

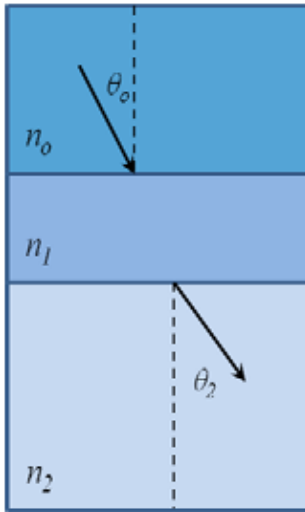
Basic Physics - Ph.D. Qualifying Exams Spring 2009

Problem 1. (6 points) Two masses, m and $2m$ (one is twice the other), are attached at the opposite ends of a rigid massless bar. The bar has length L and free to pivot at the midpoint. The moment of inertia is $(3/4)mL^2$. With the action of gravity, calculate the time it will take for the bar, which is initially horizontal and at rest, to swing by a small angle $\delta\theta$.

Problem 2. (4 points)

One fluid ounce of cream with an initial temperature of 10C is added to 10 fluid ounces of coffee with an initial temperature of 80C in a completely insulated container. Assume that the density of the creamer and coffee are identical, but the thermodynamic properties such as the heat capacity, thermal conductivity and emissivity of the creamer are 10% higher than coffee. Calculate the temperature of the resulting mixture to the nearest degree, ignoring radiative cooling.

Problem 3. (4 points) A beam of light is propagating through layers of transparent plates as shown in the diagram. The refractive indices of the plates are as follows:
 $n_o = \sqrt{\frac{12}{9}}$ $n_1 = \sqrt{\frac{11}{9}}$ $n_2 = 1$. Calculate the maximum incident angle θ_o that would allow the beam to propagate in the medium with refractive index n_2 .



Problem 4. (6 points) A beam of 9000 electrons with kinetic energy 4 eV is incident upon a potential step of height 3 eV. Calculate the number of electrons that will be transmitted.