

2.5.2 Lepton number, baryon number and strangeness

All particles are assigned quantum numbers which help to determine how they interact or decay.



Lepton number

All leptons are assigned a lepton number.

- An electron (e^-) has an electron lepton number $L_e = +1$.
- Its associated electron neutrino (ν_e) has an electron lepton number $L_e = +1$.
- The anti-electron (e^+) has an electron lepton number $L_e = -1$.
- The anti-electron neutrino ($\bar{\nu}_e$) has an electron lepton number $L_e = -1$.

We can see that the particles have lepton number +1 and the antiparticles have a lepton number -1.

The same pattern is observed for the muon.

- A muon (μ^-) has a muon lepton number $L_\mu = +1$.
- The muon neutrino (ν_μ) has a muon lepton number $L_\mu = +1$.
- The anti-muon (μ^+) has a muon lepton number $L_\mu = -1$.
- The anti-muon neutrino ($\bar{\nu}_\mu$) has a muon lepton number $L_\mu = -1$.

(1) ✎ Write down the tau lepton numbers (L_τ) for the tau (τ^-), the tau neutrino (ν_τ), the anti-tau (τ^+), and the anti-tau neutrino ($\bar{\nu}_\tau$).

All hadrons (baryons and mesons) have a lepton number $L_{e,\mu,\tau} = 0$, because they aren't leptons!

Baryon number

- All baryons have a baryon number $B = +1$
- All anti-baryons have a baryon number $B = -1$.

Mesons and leptons have a baryon number $B = 0$, because they aren't baryons!

(2) ✎ What baryon number would the following have: a proton, an anti-neutron, a positive pion, a positron?

Strangeness

- All hadrons which contain a strange quark (s) are assigned a strangeness number $S = -1$.
- All hadrons which contain an anti-strange quark ($\bar{s}$) are assigned a strangeness number $S = +1$.

Leptons, and hadrons which don't contain a strange quark have strangeness $S=0$.

(3) ✍️ What strangeness number would the following particles have: a proton (p), an anti-muon neutrino ($\bar{\nu}_\mu$), a negative kaon (K^-), a positive pion (π^+), an anti-neutron ($\bar{n}$)?

(4) ✍️ Now complete the following table:

particle	Particle name	Charge Q	L_e	L_μ	L_τ	B	S
e^-	electron	-1	1	0	0	0	0
$\bar{\nu}_\tau$	anti-tau neutrino	0	0	0	-1	0	0
μ^-	muon						
p	proton	+1	0	0	0	+1	0
$\bar{p}$							
K^-	negative kaon						
π^+	positive pion	+1	0	0	0	0	0
K^0	neutral kaon	0	0	0	0	0	+1
τ^+	anti-tau						