Tutorial Set 1: PH2202, THERMAL PHYSICS, SPRING 2021

Instructor: Arindam Kundagrami

TOTAL MARKS: Not Applicable, DUE: To be attempted and discussed in tutorial class.

THESE ARE TUTORIAL PROBLEMS TO BE ATTEMPTED BY THE STUDENTS INDIVIDUALLY IN THE TUTORIAL CLASS. THE ANSWERS WILL BE PROVIDED AFTER THE CLASS. THIS WILL BE ASSISTED PROBLEM SOLVING.

1. Start from the ideal gas law $pV_0 = RT$, where V_0 is the volume of 1 mole of ideal gas, p is pressure, and T is absolute temperature. R is the universal gas constant, assumed to be still unknown. Suggest the theoretical scheme, which, along with experimental measurements, will find the value of R.

2. Find an expression for the mean free path of an electron running within nitrogen gas in room temperature. The derivation should be in the same line that was followed in class. If you need to make assumptions, you have to justify the assumptions by comparing actual numbers/quantities. Feel free to use the values of known physical constants from the internet/book.

3. Calculate the numerical value of R from the known values of p, V_0, T.

4. Take u to be the x component of the velocity $\mathbf{c}$ of a particle. The change of momentum of that particle with mass m, from a reflection from the wall which is perpendicular to the x-axis (parallel to yz plane) is $2mu$. Considering such momentum change in one-direction only find the expression of pressure, and finally show that $p = \frac{1}{3}mn\bar{c^2}$.