1. Which of the diagrams in Eq. (4.58) contribute to the invariant matrix element $\mathcal{M}(p_1, p_2 \rightarrow p_3, p_4)$ at $O(\lambda^2)$? Write the explicit expression of $\mathcal{M}(p_1, p_2 \rightarrow p_3, p_4)$ at $O(\lambda^2)$ in momentum space.

2. Problem 4.2 of Peskin and Schroeder’s book.

3. Consider the two fermion scattering:

$$\text{fermion}(p) + \text{fermion}(k) \rightarrow \text{fermion}(p') + \text{fermion}(k')$$

in the context of the Yukawa theory. We have derived the lowest order or tree level invariant matrix element $\mathcal{M}$ for this scattering process in class. Using that result, complete our discussion by calculating the differential cross section $\left(\frac{d\sigma}{d\Omega}\right)_{CM}$ and the total cross section $\sigma$.