1. Use the masses (in MeV) of the first three rows of the baryon decuplet to estimate the masses of the $u$, $d$, $s$ quarks, and then predict the mass of the $s$' particle.

This was the only prediction of the quark model verified between conception in 1963 and the Nobel Prize for it in 1989.

2. The so-called Drell-Yan reactions, $\pi^\pm p \rightarrow \pi^0 \pi^\pm \pi^- X$ are thought to proceed via the elementary reaction $q \bar{q} \rightarrow \mu^+ \mu^-$. If so, predict $\frac{\sigma(\pi^+ p \rightarrow \pi_\mu^+ \pi^- X)}{\sigma(\pi^- p \rightarrow \mu^- \pi_\mu^+ X)}$ at high energies.

3. Estimate the neutron lifetime, due to the decay $n \rightarrow p e^- \bar{\nu}$. The art here is in a good choice of energy scale...

The Equivalence Principle states that the ratio $R$ of inertial to gravitational mass is the same for all substances. It has been tested by comparing the centrifugal force due to the earth's rotation on a body with the gravitational force of the earth (or sun). $R$ is found to be the same for Al and Pt within 1 part in $10^{12}$. These experiments also set a limit on the coupling, $K_B$ of any long-range ($1/r^2$) field coupling to baryon number. By considering nuclear binding energies and neutron/proton ratios, show that the difference in baryon number per unit mass in Al and Pt is $4 \times 10^{-4}$. Hence show that $K_B/K < 10^{-9}$, where $K$ is the gravitational constant. (For further details, see, for example, Perkins (1984)).

(You may want to peek at chap. 4 of Cottingham & Greenwood.)