$$P(E) \propto e^{-\beta E} \cdot g(E) \approx \boxed{e^{-\beta(U-TS)} \; e^{\left(-\frac{(E-U)^2}{2k_B T^2 C_V}\right)}}$$

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$(2k_B T^2 C_V)^{1/2}$ DISPERTSIOA

$$Q_N(T,V) = \int_0^\infty e^{-\beta E} g(E) \cdot dE$$

$$\simeq \int_0^\infty e^{-\beta(U-TS)} \; e^{-\left(\frac{(E-U)^2}{(2k_B T^2 C_V)}\right)} \, dE$$

$$\left[\int_{-\infty}^{\infty} e^{-x^2} dx\right] \cdot e^{-\beta(U-TS)} \cdot \sqrt{2k_B T^2 C_V}$$

$$\ln \left\{ \boxed{Q_N(T,V) = e^{-\beta(U-TS)} \sqrt{2k_B T^2 C_V \pi}} \right\} \quad (-k_B T)$$

$$-(k_B T) \ln[Q_N(T,V)] = -\beta(U-TS) - k_B T \ln \sqrt{2k_B T^2 C_V \pi}$$
$$- \tfrac{1}{2} k_B T \ln(2k_B T^2 C_V) \quad O(\ln N)$$