1. Draw the Feynman diagram for the one-loop self-energy correction to the propagator of an electron with momentum $p$. Choose the momenta of the virtual photon and electron to be $k$ and $k + p$.

2. Write down the expression for the electron self-energy in Feynman gauge.

3. The one-loop electron self-energy diagram has terms of the form

$$\int \frac{d^4k}{(2\pi)^4} \frac{1}{(k^2 + i\epsilon)[(k + p)^2 - m^2 + i\epsilon]}.$$ 

By introducing an integral over a Feynman parameter, combine the two denominators into a single denominator, so that the integral has the form

$$\int \frac{d^4k}{(2\pi)^4} \frac{1}{[k^2 + 2ak.p + bp^2 - cm^2 + i\epsilon]^2}.$$ 

4. Shift the loop momentum to change the momentum integral into the form

$$\int \frac{d^4k}{(2\pi)^4} \frac{1}{[k^2 - M^2 + i\epsilon]^2}.$$