

$$\begin{aligned}
S[U_, kk_] &:= S[U, kk] = \text{Module}[\{\text{OE}\}, \\
&\quad \text{OE} = \text{m}_{3,2,1 \rightarrow 1}[\text{Exp}_{\text{QU}_1, \$k}[\eta, S_1[\text{QU}[y_1]]] /. \text{QU} \rightarrow \text{Times}] \\
&\quad \quad \text{Exp}_{\text{QU}_2, \$k}[\alpha, S_2[\text{QU}[a_2]]] /. \text{QU} \rightarrow \text{Times}] \\
&\quad \quad \text{Exp}_{\text{QU}_3, \$k}[\varepsilon, S_3[\text{QU}[x_3]]] /. \text{QU} \rightarrow \text{Times}]; \\
\mathbb{E}[-t_1 \tau_1 + \text{OE}[[1]], \text{OE}[[2]], \text{OE}[[3]]] /. \\
&\quad \{\eta \rightarrow \eta_1, \alpha \rightarrow \alpha_1, \mathcal{A} \rightarrow \mathcal{A}_1, \varepsilon \rightarrow \varepsilon_1\}; \\
\text{tS}_{i\_} &:= S[\$U, \$k] /. \{(\mathbf{v} : \tau \mid \eta \mid \alpha \mid \mathcal{A} \mid \varepsilon)_1 \rightarrow \mathbf{v}_i, \\
&\quad (\mathbf{v} : \mathbf{t} \mid \mathbf{T} \mid \mathbf{y} \mid \mathbf{a} \mid \mathbf{x})_1 \rightarrow \mathbf{v}_i\};
\end{aligned}$$