

**Problem set 7****Due Nov. 13, 2009**

1. In the  $\phi^4$  theory, with coupling  $\lambda$ :

- (a) Find a way of specifying all *connected tree* graphs for the 6-point Green function. Let the external momenta be  $p_1, \dots, p_6$ , which are to be treated as incoming. (Tree graphs are those without loops. For this problem, you should find they have exactly two interaction vertices.)
- (b) How many of these graphs are there?
- (c) Obtain a compact formula for the sum of the graphs. You should be able to find a way of writing some multiple summations and products over external momenta, which can be written in about one line.

2. (Prob. 7.4 of Srednicki) Consider a harmonic oscillator in its ground state at  $t = -\infty$ . It is then subject to an external force  $f(t)$ . Compute the probability  $|\langle 0|0\rangle_f|^2$  that the oscillator is still in its ground state at  $t = +\infty$ .

You should be able to derive this from a functional integral representation in Ch. 7 of Srednicki's book.

Write your answer as a manifestly real expression, and in terms of the Fourier transform  $\tilde{f}(E) = \int_{-\infty}^{+\infty} dt e^{iEt} f(t)$ . Your answer should not involve any other unevaluated integrals.