Advanced Topics⇒}Particle Physics

A few lines from the Particle Physics chapter of my upcoming book (title tentative, to be publicized on this website eventually), *Reviewing Forgotten Physics for the GRE, Prelim's and Qualifier's*:

Baryons and mesons are hadrons. (Hadrons are particles that interact with the strong nuclear force.) Baryons have a baryon number of $B=\pm 1$, while mesons have $B=0$. Nucleons (which are baryons) have $B=1$, while antinucleons (antineutrons and antiprotons) have $B=-1$.

Leptons (electrons, neutrinos, muons, and tau's) interact with the weak nuclear force. There are three kinds of lepton numbers. There is the electron lepton number L_e and there is a muon lepton number, as well as a neutrino lepton number.

Electrons β^- and the electron neutrino ν_e have $L_e=1$, while positrons (antielectrons) β^+ and the electron antineutrino $\bar{\nu}_e$ have $L_e=-1$. All other particles have $L_e=0$

Conservation of baryon number or lepton number is just summing up either the baryon number or the lepton number on both sides of the reaction.

Conservation of the numbers above explain for why a reaction like $\mu \to \beta^- + \nu_\mu + \bar{\nu}_e$ must occur in lieu of $\mu \to \beta^- + \bar{\nu}_e$ or $\mu \to \beta^- + \nu_e$ or $\mu \to \beta^- + \bar{\nu}_\mu$ or $\mu \to \beta^- + \nu_\mu$.

For the first reaction, the electron Lepton numbers are $0 \to 1+0-1$, and thus L_e is conserved. (Muon Lepton numbers are $1 \to 0+1+0$)

For the second reaction, the muon lepton numbers are $1 \to 0+0$, but that does not add up, and so L_μ is not conserved.

For the third reaction, the electron Lepton numbers are $0 \to 1+1$, but that does not add up, and so L_e is not conserved.

As an exercise, one can calculate the fourth and fifth reaction.

(If you're beginning to feel like this is more alchemy than physics, then note that the Standard Model of particle physics is just a transitory theory, like alchemy was to chemistry. It is to be replaced soon with a less ad-hoc theory, perhaps by *you*.)