(50 credits)
1) At a given temperature, $\lambda_{\text{max}} = 650 \text{ nm}$ for a blackbody cavity. What will $\lambda_{\text{max}}$ be if the temperature of the cavity walls is increased so that the rate of emission of spectral radiation is doubled?

$$R_T = \sigma T^4, \quad R'_T = \sigma T'^4, \quad R'_T = 2 R_T \Rightarrow \sigma T'^4 = 2 \sigma T^4 \Rightarrow T' = 2^{1/4} T.$$ But $\lambda_{\text{max}} T = \lambda'_{\text{max}} T' \Rightarrow \lambda'_{\text{max}} = \frac{\lambda_{\text{max}}}{2^{1/4}} \approx \frac{650 \text{ nm}}{2^{1/4}} \approx 546.6 \text{ nm}$

(50 credits)
2) Provide the SI units of the following quantities:

- Spectral radiance: $[R_r(\lambda)] = \frac{\text{power}}{\text{area} \times \text{wavelength}} = \frac{\text{W}}{\text{m}^2 \cdot \text{m}}$
- Spectral radiance as a function of frequency: $[R_r(\nu)] = \frac{\text{power}}{\text{area} \times \text{frequency}} = \frac{\text{W}}{\text{m}^2 \cdot \text{Hz}}$
- Energy density as a function of wavelength: $[\rho(\lambda)] = \frac{\text{energy}}{\text{vol} \times \text{wavelength}} = \frac{\text{J}}{\text{m}^3 \cdot \text{m}}$
- Energy density as a function of frequency: $[\rho(\nu)] = \frac{\text{energy}}{\text{vol} \times \text{frequency}} = \frac{\text{J}}{\text{m}^3 \cdot \text{Hz}}$
- Radiance: $[R_r] = \frac{\text{power}}{\text{area}} = \frac{\text{W}}{\text{m}^2}$