Physics Problems:– September-2011

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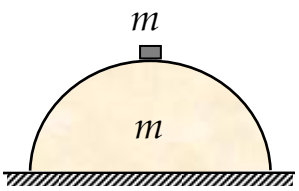
Q1. A small mass m is kept on the top of a smooth hemisphere of mass m which in turn rests on a smooth horizontal floor. A small push is given to the small mass so that it starts sliding down the hemisphere. Find the angular displacement of the small mass relative to the center of the hemisphere before they separate from each other.



Q2. A solid non-conducting sphere of radius r having a uniform charge density ρ_o is sorrounded by a thick non-conducting shell with charge density $-\rho_o$ such that the total charge of the system is zero. The potential at r can be expressed as $\frac{\rho_o r^2}{\varepsilon_o}\left[\frac{a}{6}-\frac{1}{b^{1/3}}\right]$ where a and b are integers. Find the value of $(a+b)$.

Q3. A projectile is fired on a level horizontal ground with a speed v_o. What is the maximum possible area it can cover under its trajectory. Ignore all forms of drag etc on the projectile. Gravitational acceleration at the ground can be assumed to be g.

Q4. Consider a solid non-conducting spherical shell of radius inner R and outer radius 2R whose charge density depends on the radius as $\rho = k/r$ $(R \le r \le 2R)$. Find the electrostatic energy stored in the shell itself and in the entire sorrounding space. Try all the methods you know for finding out electrostatic energy of a given charge distribution.