6.1 Bose condensation in a harmonic trap(25)

An ideal 3D gas of N identical Bose particles of mass m is trapped in a spherically-symmetric harmonic potential

$$U(r) = \frac{1}{2}m\omega^2 r^2 \tag{1}$$

Calculate the critial temperature at which the Bose-Einstein condensation starts in this system. *Hint: treat the motion of individual particles classically.*
For the integrals you encounter, use the shorthand notation

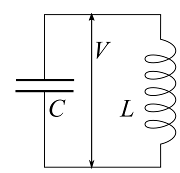
$$\int_0^\infty \frac{x^{n-1}dx}{e^x - 1} = I_n \tag{2}$$

(this integral can be expressed with special functions, $I_n = \Gamma(n)\zeta(n)$, but you don't have to do it).

6.2 Temperature of the Earth(25)

(a) Assuming that the Earth and the Sun radiate heat as black bodies, and the Earth surface has uniform temperature, calculate the average temperature of the Earth T_E provided that the radius of the Earth is $R_S = 6.37 \times 10^3\,\mathrm{km}$, the distance to the Sun is $d \approx 1.50 \times 10^8\,\mathrm{km}$, ane the temperature and the radius of the Sun are $T_S = 6000\,\mathrm{K}$ and $R_S = 6.96 \times 10^5\,\mathrm{km}$.
(b) Compare T_E to the temperature of the Moon surface when the Sun is directly above (in the zenith) assuming that there is no surface heat transfer.

6.3 Voltage fluctuation in an LC circuit(25)



An LC circuit with frequency $\omega = 1/\sqrt{LC}$ is in thermal equilibrium with the environment. Calculate the fluctuation of the voltage of the capacitor

$$\delta V = \sqrt{\overline{V^2}} \tag{3}$$

as a function of ω and temperature T.