Problem set 1

Problem 1

We consider the two-body decay $A \rightarrow B + e^-$ of nucleus A, of mass m_A, into nucleus B, of mass m_B, and an electron (m_e). Determine, in the rest frame of nucleus A, the maximum energy of the electron.

Problem 2

Draw the Feynman diagram of the following processes and specify the quantum chromodynamics (QCD) colour currents:

$$
\begin{align}
n &\rightarrow p\,e^-\,\overline{\nu}_e \tag{1} \\
\pi^- &\rightarrow \mu^-\,\overline{\nu}_\mu \tag{2} \\
\tau^- &\rightarrow \pi^-\,\pi^+\,\pi^-\,\nu_\tau \tag{3} \\
\overline{\nu}_e\,p &\rightarrow n\,e^+ \tag{4}
\end{align}
$$

Problem 3

In β decays, show that the fraction of electrons having a kinetic energy T_e in the range ΔT close to the maximum energy Q_β is proportional to $(\Delta T/Q_\beta)^3$. Consider the case $Q_\beta \gg m_e$.