PH103 (Physics-I) Tutorial-I (August 16, 2018)

[**A Recap: Dimensional Analysis, Approximation Methods and Vectors**]

1. (a) Consider a vibrating water drop, whose frequency depends on its radius R, mass density ρ, and surface tension S. Using dimensional analysis, obtain the dependence of ν on R, ρ, and S? How is frequency changed if the radius of water drop is doubled.
   (b) Using dimensional analysis, construct the expression for Planck's mass $M_{\rm P}$ in terms of $\hbar$, c and G (reduced Planck's constant, speed of light in vacuum and Gravitational constant respectively).
   (c) Obtain the expression for Planck's time $T_{\rm P}$ following a method similar to (b) above.

2. (a) Obtain the electrical conductance of a wire if a current of 1 μA flows upon the application of 1 Volt potential difference across its ends.
   (b) Obtain the thermal conductance of the medium if 5 mJ of heat is conducted across a temperature gradient of 100 K in 1 s.
   (c) Obtain the fluid flow conductance of a pipe of length 1 m and diameter 2 cm for mercury whose viscosity is 0.015 Ns/m^2.

3. What is the nature of constraint (among scleronomic, rheonomic, holonomic, non-holonomic, conservative and dissipative) for:
   (a) Simple pendulum with rigid support.
   (b) Deformable body.
   (c) An expanding/contracting spherical container of gas.

4. Obtain the degrees of freedom for:
   (a) A dumbbell in 2 dimensional space.
   (b) Bob of a conical pendulum.
   (c) Rigid body fixed at a point.

Homework/Assignment: Due on August 17, 2018 using circulated Google form

1. Estimate the numerical values of Planck time and Planck mass based on the expressions obtained above (assume the dimensionless constant pre-factors to be 1).