

Quantum Field Theory I: PHYS 721 (Fall 2021)

Quick quiz 7

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Instructions

These quick quizzes are low-stakes assessment tools to help cement your understanding of our material. They will help you remember the key facts and can serve as a study guide to help you focus on material you are less familiar with. These quizzes do not contribute to your grade and are for your own use.

1. **Without looking at your notes or the textbook, and without consulting with your neighbour**, write your answer to each question in the **first column**.
2. Discuss with your neighbour and use your notes or the textbook as needed to answer each question and write your answers to each question in the **second column**. You should complete the second column, but do not add anything to your first column.

There are five questions.

Question 1

How do we obtain Feynman rules from a given Lagrangian?

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Question 2

What are the practical steps required to obtain a prediction for a scattering cross-section of a given process from a given Lagrangian?

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Question 3

A model Lagrangian has the interaction term $\lambda(|\phi|^2)^2$, where ϕ is a complex scalar field. What is the Feynman rule for the interaction in this theory?

Question 4

What is the Feynman diagram and the corresponding invariant matrix element for the $\mathcal{O}(\lambda)$ (“tree-level” or “leading order”) contribution to $\phi\phi^* \rightarrow \phi\phi^*$ scattering in the model from Q. 3?

Question 5

Draw the classes of connected $\mathcal{O}(g^6)$ contributions to $\phi\phi \rightarrow \phi\phi$ scattering in real scalar $g\phi^3$ theory (don’t worry about drawing each permutation within each class). These are also known as next-to-next-to-leading order (NNLO) or “two loop” diagrams. [Hint: there are a ton.]