

All from the Srednicki solutions manual:

14.3) a) The integrand in eq. (14.52) is odd under $q \rightarrow -q$, and so vanishes when integrated. The left-hand side of eq. (14.53) is a two-index constant symmetric tensor, and so must equal $g^{\mu\nu}A$, where A is a Lorentz scalar. To determine A , we contract both sides with $g_{\mu\nu}$; since $g_{\mu\nu}g^{\mu\nu} = \delta_{\mu}^{\mu} = d$, we find $C_2 = 1/d$.

b) The result is a constant four-index completely symmetric tensor, and hence must equal $(g^{\mu\nu}g^{\rho\sigma} + g^{\mu\rho}g^{\sigma\nu} + g^{\mu\sigma}g^{\nu\rho})B$. Contracting this with $g_{\mu\nu}g_{\rho\sigma}$, we get $(d^2 + d + d)B = d(d+2)B$. Therefore

$$\int d^d q q^\mu q^\nu q^\rho q^\sigma f(q^2) = \frac{1}{d(d+2)}(g^{\mu\nu}g^{\rho\sigma} + g^{\mu\rho}g^{\sigma\nu} + g^{\mu\sigma}g^{\nu\rho}) \int d^d q (q^2)^2 f(q^2). \quad (14.58)$$

14.5) See section 31. From eq. (31.5), we have

$$\Pi(k^2) = \frac{\lambda}{16\pi^2} \left[\frac{1}{\varepsilon} + \frac{1}{2} + \ln(\mu/m) \right] m^2 - Ak^2 - Bm^2 + O(\lambda^2). \quad (14.60)$$

We see immediately that

$$\begin{aligned} A &= O(\lambda^2), \\ B &= \frac{\lambda}{16\pi^2} \left[\frac{1}{\varepsilon} + \frac{1}{2} + \ln(\mu/m) \right] + O(\lambda^2). \end{aligned} \quad (14.61)$$

and that $\Pi(k^2) = 0$ to $O(\lambda)$.

14.6) The only difference is that the loop has a symmetry factor of $S = 1$ rather than $S = 2$, so there is an extra factor of 2 in the loop correction, and hence in B ; A is still zero at one loop.