There are no calculational problems in this set, just reading assignments:

1. §12.1 of the *Peskin and Schroeder* textbook (Introduction to QFT) about the Wilsonian approach to the renormalization theory.

2. §11.3, §11.5, and §11.6 of the *Peskin and Schroeder* textbook about the effective classical action $\Gamma[\phi(x)]$ of a quantum theory and its relation to the generating functional of the 1PI Feynman graphs.

⋆ Make sure you understand the difference between the Wilsonian and the conventional renormalization groups:

In the Wilsonian renormalization, the "effective action" is the bare action $S_{\text{bare}}[\phi]$ of the cutoff quantum theory with a *sliding cutoff scale* Λ; the Wilsonian running couplings are the Λ–dependent coefficients of various terms in the $\S_{\text{bare}}[\phi]$; and the Wilsonian renormalization group governs the dependence of these couplings on the sliding cutoff scale Λ,

$$\frac{d\lambda_w(\Lambda)}{d\log\Lambda} = \beta\bigl(\lambda_w(\Lambda)\bigr). \tag{1}$$

In the conventional renormalization, the "effective action" is the "effective classical action" AKA the generating functional $\Gamma[\phi]$ of the 1PI diagrams; the running couplings $\lambda(\mu)$ are the energy-scale-dependent coefficients of some (on-shell or off-shell) amplitudes — which may also be identified as the coefficients of the suitable terms in the generating functional $\Gamma[\phi]$; and the conventional renormalization group governs the dependence of such couplings on the energy scale μ of the amplitude used to measure each coupling,

$$\frac{d\lambda(\mu)}{d\log\mu} = \beta\bigl(\lambda(\mu)\bigr). \tag{2}$$

3. Finally, refresh your memory of the Ward–Takahashi identities (for the ordinary QED). Read §7.4 of *Peskin and Schroeder* and my notes on the subject from February 2013.