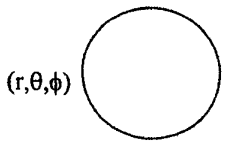
系所別: 物理學系　科目: 古典物理

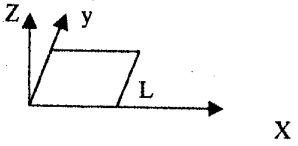
You must show derivations. Without derivation, there is no point given for whatever answer you provide. 必須清楚說明寫出演算過程， 只寫答案不論正確予否是不給分的!

1. A particle of mass m is constraint to move on a spherical surface of radius R (Fig. 1) in a potential (1/2) kr^2.: (1) Derive the Langrangian function L in terms of (θ,ϕ) (b) Find the conjugate momentum for these coordinates (c) derive the Hamiltonian of the system in terms of momenta defined as above (d) derive the equations of motion in θ and ϕ. .20%
2. In Fig. 2 below
   (a) Find the moment of inertia of a square plate of dimension L and mass M about x-axis.
   (b) Find the angular momentum and kinetic energy about the center of mass when it is rotation with angular speed ω along the z axis.
   (c) Find the moment of inertia for (b) .(15 %)
3. Derive the boundary conditions of EM field vectors across two media (Fig. 3) where no free charge exists : (a) show the normal component of **D** is continuous and the tangential component of **E** is continuous. (b) Derive similar boundary conditions for **B** and **H**. (20 %)
4. Show that (a) for a current source **j** the vector potential **A** is: $\nabla^2\mathbf{A} = -\mathbf{j}/\varepsilon_0 c^2$ where c is the speed of light. (b) derive the vector potential **A** for a long wire of diameter a carrying current I (c) and calculate the magnetic field strength **B** from **A** for the problem (b) (15 %)
5. Derive for an ideal gas the heat capacity C_v and C_p. and show that the entropy of n mole of an ideal gas is $S=nR\ln[(T/T_o)^{3/2}(V/V_o)] + S_o$ where $S=S_o$ when $T=T_o$ and $V=V_o$. (15 %)
6. (a) Define the Carnot cycle for a thermal engine running on a perfect gas and (b) calculate the heat and work done on each step of the cycle. 15%

1.



2.



3.