

**Physics 221A**

**Quantum Field Theory**

**Fall 2007**

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Course web page: <http://www.kitp.ucsb.edu/~joep/Web221A/221A.html>

ASSIGNMENT #9

Due: Friday, Dec. 7, 5pm in TA's mailbox (5th floor Broida). Absolute final deadline Monday, Dec. 10, 5pm (so I can post solutions before the final).

1. Srednicki 24.2.

2. Srednicki 24.3.

3. Srednicki 24.4.

4. Srednicki 32.3. This is for the QFT of eq. 32.1. Do part a only (I am not sure what part b was looking for). Also, calculate

$$\langle 0 | T \tilde{\phi}(k_1) \tilde{j}^\mu(k_2) | 0 \rangle ,$$

at tree level. Verify the Ward identity.

5. Consider a field theory with two scalar fields and the discrete symmetries  $(\phi_1, \phi_2) \rightarrow (\phi_2, \phi_1)$  and  $(\phi_1, \phi_2) \rightarrow (-\phi_1, \phi_2)$ .

a) Find the complete set of symmetries generated by repeated actions of these two.

b) Find the most general renormalizable Lagrangian in  $D = 4$  with this set of symmetries.

c) Determine the ground state. Hint: there are several possibilities, depending on the values of the parameters. In particular, identify the region of parameter space where the potential is unbounded below.

d) For each ground state, determine the unbroken discrete symmetries.

e) Show that for special values of the quartic interaction there is an extra global symmetry.