1 Classical prediction

$$\langle \text{energy rate} \rangle = \frac{2}{3}\frac{q^2}{4\pi\epsilon_0 c^3}\frac{k_B T}{m}\omega_0^2 \tag{1}$$

Draw a graph with ⟨energy rate⟩ (the optical power output) on the vertical axis, and the oscillator frequency (or alternatively $\hbar\omega_0$) on the horizontal axis. Sketch the relationship when

1. $T = 300$ K
2. $T = 600$ K

Assume the mass and charge of the the oscillators are constants.

2 Quantum prediction

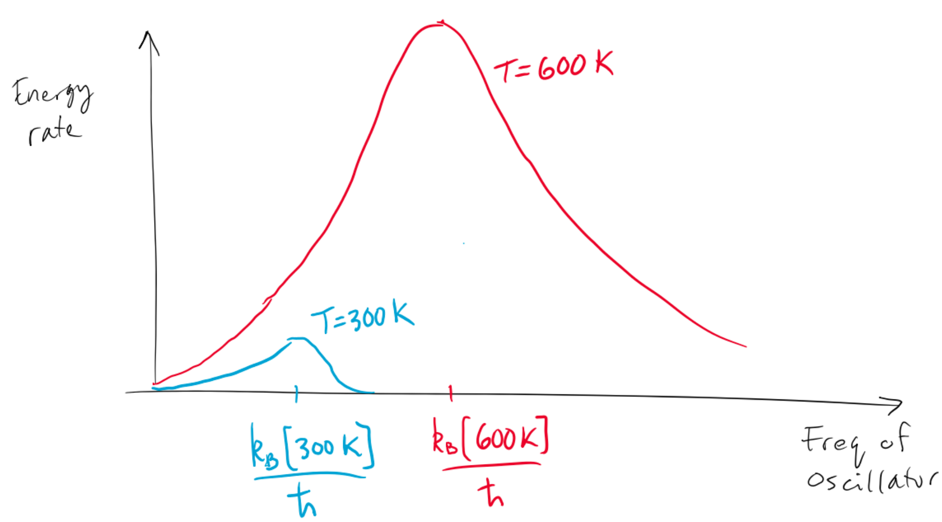
When we account for energy quanta, the expression changes to

$$\langle \text{energy rate} \rangle = \begin{cases} \frac{2}{3}\frac{q^2}{4\pi\epsilon_0 c^3}\frac{k_B T}{m}\omega_0^2 & \text{when } \hbar\omega \ll k_B T \\ \frac{\hbar\omega^3}{4\pi^2 c^2} e^{-\frac{\hbar\omega}{k_B T}} & \text{when } \hbar\omega \gg k_B T \end{cases} \tag{2}$$

Sketch the relationship on your same graph, when

1. $T = 300$ K
2. $T = 600$ K

Assume the mass and charge of the the oscillators are constants.



Solution