EP 1108 Assignment 2

Deadline **18** Jan 2021 before **17:00 hrs**

1. Calculate the surface temperature of the Sun (in Kelvin) by assuming that it is a spherical black body with a radius of 7×10^8 m. The intensity of solar radiation at the surface of the Earth is $1.4 \times 10^3 W/m^2$ and the distance between the Earth and the Sun is 1.5×10^{11} m. [3 pts]

2. Obtain the Rayleigh-Jeans spectral distribution law as the long-wavelength limit of the Planck spectral distribution law. [2 pts]

3. Using the Planck spectral distribution law for $\rho(\lambda, T)$ prove Wien's displacement law. [3 pts] [Hint : Set x=$hc/\lambda kT$ and show that x must satisfy the equation $x = 5(1 - e^{-x})$ for which the solution $x = 4.965$ can be assumed]

4. The Barnard star has a temperature of 3000 K. Calculate its total emissive power and the wavelength at which its spectral emittance $R(\lambda, T)$ peaks. [4 pts]

5. Derive the inverse Lorentz transformation equation for x' as a function of x and t, from the Lorentz transformation equations for x' and t' as a function of x and t [3 pts]

6. A rocket ship is 100 m long on the ground. When it is in flight, its length is 99 m to an observer on the ground. What is its speed? [2 pts]

7. How mass must an electron move in order that its mass equal to the rest mass of a proton? (Mass of an electron is 0.5 MeV and rest mass of a proton is 1 GeV). [3 pts]

8. If the Kinetic energy of a particle is same as its rest energy, calculate its speed. [3 pts]

9. For the muon decay example shown in class, calculate the total time travelled by a muon of energy 100 GeV, if it its rest mass is equal to 100 MeV and lifetime 2μ s [2 pts]