.

Gamma γ radiation does not cause the atomic mass or the atomic number to change.





You will always be given all the information that you need in the examination question, but it is a good idea to learn the different properties of the different types of radiation.



Equation practice

Write the equations for the following decay:-

1. Polonium-224 decay by alpha emissions:-

$^{204}_{84}Po \rightarrow \square + \square$

2. Strontium-90 decay by beta emissions:-

$^{90}_{38}Sr \rightarrow \square + \square$

3. Uranium-235 decay by beta emissions:-

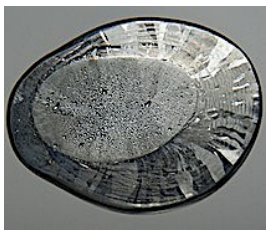
$^{235}_{92}U \rightarrow \square + \square$

4. Nickel-63 decay by beta emissions:-

$^{63}_{28}Ni \rightarrow \square + \square$

5. Lead-209 decay by beta emissions:-

$^{209}_{82}Pb \rightarrow \square + \square$



6. Radium-224 decay by alpha emissions:-

$^{224}_{86}Rn \rightarrow \square + \square$

Half-life and emissions

7. If gallium-68 has a half-life of 68.3 minutes, how much of a 10mg sample is left after 2 half-lives?

8. If the passing of 5 half-lives leaves 25mg of a strontium-90 sample, how much was present in the beginning?

9. The radioisotope ceasium-137 has a half life of 30 years. A sample decays at 544/minute (544 cpm) in 1985. In what year will it decay to 17 cpm?

Complete the equation	Alpha or beta?
$^{201}_{79}Au \rightarrow {}^{201}_{80}Hg + \square$	
$^{185}_{79}Au \rightarrow {}^{181}_{77}Ir + \square$	
$^{231}_{91}Pa \rightarrow {}^{227}_{89}Ac + \square$	
$^{52}_{26}Fe \rightarrow {}^{52}_{27}Co + \square$	