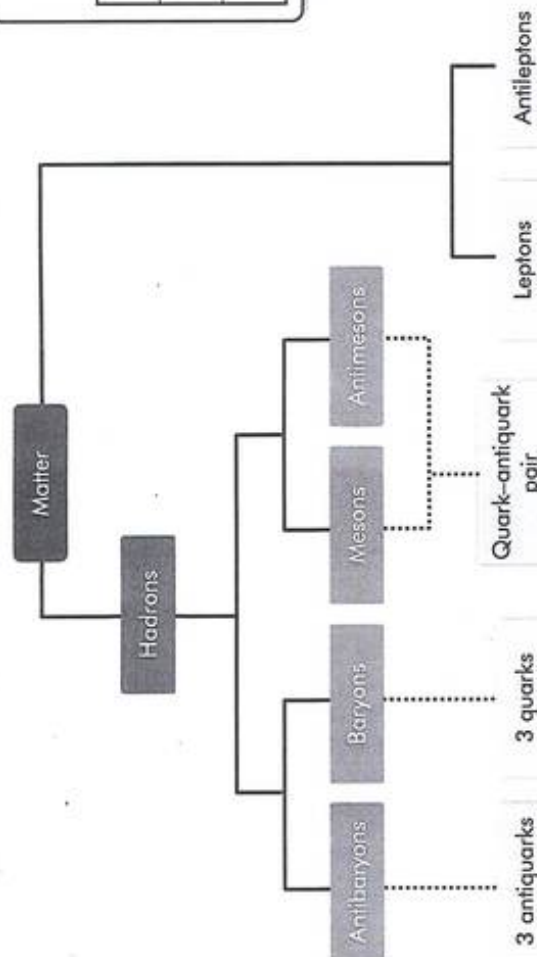


Classification of particles



Quarks

Symbol	Charge	Baryon number
Up	$+\frac{2}{3}$	$+\frac{1}{3}$
Down	$-\frac{1}{3}$	$+\frac{1}{3}$
Strange	$-\frac{1}{3}$	$+\frac{1}{3}$

Quarks and antiquarks

Quarks: elementary particles that are the smallest known constituents that make up matter. There are three types of quarks you need to know.

Quark composition

- Neutron: udd
- Proton: uud
- Antineutron: $\bar{u}\bar{d}\bar{d}$
- Antiproton: $\bar{u}\bar{u}\bar{d}$
- Pion: $u\bar{d}$ (π^+); $\bar{u}d$ or $d\bar{d}$ (π^0); $d\bar{u}$ (π^-)
- Kaon: us (K^+); $\bar{d}s$ or $s\bar{d}$ (K^0); su (K^-)

Application of conservation laws

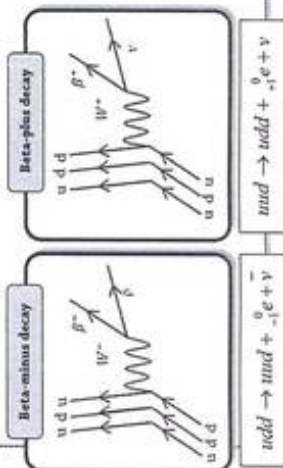
You would be expected to know the decay of a baryon in terms of quarks

Conservation laws for decays/interactions

- Conservation of energy, momentum and charge apply to all changes.
- In any interaction, baryon and lepton numbers are conserved.
- Strangeness must be conserved in strong interactions, but not weak interactions.

Exam Tip!

It is important you are comfortable with the conservation laws, as you will be expected to comment on whether decays/interactions are valid or not based on these laws.



New particles

Many particles are created when high-energy cosmic rays hit the Earth's atmosphere, creating showers of particles at higher energies than can be easily recreated on Earth. These cosmic ray showers can be detected with two Geiger counters, placed in an array such that the direction of the showers of particles can be determined.

Particle paths can also be seen in cloud chambers - particles ionise the vapour in a sealed chamber, showing the paths particles take through the chamber.

Strangeness

- Strangeness is a quantum number and is a property of subatomic particles.
- Strange particles are produced through strong interactions and decay through weak interactions.
- Strangeness is conserved in strong interactions.
- Strangeness is a quantum number to indicate that strange particles are always created in pairs.
- Strangeness can change by 0, +1 or -1 in weak interactions.

- Protons and neutrons are examples of baryons.
- Proton is the only stable baryon.
- All other baryons eventually decay into protons.
- Examples of antibaryons are antiprotons and antineutrons.
- Baryons have a baryon number of +1, whereas antibaryons have a baryon number of -1.

- Pions and kaons are examples of mesons.

- Pion is the exchange particle of the strong nuclear force.
- Kaon is a particle that decays into pions.
- Muon is a particle that decays into an electron.

- Electrons, muons and neutrinos are types of leptons.
- Their antiparticles are examples of antileptons.
- Leptons have a lepton number of +1 and antileptons have a lepton number of -1.