Physics Problems March-2010

Q1. A mass m hangs on a vertical spring of force constant k and relaxed length l_o, suspended from a ceiling. Initially, the spring is compressed by a distance $l_o/2$. If the system is now released, what is the distance of the mass from the ceiling when it comes to rest for the first time?

Q2. Three blocks, identical in all respects are arranged as shown in the figure. There exists friction only between blocks B and C as μ. Rest all surfaces are smooth and the plane is horizontal. Initially the

blocks A & B are approaching C with a common speed V_o. If the block B stops slipping on C after it reaches completely on top of C and the three blocks move together thereafter, find the length of each block. Assume that blocks A & C stick to each other after the collision.
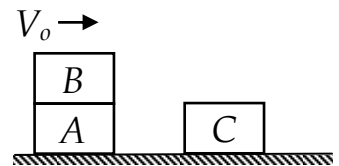
Q3. A uniform massive rod is pivoted at one end on a fixed smooth horizontal pin such that the rod can swing in the vertical plane. Initially the rod is held at rest such that it is horizontal. It is then released. Find the ratio of the total reaction at the pin to the weight of the rod when the horizontal component of the pin reaction is maximum? What is the angular displacement covered by the rod so far?

Q4. A special type of rod AB, of length l is made such that its modulus of elasticity varies with distance x measured from one end A as $Y = Y_o(1 + x/l)$. What is the change in the length of this rod if it is rotated in a horizontal plane about a vertical axis through A with an angular velocity ω_o?