By integrating $p_r$ from $-\sum_{j\neq r} g^{rj}\, p_j/g^{rr}$ to $\infty$ and by integrating the remaining $p_j$ from $-\infty$ to $\infty$ this integration can be performed. During a subsequent integration over all $q^i$ other than $i=r$, $q^r$ is kept at the value zero. Since $\dot{q}^r$ is $\partial H/\partial p_r$, $\dot{q}^r \exp(-H/kT)$ equals $-kT\, \partial e^{-H/kT}/\partial p_r$. The $p_r$ integration yields (23):

$$k_{rate} = \frac{kT}{h}\, e^{-(F^{\ddagger}-F)/kT} \tag{23}$$

where

$$e^{-F^{\ddagger}/kT} = \int e^{-H^{\ddagger}(p,q)/kT} \prod_{i\neq r} dq^i dp_i/h^{n-1} \tag{24}$$

$$e^{-F/kT} = \int e^{-H(p,q)/kT} \prod_{i=1}^{n} dq^i dp_i/h^n \tag{25}$$

and $H^{\ddagger}$ is given by (26). It is the value of H when $q^r = \dot{q}^r = 0$. Thus, it is the value of H for a system constrained to exist on the hypersurface of S.

$$H^{\ddagger} = T^{\ddagger} + U^{\ddagger} \tag{26}$$

where

$$U^{\ddagger} = U(q^1,\ldots,q^n) \text{ at } q^r = 0 \tag{27}$$

$$T^{\ddagger} = \tfrac{1}{2} \sum_{i,j\neq r} g_{ij}\, \dot{q}^i \dot{q}^j = \tfrac{1}{2} \sum_{i,j\neq r} g^{ij^{\ddagger}}\, p_i p_j \tag{28}$$

and

$$g^{ij^{\ddagger}} = \sum_{i,j\neq r} \left[ g^{ij} - g^{ir}\, g^{jr} (g^{rr})^{-1} \right] \tag{29}$$

The quantity $g^{ij^{\ddagger}}$ is easily shown to be conjugate to $g_{ij}$ on a subspace for which $dq^r = 0$, i.e., on the hypersurface, S.