

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL
Department of Physics
Even Semester 2025 – 2026
PH110 COMMON ASSIGNMENT

Due Date: April 14, 2025

Marks 10

Each question is of 2.5 marks

1. A particle X at rest is a sphere of rest-mass m and radius r and has a proper lifetime τ . If the particle is moving with speed of $(\sqrt{3}/2)c$ with respect to the lab frame (c is the speed of light):
 - (a) Determine the total energy of the particle in the lab frame
 - (b) The average distance the particle travels in the lab before decaying
 - (c) Sketch the shape and dimensions of the particle when viewed perpendicular to its motion in the lab frame, include an arrow to indicate its direction of motion on your sketch.
2. Derive both Stefan's law and Wien's law from the Planck's radiation formula.
For the Stefan's law use the following identity:

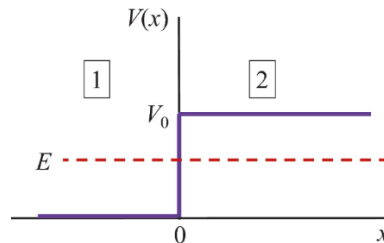
$$\int_0^{\infty} \frac{x^3}{e^x - 1} dx = \frac{\pi^4}{15}$$

For Wien's law, you may end up with an equation of the form

$$3(e^u - 1) - ue^u = 0$$

which has a solution of $u = 2.8214$. Use this in your calculations to obtain the final result.

3. Write down the Schrodinger's equation in both region 1 and 2, for a particle approaching a finite potential step from region 1 to region 2 with energy $E < V_0$ as shown in the figure below:



Obtain the general solution to the wavefunction in both the regions.

4. Without doing any calculations, sketch the wavefunction inside the infinite potential well which will be a possible solution to the Schrodinger's equation) ensure several cycles of the wavefunction in your sketch.

