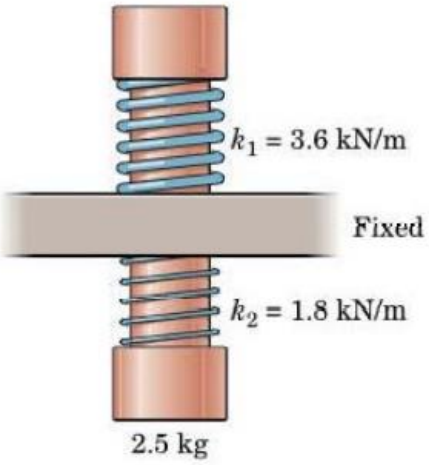
DYNAMICS(ME232)

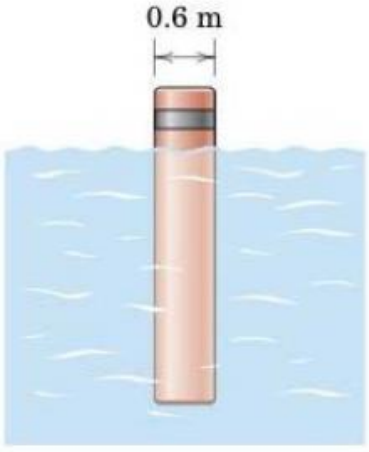
TUTORIAL-1: VIBRATION

25JAN, 2021

1. The vertical plunger has a mass of 2.5 kg and is supported by the two springs, which 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 from rest. Friction in the guide is negligible.

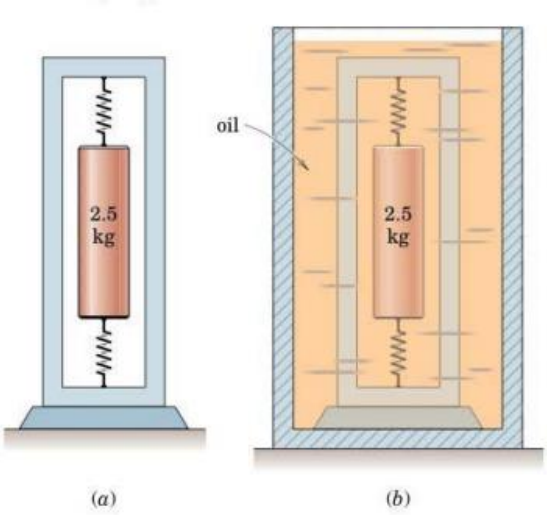


2. The cylindrical buoy floats in salt water (density 1030 kg/m^3) and has a mass of 800 kg with a low center of mass to keep it stable in the upright position. Determine the frequency f_n of vertical oscillation of the buoy. Assume that the water level remains undisturbed adjacent to the buoy.

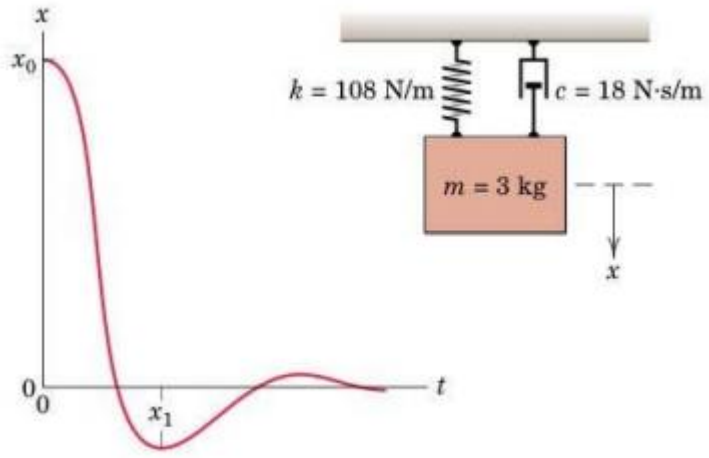


3. The 2.5-kg spring-supported cylinder is set into free vertical vibration and is observed to have a period of 0.75 s in part (a) of the figure. The system is then completely immersed in an oil bath in part(b) of the figure, and the cylinder is displaced from its equilibrium position and released. Viscous damping ensues, and the ratio of two successive positive-displacement amplitudes is 4. Calculate the

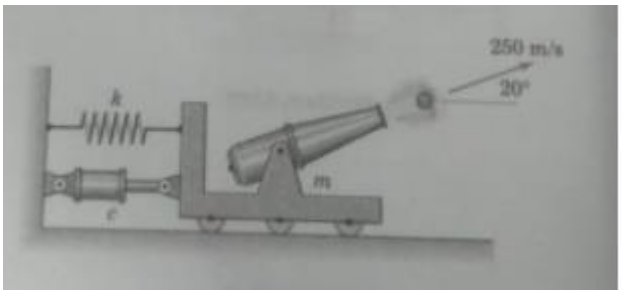
viscous damping ratio ζ, the viscous damping constant c, and the equivalent spring constant k.



4. The system shown is released from rest from an initial position x_0. Determine the overshoot displacement x_1. Assume translational motion in the x-direction.



5. The canon fires a 4.5-kg cannonball with an absolute velocity of 250 $\frac{m}{s}$ at 20^o to the horizontal. The combined mass of the cannon and its cart is 750 kg. If the recoil mechanism consists of the spring of constant $k = 27$ KN/m and the damper with viscous coefficient $c = 9000$ N.s/m, determine the maximum recoil deflection x_{max} of the cannon unit.



6. When the person stands in the center of the floor system shown, he causes a static deflection δ_{st} of the floor under his feet. If he walks (or run quickly) in the same

area, how many steps per second would cause the floor to vibrate with the greatest vertical amplitude?

7. Determine the amplitude of the vertical vibration of the spring-mounted trailer as it travels at a velocity of 25km/hr over the corduroy road whose contour may be expressed by a sine or cosine term. The mass of the trailer is 500 kg and that of the wheel alone may be neglected. During the loading, each 75 kg added to the load caused the trailer to sag 3mm on its springs. Assume that the wheels are in contact with the road at all times and neglect damping. At what critical speed v_c is the vibration of the trailer greatest?

8. Two identical uniform bars are welded together at a right angle and are pivoted about a horizontal axis through point O as shown. Determine the critical driving frequency ω_c of the block B which will result in excessively large oscillations of the assembly. The mass of welded assembly is m.