Physics Problems July-2010

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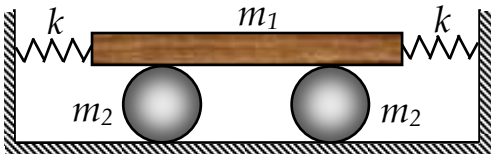
By Sanjeet Singh Adarsh (sadarsh@iitbombay.org)

Q1. A plank of mass m_1 is kept symmetrically on two solid balls of mass m_2 each which in turn are kept on a rough horizontal surface. The plank is connected to springs of force constant k one on either side. The springs are fixed to opposing vertical walls on both sides. Assuming no slipping anywhere, find the frequency of small oscillations of this system if disturbed slightly.



Q2. A fixed, thin spherical shell of mass M and radius R has a very small opening at its top most point. A small particle at a height R directly above the opening is released from rest. Find the time it spends inside the shell. Assume both the bodies to be elastic in nature.

Q3. A uniform circular disc of radius R is rolling without slipping on a smooth horizontal plane with a velocity v_o. Suddenly the highest point of the disc is fixed (somehow!!). Find the minimum v_o required such that the disc completes one complete revolution about this fixed point.

Q4. Suppose you start driving a vehicle on a rough horizontal floor on a circle of radius R. Find the minimum distance you need to travel to reach the maximum possible constant speed with which the vehicle can be driven safely without slipping out of the circle. (You should not slip any time during the motion!). Try solving this without too messy calculus affairs ☺.