Feynman Diagrams

Feynman diagrams are a method of visualizing the interactions that occur between particles. We are going to examine some of the basic rules.

1. Quarks and leptons are drawn as solid, straight lines with arrows in the center.
2. Exchange particles are curvy lines with no arrows. (A sine-like segment represents photons, a curly segment represents a gluon and a dashed line represents W and Z particles)
3. Vertices represent interactions. Each vertex is made up of two particles and an exchange particle.
4. We will use the convention that time progresses from left to right. Space is represented on the vertical axis. There are some who will use draw time on the vertical axis, but not in this course.
5. Particles have arrows pointing forward in time. Anti-particles have arrows pointing backwards. This does not mean that anti-particles move backwards in time, it is the accepted convention to identify the type of particle.
6. There is always one arrow entering a vertex and one leaving.
7. The labels for the particles are shown on the end of the line.

Forces between objects are the result of the exchange of particles.

1. Electromagnetic forces are the result of photons.
2. The strong force acts between quarks and therefore between nucleons. DP Physics will limit the scope of the assessment of this interaction to pions (π^+, π^-, or π^0). Gluons are the exchange particle for the color force which is beyond the assessment of this course, but you may see them in examples.
3. The weak force is responsible for radioactive decay by beta emission. A W^+, W^-, or Z^0 boson in this process.

Draw the Feynman Diagrams for the following:

1. Electron scattering
2. Beta$^+$ decay
3. Beta$^-$ decay
4. Pion decay
5. Electron positron annihilation
6. Pair production
7. Muon decay