Griffiths 7.38 (?)

This diagram is identical to that of 2nd order with an additional loop in the middle. So we take the electron-muon amplitude and insert a loop in the middle:

$$(2\pi)^4 \int d^4q\, \delta^4(q_1 - p_3 - q)\, \delta^4(p_2 + q - p_4)\, [\bar{u}_3 (\cancel{i} g_e \gamma^\mu) u_1]\, \frac{\cancel{-i} g_{\mu\alpha}}{q_1^2}\, \frac{\cancel{i}[\not{k} + mc]}{\not{k}^2 - m^2c^2}\, \frac{\cancel{i}[\cancel{(q-k)}]}{\cancel{(q-k)} - m^2c^2}\, \cancel{i} g_e \gamma^\alpha$$

$$\cancel{\frac{-i g}{\beta\nu}}\ \cancel{i} g_e \gamma^\beta\, \frac{\cancel{-i} g_{\beta\nu}}{q_2^2}\, [\bar{u}_4 (\cancel{i} g_e \gamma^\nu) u_2]\, d^4k\, d^4q_1\, d^4q_2.$$

$$\cancel{\delta(q - k + k - q)}\ \cancel{\delta(k - (k-q) - q)}$$

$$= \int \frac{i g_e^4}{q^4} [\bar{u}_3 \gamma^\mu u_1]\, \frac{[\not{k} + mc]}{\not{k} - m^2c^2}\, \frac{[(\cancel{q-k} + mc)]}{\cancel{(q-k)} - m^2c^2}\, \gamma_\mu \gamma^\beta [\bar{u}_4 \gamma_\beta u_2]\, \frac{d^4k}{(2\pi)^4}$$

$$= \frac{i g_e^4}{q^4} [\bar{u}_3 \gamma^\mu u_1] \left[\int \frac{d^4k}{(2\pi)^4} \frac{[\not{k} + mc]}{\not{k} - m^2c^2} \frac{[\cancel{q-k} + mc]}{(q-k) - m^2c^2} \gamma_\mu \gamma^\beta \right] \cancel{\beta} [\bar{u}_4 \gamma_\beta u_2].$$