

(Prob. 1) 20pt.

A flyball governor is shown rotating at a constant speed  $\omega$  of 500 rpm. The weights  $C$  and  $D$  are each of mass 500 g and are pin-connected to light rods.

What is the tension in the rods and the downward force  $F$  at  $B$  needed to maintain the configuration shown for the given  $\omega$ ?

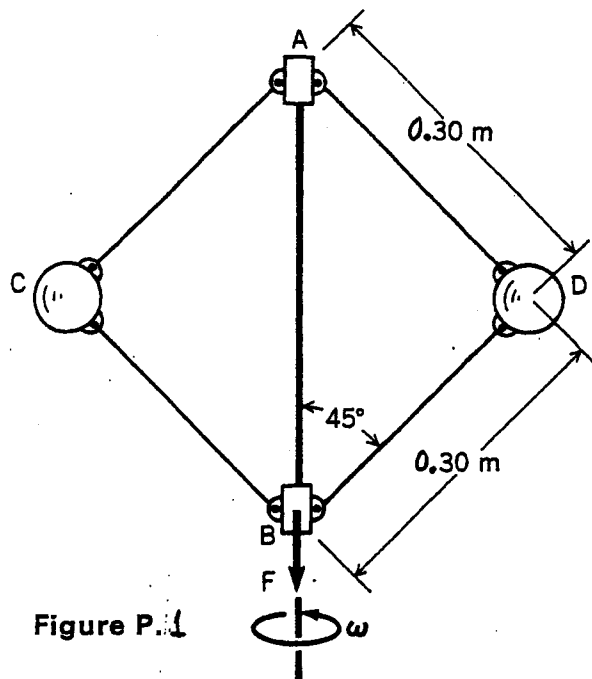


Figure P.1

(Prob. 2) 20pt.

If  $W = 1000 \text{ N}$  and  $P = 300 \text{ N}$ , find the angle  $\theta$  for equilibrium.

Notice: Use the method of Virtual Work, other methods are not acceptable!

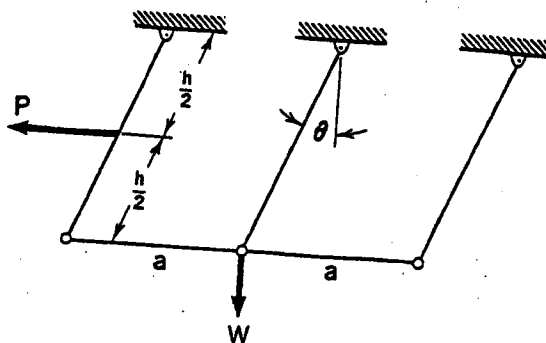


Figure P. 2

(Prob. 3) 20pt.

A weight  $W$  is welded to a light rod  $AB$ . At  $B$  there is a torsional spring for which it takes  $500 \text{ N}\cdot\text{m}$  to rotate 1 rad. The torsional spring is linear and restoring and is, for rotation, the analog of the ordinary linear spring for extension or contraction. If the torsional spring is unstrained when the rod is vertical, what is the largest value of  $W$  for which we have stable equilibrium in the vertical direction?

Notice: Use the method of Potential Energy, other methods are not acceptable!

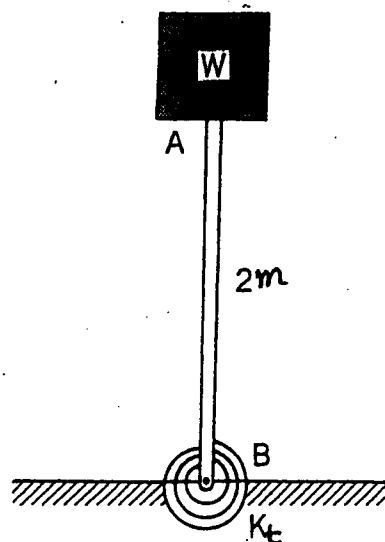


Figure P. 3

(背面仍有題目,請繼續作答)

(Prob. 4) 20 pt.

A submarine is moving at constant speed of 15 knots below the surface of the ocean. The sub is at the same time descending downward while remaining horizontal with an acceleration of  $0.023 g$ . In the submarine a flyball governor operates with weights having a mass each of 500 g. The governor is rotating with speed  $\omega$  of 5 rad/sec. If at time  $t$ ,  $\theta = 30^\circ$ ,  $\dot{\theta} = 0.2$  rad/sec, and  $\ddot{\theta} = 1$  rad/sec<sup>2</sup>, what is the force developed on the support of governor system as a result solely of the motion of the weights at this instant?

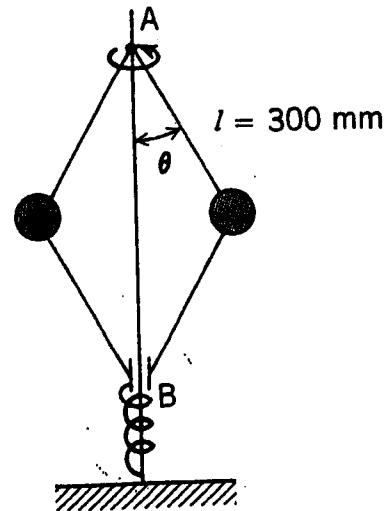


Figure P. 4

(Prob. 5) 20 pt

A hydrometer is a device to measure the specific gravity of liquids. The hydrometer weighs 0.36 N, and the diameter of the cylindrical portion above the base is 6 mm.

The hydrometer of Figure P. 5 is used to test the specific gravity of battery acid in a car battery.

If the hydrometer is disturbed in the vertical direction, what is the frequency of vibration in cycles/sec as it bobs up and down?

(Hint: (1) Recall from Archimedes' principle that the buoyant force equals the weight of the water displaced. (2) Note if hydrometer goes down, the water surface will have to rise a certain amount simultaneously. The battery acid has a density of  $1100 \text{ kg/m}^3$ .)

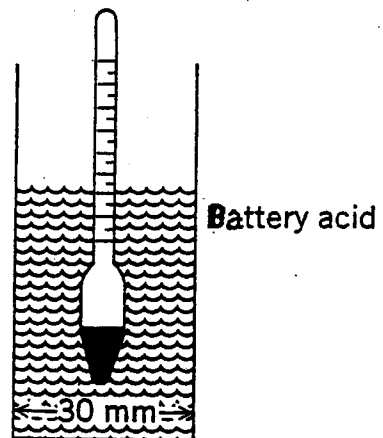


Figure P. 5