Physics (2004)
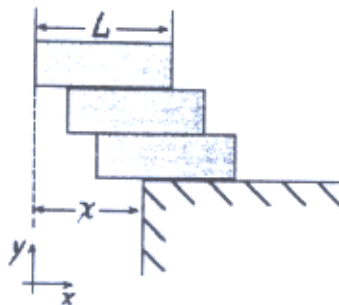
1. Three identical uniform bricks of length L are stacked over the edge of a horizontal surface with the maximum overhang x possible without falling. Find x for three blocks. Answer in units of L. (25 points)

2. A uniform plank of mass 0.742 kg and length 26.3 cm is pivoted at one end. A spring of force constant 363 N/m is attached to the center of the plank, as shown in the figure below. The height of the pivot has been adjusted so that the plank will be in equilibrium when it is horizontally oriented. Find the period of small oscillation about the equilibrium point. Answer in units of s. Please give conditions of every approximation you may make. (25 points)
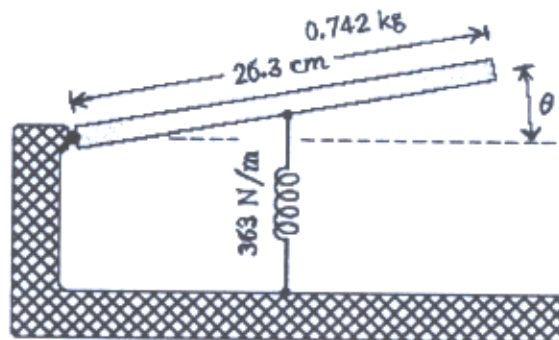
3. The equation of state for an ideal gas is given below.

$$PV = nRT \, ,$$
R=8.314 J/mol K

where n is the number of mole of the ideal gas, T is the Kelvin temperature. Assume that 3 moles of ideal gas are initially at 20℃ and a pressure of 1 atm. What is the work done by the gas if the volume is doubled (a) at constant pressure (1 atm = 101 kPa = $1.01 \times 10^5 \ N/m^2$), or (b) isothermally? (15 points each, total 30 points)

4. Maxwell's equations, while supplemented by the Lorentz force equation $\vec{F} = q(\vec{E} + \vec{v} \times \vec{B})$ and the conservation of charge, describe all the electromagnetic phenomena we encounter. Collectively, Maxwell's equations consist of four equations. Give them. (20 points)