$$E_n = \left(\frac{1}{2} + n\right)\hbar\omega$$

$$P_n = \alpha\, e^{-\frac{E_n}{k_B T}}$$

$$\alpha\, e^{-\frac{\hbar\omega}{2k_B T}} \frac{1}{1 - e^{-\frac{\hbar\omega}{kT}}} = 1$$

$$\alpha = e^{\frac{\hbar\omega}{2kT}} \left(1 - e^{-\frac{\hbar\omega}{kT}}\right)$$

$$\left(\frac{\hbar\omega}{e^{\frac{\hbar\omega}{kT}} - 1}\right)' = \hbar\omega\,(\text{—}\,''\,\text{—})^{-1\,\prime} = -\hbar\omega\,(\text{—}\,''\,\text{—})^{-2}$$

· innere

$$= +\hbar\omega\,(\text{—}\,''\,\text{—})^{-2} \cdot e^{\frac{\hbar\omega}{kT}} \cdot \frac{\hbar\omega}{k}\frac{1}{T^2}$$

$$= (\text{—}\,''\,\text{—})^{-2} \frac{(\hbar\omega)^2}{T^2} \frac{1}{k} e^{\frac{\hbar\omega}{kT}}$$ ✓