PHY 5667 : Quantum Field Theory A, Fall 2006

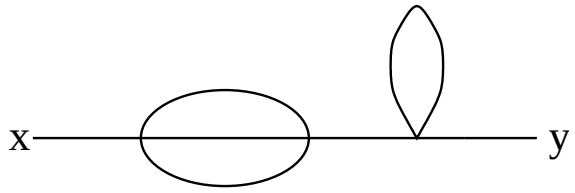
October 19^{th}, 2006

Assignment # 4

(due Thursday November 2^{nd}, 2006)

1. Using the same technique applied to prove Eq. (4.37) of Peskin and Schroeder's book, show explicitly how to obtain Eq.(4.39). Also, show that $\langle 0|T\{\phi(x_1)\phi(x_2)\phi(x_3)\}|0\rangle = 0$.

2. The following Feynman diagram:



represents a contribution to $\langle\Omega|T\{\phi(x)\phi(y)\}|\Omega\rangle$. Explain from which term of the perturbative expansion of $\langle\Omega|T\{\phi(x)\phi(y)\}|\Omega\rangle$ does it come from and write the corresponding analytical contribution both in position-space and in momentum-space.

3. Show that at $\mathcal{O}(\lambda^2)$ the four point correlation function $\langle\Omega|T\{\phi(x_1)\phi(x_2)\phi(x_3)\phi(x_4)\}|\Omega\rangle$ corresponds to the series of diagrams in Eq. (4.58). Which of the diagrams in Eq. (4.58) contribute to the invariant matrix element $\mathcal{M}(p_1, p_2 \to p_3, p_4)$ at $\mathcal{O}(\lambda^2)$? Write the explicit expression of $\mathcal{M}(p_1, p_2 \to p_3, p_4)$ at $\mathcal{O}(\lambda^2)$ in momentum space.

4. Problem 4.2 of Peskin and Schroeder's book.