2.7 Three springs and a mass are attached to a rigid, weightless bar PQ as shown in Fig. 2.51. Find the natural frequency of vibration of the system.

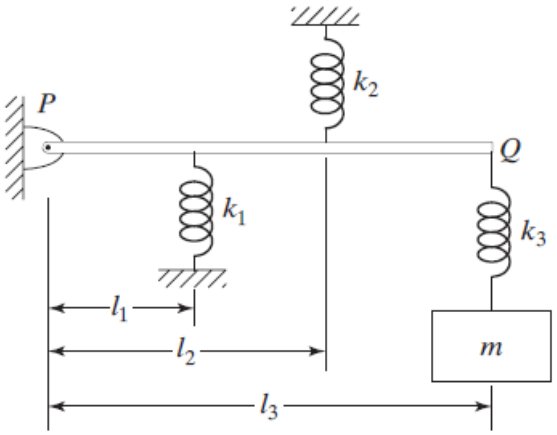

FIGURE 2.51

2.32 The inclined manometer, shown in Fig. 2.73, is used to measure pressure. If the total length of mercury in the tube is L, find an expression for the natural frequency of oscillation of the mercury.

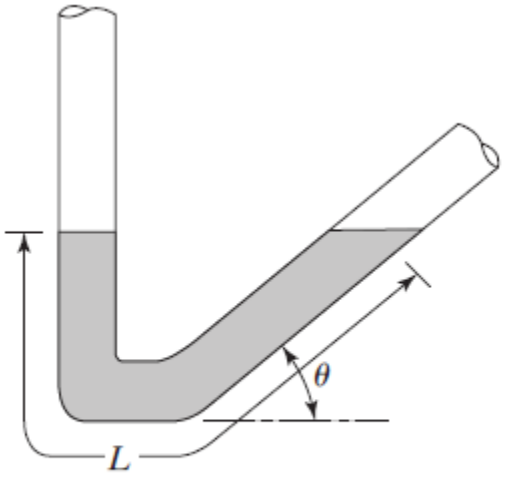

FIGURE 2.73

2.45–2.46 Draw the free-body diagram and derive the equation of motion using Newton's second law of motion for each of the systems shown in Figs. 2.85 and 2.86.

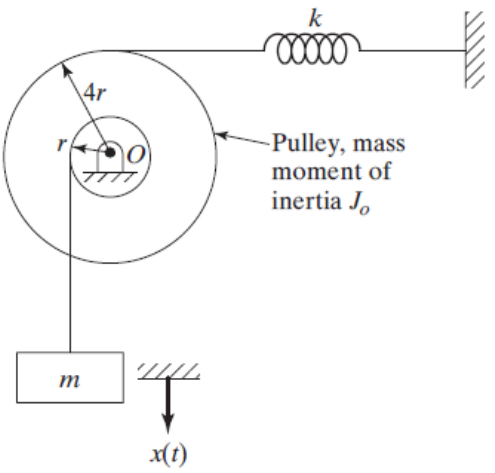

FIGURE 2.85

2.74 A cylinder of mass m and mass moment of inertia J_0 is free to roll without slipping but is restrained by two springs of stiffnesses k_1 and k_2, as shown in Fig. 2.97. Find its natural frequency of vibration. Also find the value of a that maximizes the natural frequency of vibration.

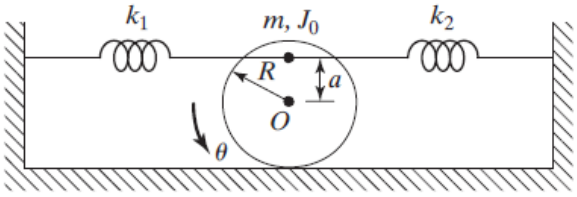

FIGURE 2.97

2.110 A viscously damped system has a stiffness of 5,000 N/m, critical damping constant of 0.2 N-s/mm, and a logarithmic decrement of 2.0. If the system is given an initial velocity of 1 m/s, determine the maximum displacement of the system.