Name: _____ Student #: _____

Applications of Classical Mechanics
Physics 350 2018W
Challenge Problem #2: Monday, January 28, 2019

Review and Concept Check:

(a) When solving a linear differential equation we may use the _____ to generate new solutions by taking a linear combination of two or more independent solutions.
(b) [T/F] ____ : An object subject to a drag force stops moving when it reaches its terminal velocity.
(c) [T/F] ____ : While the equations we write down will depend upon them, the physical trajectory of an object in a fixed frame is independent of the coordinate system we use to describe its motion.
(d) [T/F] ____ : No matter how big N is, the total momentum of a system of N particles is constant.

Problem 2: A Double Pendulum

A double pendulum consists of a pendulum of mass m and length ℓ suspended from another pendulum of mass m and length ℓ with a pivot point a height H above the surface of the Earth. Assume the mass of the rods is negligible. Both moves under the acceleration due to gravity g on the surface of the earth. The upper and lower pendula make an angles θ_1 and θ_2 with respect to the vertical axis respectively. Assume the systems motion is confined to a plane.

(a) Write down an expression for the total gravitational potential energy U of this pendulum in terms of the heights h_1 and h_2 of the pendulum masses above the surface of the earth.

(b) Write down an expression for the total kinetic energy of the system in cartesian coordinates.

(c) How many degrees of freedom does this system have after being reduced by constraints? Choose an appropriate set of generalized coordinates.

(d) Express the kinetic energy, potential energy, and Lagrangian of this system in terms of your chosen generalized coordinates.

(e) Write down, but do not solve, the set of Lagrange equations for this system.

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