

Chapter 9

- Explain the general reasoning behind

$$U(q_a, q_b, T) \equiv \langle q_a | e^{-iHT} | q_b \rangle = \int \mathcal{D}q \mathcal{D}p \exp \left(i \int_0^T dt (p\dot{q} - H(q, p)) \right) \quad (1)$$

- More general, how do you get Green functions/correlations functions out of the path integral?
- Describe the derivation of

$$\langle \Omega | T(\phi(x)\phi(0)) | \Omega \rangle = \frac{\int \mathcal{D}\phi \phi(x)\phi(0) e^{-i\int \mathcal{L}}}{\int \mathcal{D}\phi e^{-i\int \mathcal{L}}} \quad (2)$$

- What is a generating functional?
- Explain the reasoning behind a Fadeev-Popov ghost and the physics of why it is necessary.
- How do you put fermions in the functional integral?
- Explain Grassmann variables.

Chapter 10

- What is a superficial degree of divergence and how do we use it?
- Explain bare versus renormalized perturbation theory? Do you have a preference?
- How do you calculate δ_Z ?
- Describe the renormalization program in QED, what is needed to fix all renormalizations?
- What are nonlocal divergences and what happens with them?

Chapter 11

- Explain symmetry breaking in the linear sigma model
- Explain Goldstone's theorem
- Are currents still conserved after spontaneous symmetry breaking?

Chapter 12

- Explain rescaling and Wilson's renormalization group
- Explain the Callan-Symanzik relation, is it related to Wilson's renormalization group?
- What are fixed points in general and IR and UV in particular?
- What is a renormalization scale, is it uniquely defined?
- explain anomalous dimensions
- Discuss coupling constant flow (i.e. give some examples of different types)

Chapter 15

- Explain gauge invariance
- What is a covariant derivative
- What is a field strength

You are really expected to know this chapter from a particle physics course

Chapter 17

- Explain 3 jet production
- Give a heuristic overview of parton distributions and the approximations that are involved
- Explain the relevance of the $1/(1-x)_+$ parts of the splitting functions and how you determine their coefficients

Chapter 20

- Explain how the scalar particle can become the longitudinal part in a vector propagator
- Explain why the Goldstone bosons disappear as physical particles
- Explain anomaly cancellation in the Standard Model, why do we need it