We make a preliminary normalization by setting $n_1^{\pm} = 1$.

Then, $n_2^{\pm}\left[1 \pm \sqrt{\frac{m_2}{m_1+m_2}}\right] = 1 + n_2^{\pm} \Rightarrow \pm n_2^{\pm}\sqrt{\frac{m_2}{m_1+m_2}} = 1$

$$\Rightarrow \boxed{n_2^{\pm} = \pm\sqrt{\frac{m_1+m_2}{m_2}}, \quad n_1^{\pm} = 1} \Leftarrow \text{unnormalized.}$$

Next require $(n^{\alpha}, M n^{\beta}) = \delta_{\alpha\beta}$

$$(n^{+}, M n^{+}) = \left(1, \sqrt{\frac{m_1+m_2}{m_2}}\right)\begin{pmatrix}(m_1+m_2)l^2 & m_2 l^2 \\ m_2 l^2 & m_2 l^2\end{pmatrix}\begin{pmatrix}1 \\ \sqrt{\frac{m_1+m_2}{m_2}}\end{pmatrix}$$

$$= \left(1, \sqrt{\frac{m_1+m_2}{m_2}}\right)\begin{pmatrix}(m_1+m_2)l^2 + m_2 l^2\sqrt{\frac{m_1+m_2}{m_2}} \\ m_2 l^2 + m_2 l^2\sqrt{\frac{m_1+m_2}{m_2}}\end{pmatrix} = l^2\left[(m_1+m_2) + \sqrt{(m_1+m_2)m_2} + \sqrt{m_2(m_1+m_2)} + m_1+m_2\right]$$

$$= 2l^2\left[(m_1+m_2) + \sqrt{(m_1+m_2)m_2}\right]$$