Answer on Question#55068 - Physics - Mechanics | Kinematics | Dynamics

A simple pendulum of length l is suspended from a hook mounted on a slanted wall. The wall makes a small angle theta with the vertical. The pendulum is displaced from the vertical by a small angle phi(phi>theta) ⍰ and released. Assuming that the collision of the bob is elastic, the time period of oscillation is

Solution.

Without wall period of oscillation would be $T_0 = 2\pi\sqrt{\frac{l}{g}}$. Period of oscillation with wall: $T = T_0 - \Delta t$, where Δt is time in which pendulum without wall would move from angle θ to φ and return to θ. To find Δt we have to solve the equation: $\varphi \sin\sqrt{\frac{g}{l}} = \theta$. We have $t_1 = \sqrt{\frac{l}{g}}\sin^{-1}\left(\frac{\theta}{\varphi}\right)$ (first time pass θ) and $t_2 = \sqrt{\frac{l}{g}}(\pi - \sin^{-1}\left(\frac{\theta}{\varphi}\right))$ (return to θ). Now we find $\Delta t = t_{2-}t_1 = \sqrt{\frac{l}{g}}\left(\pi - 2\sin^{-1}\left(\frac{\theta}{\varphi}\right)\right)$ and, finally, T=$\sqrt{\frac{l}{g}}\left(\pi + 2\sin^{-1}\left(\frac{\theta}{\varphi}\right)\right)$.

Answer: T=$\sqrt{\frac{l}{g}}\left(\pi + 2\sin^{-1}\left(\frac{\theta}{\varphi}\right)\right)$.