PHY3110 Homework Assignment 9

1. (15 points) A mass particle moves in a constant vertical gravitational field along the curve defined by $y = ax^4$, where y is the vertical direction. Find the equation of motion for small oscillations around the equilibrium position.

2. (25 points) Find the normal modes of vibration for a system described by the following kinetic and potential energy:

$$T = \frac{1}{2}mR^2(\dot{\theta}_1^2 + \dot{\theta}_2^2 + \dot{\theta}_3^2), V = \frac{1}{2}kR^2[(\theta_1 - \theta_2)^2 + (\theta_2 - \theta_3)^2 + (\theta_3 - \theta_1)^2]. \tag{1}$$

3. (30 points) Consider a system under small oscillations. Express its kinetic and potential energy in terms of normal coordinates. Try to show that the time average of the kinetic energy is equal to that of the potential energy.

4. (30 points) A simple pendulum of length l and mass m is attached to a block of mass $2m$, which can slide on a frictionless surface. Assume the motion is in the vertical plane, solve the small oscillation problem for this system.