Problem Sheet No. 9

1. The vertical plunger has a mass of 2.5 kg and is supported by the two springs that are always in compression. Calculate the natural frequency f_n of the vibration of the plunger if it is deflected from the equilibrium position and released. Friction in the guide is negligible.
   Ans. f_n = 7.40 Hz

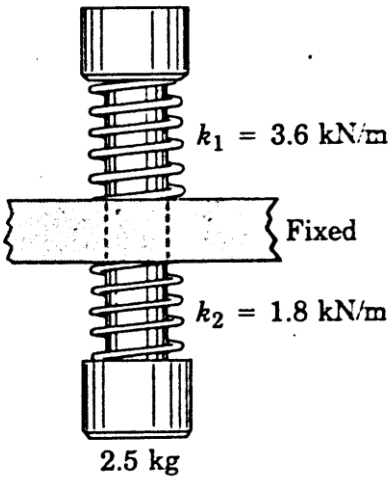

Figure-1

2. A small particle of mass m is attached to two highly tensioned wires as shown. Determine the system natural frequency ω_n for small vertical oscillations if the tension T in both wires is assume to be constant. Is the calculation of small static deflection of the particle necessary?
   Ans. $\omega_n = \sqrt{\frac{2T}{ml}}$

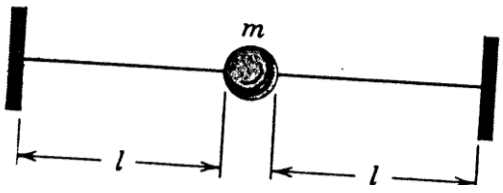

Figure-2

3. The cylindrical buoy floats in salt water (density 1030 kg/m3) and has a mass of 800 kg with a low center of mass to keep it stable in the upright position. Determine the frequency f_n of vertical oscillation of the bouy. Assume that the water level remains undisturbed adjacent to the bouy.
   Ans. f_n = 0.301Hz

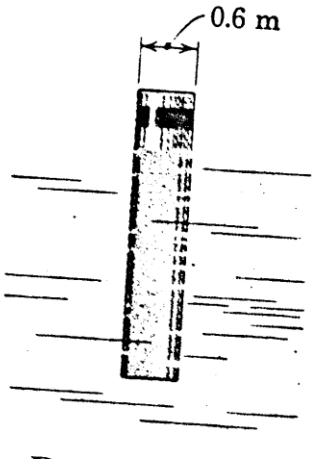

Figure-3

4. A 3-kg piece of putty is dropped 2 m onto the initially stationary 28-kg block, which is supported by four springs, each of which has a constant k = 800 N/m. Determine the displacement x as a function of time during the resulting vibration, where x is measured from the initial position of the block as shown.
   Ans. x = 9.20 (1-cos10.16t) + 59.7 sin 10.16t mm

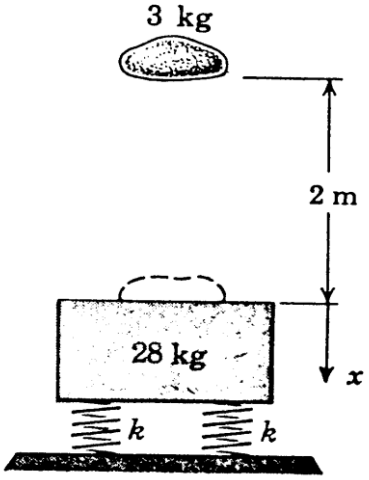

Figure-4

5. Calculate the natural frequency ω_n of the system shown in the figure. The mass of friction of the pulley is negligible.

Ans. $\omega_n = \sqrt{\frac{4k}{5m}}$

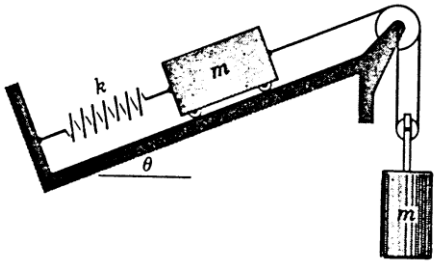

Figure-5