

## Week 8 (due Nov. 27)

Reading: Srednicki, section 27.

1. Problem 9.3 (a)

2. For the theory in problem 9.3 (in four dimensions), show that

(a)  $Z_\phi$  is finite at leading order (i.e. at order  $\lambda$ ), while  $Z_m$  and  $Z_\lambda$  are infinite.

(b) Compute the divergent parts of  $Z_m$  and  $Z_\lambda$  at leading order (the computation involves the same kind of integrals as those encountered in the evaluation of  $\Pi(p^2)$  in the  $\phi^3$  theory, so you may use the values of these integrals computed in Srednicki).

(c) Compute the beta-function for  $\lambda$  using the result of part (b) and solve the renormalization group equation for the running coupling. Is the theory asymptotically free?

(d) Using the results of part (b), derive the renormalization-group equation for the running mass to leading order in  $\lambda$  and solve it.