HW11

1 One-loop structure of QED

The Lagrangian is given by

$$\mathcal{L} = -\frac{1}{4}F_{\mu\nu}F^{\mu\nu} + i\bar{\psi}(\not{D} - m)\psi, \tag{1}$$

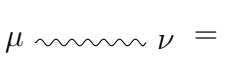
where covariant derivative is defined as

$$D_\mu = \partial_\mu + ieA_\mu. \tag{2}$$

Similarly to Yukawa find counter terms needed to render the theory finite at one loop level. To this end use the following propagators, for fermions

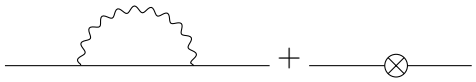
$$= \frac{i(\not{p} + m)}{p^2 - m^2 + i\varepsilon}, \tag{3}$$

and photons



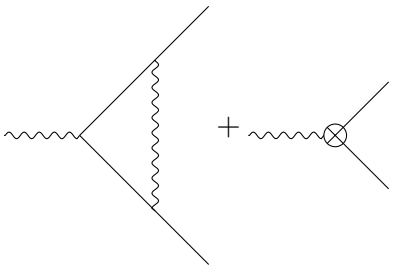
$$= \frac{-i\eta_{\mu\nu}}{p^2 + i\varepsilon}. \tag{4}$$

- Diagrams contributing to fermionic 2-pt function:



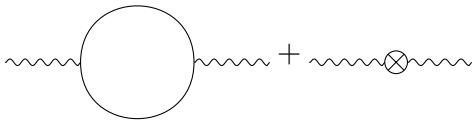
(5)

- 3-pt function $A_\mu\bar{\psi}\gamma^\mu\psi$:



(6)

- Diagrams contributing to bosonic 2-pt function:



(7)

- What diagrams contribute to charge renormalization? Why? Compute the corresponding beta-function.