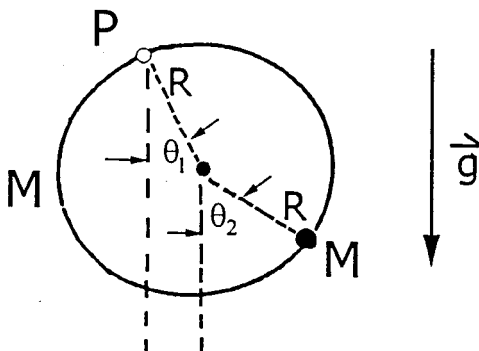


A thin uniform loop of radius R and mass M is allowed to oscillate in its own plane with one point (P) of the hoop fixed. Attached to the hoop is a point mass M (equal to the mass of the loop) constrained to move without friction along the hoop as shown in the figure. The system is in a uniform gravitational field g .

Consider only small oscillations such that θ_1 and $\theta_2 \ll 1$.

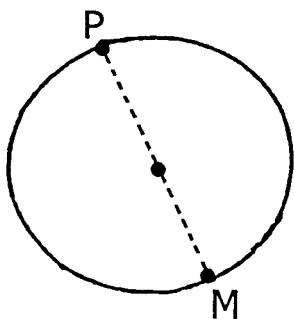


- (a) Write down the kinetic and potential energies of the system in terms of θ_1 and θ_2 .

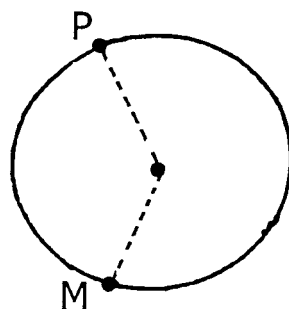
Take the potential to be zero at point P .

- (b) Determine the normal-mode frequencies ω_1 and ω_2 and show that $\omega_1 = 2\omega_2 = \sqrt{2g/R}$.

- (c) The sketches below represent the two modes of oscillations. Which diagram pertains to the lower frequency of oscillation ω_2 ([A] or [B]?).



[A]



[B]