

$$\begin{aligned}
& + \tilde{K}^{(1)}(\xi, \eta) \int_0^\xi [(\eta+\zeta)(\eta+3\zeta) - (\xi+\eta)(\xi+\eta+2\zeta)] e^{-3s(\xi+\eta)(2\eta+\zeta)\zeta} d\zeta \Big\} \\
& + 8 \sin^4 \theta \left\{ \tilde{K}^{(0)}(\xi, \eta) \int_0^\xi d\zeta e^{-3s\xi\zeta^2} \int_0^{\eta+\zeta} (v-\eta-\zeta)[1+6s(\xi-\zeta)\zeta^2] e^{-s(2v^3+3\xi v^2)} dv \right. \\
& + 2\tilde{K}^{(1)}(\xi, \eta) \int_0^\xi d\zeta \Pi_0(\xi, \eta, \zeta) \int_0^\zeta (\zeta-v)[1+6s(\xi-\zeta)(\xi+\eta+\zeta)^2] e^{s(2v^3+3\eta v^2)} dv \\
& \left. + \tilde{K}^{(1)}(\xi, \eta) \int_0^\xi d\zeta e^{-3s(\xi+\eta)(2\eta+\zeta)\zeta} \int_0^\zeta (v-\zeta)[1+6s(\xi-\zeta)(\eta+\zeta)^2] e^{-s[2v^3+3(\xi+\eta)v^2]} dv \right\}, \tag{B1}
\end{aligned}$$

where

$$\begin{aligned}
\tilde{K}^{(0)}(\xi, \eta) &= e^{-s(2\xi^3+3\xi^2\eta)}, \quad \tilde{K}^{(1)}(\xi, \eta) = e^{-s[\xi^3+\eta^3+(\xi+\eta)^3]}, \\
\Pi_0(\xi, \eta, \zeta) &= e^{-s(4\zeta^3+6\xi\zeta^2+9\eta\zeta^2+6\xi\eta\zeta+6\eta^2\zeta)}.
\end{aligned}$$

$$\begin{aligned}
K_{21}(\xi, \eta) &= 16\xi(\xi+\eta)(2\xi+\eta) e^{-2s(2\xi+\eta)^3+4s\xi^3} \\
& + 4 \sin^2 \theta \xi(2\xi+\eta)(3\xi+2\eta) e^{-2s(2\xi+\eta)^3} \\
& - 8 \sin^2 \theta \int_0^\xi (2\xi+\eta) [(2\xi+3\eta+3\gamma) - 3s\gamma^3(2\xi+2\eta+\gamma)] \\
& \quad e^{-s\gamma^3-2s(2\xi+\eta)^3+s(2\xi-\gamma)^3-4s(\xi-\gamma)^3} d\gamma. \tag{B2}
\end{aligned}$$

$$\begin{aligned}
K_{22}(\xi, \eta) &= 32\xi^3 e^{-12s\xi^3-12s\xi^2\eta} + 4 \sin^2 \theta (\xi+\eta)(2\xi+\eta)(3\xi+\eta) e^{-2s(2\xi+\eta)^3} \\
& - 4 \sin^2 \theta \eta(\xi+\eta)(3\xi+\eta) e^{-\frac{2}{3}s\eta^3-\frac{4}{3}s(3\xi+\eta)^3} \\
& + 8 \sin^2 \theta \xi \eta(2\xi+\eta) e^{-s\eta^3-s(2\xi+\eta)^3-4s\xi^3} \\
& - 8 \sin^2 \theta \int_0^\xi (2\xi+\eta) [(2\xi+2\eta+3\gamma) - 3s(\eta+\gamma)^3(2\xi+\eta+\gamma)] \\
& \quad e^{-s(\eta+\gamma)^3-2s(2\xi+\eta)^3+s(2\xi+\eta-\gamma)^3-4s(\xi-\gamma)^3} d\gamma \\
& + 8 \sin^2 \theta \int_0^\xi \eta [(2\xi-\gamma) - 3s(\eta+\gamma)(2\xi+\eta+\gamma)^3] \\
& \quad e^{-s(2\xi+\eta+\gamma)^3-\frac{2}{3}s\eta^3-\frac{4}{3}s(\eta+3\gamma)^3-4s(\xi-\gamma)^3} d\gamma. \tag{B3}
\end{aligned}$$

## Appendix C

$$\begin{aligned}
R_4 &= 2i\alpha\hat{U}_{1,Y}\hat{V}_{3,Y} + i\alpha\hat{U}_{1,YY}\hat{V}_3 - 4i\alpha\beta\hat{U}_{1,Y}\hat{W}_3 \\
& - 4i\alpha\beta\hat{U}_1\hat{W}_{3,Y} - 3i\alpha\hat{U}_1\hat{V}_{3,YY} - \hat{A}(\hat{V}_{3,YYY} + \beta\hat{W}_{3,YY}) \\
& + \frac{2}{3}i\alpha\hat{U}_{1,Y}^*\hat{V}_{3,Y} + i\alpha\hat{U}_{1,YY}^*\hat{V}_3 - \frac{4}{3}i\alpha\beta\hat{U}_{1,Y}^*\hat{W}_3 - \frac{4}{3}i\alpha\beta\hat{U}_1^*\hat{W}_{3,Y} - \frac{1}{3}i\alpha\hat{U}_1^*\hat{V}_{3,YY} \\
& + 2i\alpha\hat{U}_{2,Y}^{*(0,0)}\hat{V}_2^{(2,0)} - 4i\alpha\beta\hat{U}_2^{*(0,2)}\hat{W}_2^{(2,2)} - \beta\hat{V}_2^{*(0,2)}\hat{W}_2^{(2,2)} - 2i\alpha\hat{U}_2^{*(0,0)}\hat{V}_2^{(2,0)} \\
& - 4i\alpha\beta\hat{U}_{2,Y}^{*(0,2)}\hat{W}_2^{(2,2)} - 2\beta\hat{V}_{2,Y}^{*(0,2)}\hat{W}_2^{(2,2)} - \beta\hat{V}_{2,YY}^{*(0,2)}\hat{W}_2^{(2,2)}. \tag{C1}
\end{aligned}$$

$$\begin{aligned}
N^{(b)} = & -2i\alpha\beta\hat{U}_{1,Y}\hat{W}_3^{(b)} - 4i\alpha\beta\hat{U}_1\hat{W}_{3,Y}^{(b)} - 3i\alpha\hat{U}_1\hat{V}_{3,Y}^{(b)} - \hat{A}(\hat{V}_{3,Y}^{(b)} + \beta\hat{W}_{3,Y}^{(b)}) \\
& - 2i\alpha\beta\hat{U}_{1,Y}^*\hat{W}_3^{(b)} - \frac{4}{3}i\alpha\beta\hat{U}_1^*\hat{W}_{3,Y}^{(b)} - \frac{1}{3}i\alpha\hat{U}_1^*\hat{V}_{3,Y}^{(b)} \\
& - i\alpha\bar{U}_y^{-1}\hat{U}_{1,Y}\hat{U}_{1,Y}^*\hat{B} - i\alpha\bar{U}_y^{-1}\hat{U}_{1,Y}^*\hat{U}_{1,Y}\hat{B} + 2i\alpha\hat{U}_{2,Y}^{*(0,0)}\hat{B} \\
& + 2\lambda\bar{U}_y^{-1}\hat{U}_{1,Y}(\hat{V}_{3,Y}^{(b)} + \beta\hat{W}_{3,Y}^{(b)}) + \frac{2}{3}\lambda\bar{U}_y^{-1}\hat{U}_{1,Y}^*(\hat{V}_{3,Y}^{(b)} + \beta\hat{W}_{3,Y}^{(b)}) . \tag{C2}
\end{aligned}$$

$$\begin{aligned}
N^{(r)} = & -i\alpha\bar{U}_y^{-1}\hat{U}_{1,Y}^*[\hat{A}\hat{U}_{2,Y}^{(2,0)} + \frac{1}{2}\hat{A}\hat{U}_{2,Y}^{(2,2)} - 3\beta\hat{U}_1\hat{W}_2^{(2,2)} - \bar{U}_y^{-1}\hat{U}_{1,Y}S_{11}^{(2,0)}] \\
& - i\alpha\bar{U}_y^{-1}\hat{U}_{1,Y}[\hat{A}\hat{U}_{2,Y}^{*(0,0)} + \frac{1}{2}\hat{A}\hat{U}_{2,Y}^{*(0,2)} - \beta\hat{W}_1\hat{U}_2^{*(0,0)} + \frac{1}{4}\hat{U}_1\hat{V}_{2,Y}^{*(0,2)} - \bar{U}_y^{-1}\hat{U}_{1,Y}^*S_{11}^{(2,0)}] \\
& - 2i\alpha\beta\hat{U}_{1,Y}\hat{W}_3^{(r)} - 4i\alpha\beta\hat{U}_1\hat{W}_{3,Y}^{(r)} - 3i\alpha\hat{U}_1\hat{V}_{3,Y}^{(r)} - \hat{A}(\hat{V}_{3,Y}^{(r)} + \beta\hat{W}_{3,Y}^{(r)}) \\
& - 2i\alpha\beta\hat{U}_{1,Y}^*\hat{W}_3^{(r)} - \frac{4}{3}i\alpha\beta\hat{U}_1^*[\hat{W}_{3,Y}^{(r)} + \frac{1}{2}i\bar{S}^{-1}\hat{W}_{1,Y}\hat{V}_{2,Y}^{(2,0)}] - \frac{1}{3}i\alpha\hat{U}_1^*\hat{V}_{3,Y}^{(r)} \\
& + [-2i\alpha\hat{U}_2^{*(0,0)}\hat{V}_{2,Y}^{(2,0)} - 4i\alpha\beta\hat{U}_{2,Y}^{*(0,2)}\hat{W}_2^{(2,2)} \\
& \quad - 2\beta\hat{V}_{2,Y}^{*(0,2)}\hat{W}_{2,Y}^{(2,2)} - \beta\hat{V}_{2,Y}^{*(0,2)}\hat{W}_2^{(2,2)} - 2i\alpha\bar{U}_y^{-1}\hat{U}_{2,Y}^*S_{11}^{(2,0)}] \\
& - 4i\alpha\beta\hat{U}_1[\frac{1}{2}i\bar{S}^{-1}\hat{W}_{1,Y}^*\hat{V}_{2,Y}^{(2,0)} - \frac{1}{2}\bar{U}_y^{-1}\hat{W}_{1,Y}\hat{U}_{2,Y}^{*(0,2)}] \\
& - \hat{A}[\frac{1}{2}i\beta\bar{S}^{-1}\hat{W}_{1,Y}^*\hat{V}_{2,Y}^{(2,0)} - \frac{1}{2}\beta\bar{U}_y^{-1}\hat{W}_{1,Y}\hat{U}_{2,Y}^{*(0,2)}] \\
& + \frac{1}{2}i\alpha\bar{U}_y^{-2}\hat{U}_{1,Y}\hat{U}_{1,Y}^*S_{11}^{*(0,2)} + \beta\bar{U}_y^{-1}\hat{W}_{2,Y}^{(2,2)}S_{11}^{*(0,2)} \\
& + 2\lambda\bar{U}_y^{-1}\hat{U}_{1,Y}(\hat{V}_{3,Y}^{(r)} + \beta\hat{W}_{3,Y}^{(r)}) + \frac{2}{3}\lambda\bar{U}_y^{-1}\hat{U}_{1,Y}^*(\hat{V}_{3,Y}^{(r)} + \beta\hat{W}_{3,Y}^{(r)}) \\
& - 2\lambda\bar{U}_y^{-2}[\hat{U}_{1,Y}^*\hat{U}_{1,Y} + \hat{U}_{1,Y}\hat{U}_{1,Y}^* + \frac{1}{3}\hat{U}_{1,Y}\hat{U}_{1,Y}^*]\hat{V}_{2,Y}^{(2,0)} \\
& + i\alpha\lambda\bar{U}_y^{-2}[\hat{U}_{1,Y}\hat{U}_{1,Y} + (\hat{U}_{1,Y}\hat{U}_{1,Y})_Y]\hat{U}_{2,Y}^{*(0,2)} \\
& + 2\lambda\beta\bar{U}_y^{-1}\hat{W}_{2,Y}^{(2,2)}\hat{U}_{2,Y}^{*(0,2)} + 2\lambda\bar{U}_y^{-1}\hat{U}_{2,Y}^*(\hat{V}_{2,Y}^{(2,0)} + \beta\hat{W}_{2,Y}^{(2,2)}) . \tag{C3}
\end{aligned}$$

## Appendix D

$$\begin{aligned}
& K_b(\xi, \eta, \zeta) \\
= & -2[\zeta\hat{K}_v(\eta + 2\zeta, \xi, \eta) + 2\zeta^2\hat{K}_w(\eta + 2\zeta, \xi, \eta)]e^{-4s\zeta^3} \\
& + \frac{1}{3}\sin^2\theta(\xi + 2\eta + 3\zeta)[\hat{K}_v(\xi, \eta, \zeta) - (\xi + 2\eta + 3\zeta)\hat{K}_w(\xi, \eta, \zeta)]e^{-s(\xi+2\eta+3\zeta)^3} \\
& - \sin^2\theta\left\{\zeta[\hat{K}_v(\eta + 2\zeta, \xi, \eta + \zeta) + \zeta\hat{K}_w(\eta + 2\zeta, \xi, \eta + \zeta)]e^{-s\zeta^3} \right. \\
& \quad + (\eta + \zeta)[\hat{K}_v(\eta + 2\zeta, \xi + \eta, \zeta) + (\eta + \zeta)\hat{K}_w(\eta + 2\zeta, \xi + \eta, \zeta)]e^{-s(\eta+\zeta)^3} \\
& \quad \left. + (\xi + \eta + \zeta)[\hat{K}_v(\xi + \eta + 2\zeta, \eta, \zeta) + (\xi + \eta + \zeta)\hat{K}_w(\xi + \eta + 2\zeta, \eta, \zeta)]e^{-s(\xi+\eta+\zeta)^3}\right\} \\
& + \frac{1}{3}\sin^2\theta\int_0^\zeta\left\{[2(\xi + 2\eta + 6\zeta - 3\gamma) - 6s(\xi + 2\eta + 3\gamma)(\xi + 2\eta + 2\zeta + \gamma)^3]\hat{K}_w(\xi, \eta, \gamma) \right.
\end{aligned}$$