ELEMENTARY PARTICLE PHYSICS

WS 2016/2017: Exercise sheet 10

31. In second order perturbation theory compute the unpolarized cross section for $e^-(k)\,\mu^-(p) \to e^-(k')\,\mu^-(p')$ in a system in which the incoming muon is at rest. The angle between $\vec{k}$ and $\vec{k}'$ be θ. You can neglect the electron mass.
(i) First draw the Feynman diagrams and translate them into the formula for the matrix element.
(ii) After squaring, averaging over the spins and evaluating the traces you should obtain

$$\frac{1}{4}\sum_{\text{spins}} |\mathcal{M}|^2 = \frac{8e^4}{q^4}\left[(kp)(k'p') + (kp')(k'p) - m_\mu^2(kk')\right]$$

with $q = k - k'$.
(iii) Use (ii) (even if you did not derive the result there) to compute the differential cross section

$$\frac{d\sigma}{d\cos\theta\, dE'}$$

where E' is k'_0, the energy of the scattered electron.