Polynomial basis

If we transform integrals to the dimension $D = d+2n-2$ (assuming that $d = 4-2\varepsilon$) then expansion of $I_n^{(d+2n-2)}$ at small $\varepsilon = 2 - d/2$ is

$$I_n^{(d+2n-2)} = \Gamma\left(1+\varepsilon\right)\left[-\frac{s_n}{\varepsilon} - s_n - R_n^1 + O(\varepsilon)\right],$$

where

$$s_n = \int_0^1 \ldots \int_0^1 \{dx\}\; J_n h_n = -\frac{1}{(n+1)!}\sum p_{ij}^2 + \frac{1}{n!}\sum_{j=1}^{n} m_j^2,$$

$$R_n^1 = \int_0^1 \ldots \int_0^1 \{dx\}\; J_n h_n \ln h_n.$$

Logarithmic basis

If we transform integrals to the dimension $D = d+2n-4$ then expansion of $I_n^{(d+2n-4)}$ at small ε is

$$I_n^{(d+2n-4)} = \Gamma\left(1+\varepsilon\right)\left[-\frac{1}{(n-1)!\varepsilon} - \frac{1}{(n-1)!} - R_n^0 + O(\varepsilon)\right],$$

where

$$R_n = \int_0^1 \ldots \int_0^1 \{dx\}\; J_n \ln h_n.$$