PHY 250: Homework 4

Fall 2020

Death-line: November 12th

Exercise 1

A bungee jumper with mass 65.0 kg jumps from a high bridge. After reaching his lowest point, he oscillates up and down, hitting a low point eight more times in 43.0 s. He finally comes to rest 25.0 m below the level of the bridge. Estimate the spring stiffness constant and and the unstretched length of the bungee cord assuming a Simple Harmonic Oscillation (SHO).

Exercise 2

A mass m bullet strikes a mass M block attached to a fixed horizontal spring whose spring constant is K and sets it into oscillation with an amplitude A. What was the initial speed of the bullet if the two objects move together after impact?

Exercise 3
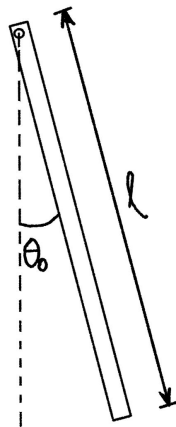
    A physical pendulum consists of an uniform wooden rod of longitude ℓ and mass m hung from a nail near one end. The motion is damped because of friction in the pivot; the damping force is approximately proportional to $d\theta/dt$. The rod is set in oscillation

by displacing it and initial angle θ_0 from its equilibrium position and releasing it. After a time Δt, the amplitude of the oscillation has been reduced to $\theta_0/3$. If the angular displacement can be written as $\theta(t) = Ae^{-\gamma t}\cos(\omega' t)$, find (a) γ, (b) the approximate period of the motion, and (c) how long it takes for the amplitude to be reduced to $1/2$ of its original value.

Exercise 4

(a) For a forced oscillation at resonance ($\omega = \omega_0$), what is the value of the phase angle ϕ_0? (b) What, then, is the displacement at a time when the driving force F_{ext} is a maximum, and at a time when $F_{ext} = 0$? (c) What is the phase difference (in degrees) between the driving force and the displacement in this case?