

$$1. \quad \text{MAX EFFICIENCY} = 1 - \frac{T_c}{T_h}$$

$$= 1 - \frac{277}{300} = \frac{23}{300} \approx \boxed{8\%}$$

2.

$$G = U + pV - TS$$

$$dG = dU + p dV + V dp - T dS - S dT$$

$$dU = T dS - p dV + \mu dN$$

$$\text{So } dG = -S dT + V dp + \mu dN$$

$$-\left(\frac{\partial G}{\partial T}\right)_{p,N} = S, \quad V = \left(\frac{\partial G}{\partial p}\right)_{T,N}, \quad \mu = \left(\frac{\partial G}{\partial N}\right)_{T,p}$$

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$$a) \quad Z = e^{-\epsilon\beta} + e^{\epsilon\beta}$$

$$b) \quad \bar{E} = \frac{\epsilon e^{-\epsilon\beta} - \epsilon e^{\epsilon\beta}}{Z}$$

$$c) \quad \bar{\mu} = \frac{-\mu e^{-\epsilon\beta} + \mu e^{\epsilon\beta}}{Z}$$

$$d) \quad T = \infty \rightarrow \beta \rightarrow 0 \quad \bar{E} = 0$$

$$e) \quad \beta = 0 \quad \bar{\mu} = 0$$