

Name: _____

Student #: _____

Applications of Classical Mechanics
Physics 350 2018W
Challenge Problem #3: Monday, February 4, 2019

Review and Concept Check:

- (a) [T/F] ____ : If $S[x(t)]$ is a functional of the function $x(t)$ then we denote x as the “dependent” variable and t as the “independent” variable.
 - (b) [T/F] ____ : Provided the Lagrangian is defined in an inertial frame, the generalized coordinates are arbitrary, and can even be chosen to be coordinates of the system in an accelerating frame.
 - (c) [T/F] ____ : The Lagrangian description of mechanics can be shown to be equivalent to the Newtonian description of mechanics, but only in Cartesian coordinates.
 - (d) [T/F] ____ : If a Lagrangian L is independent of some generalized coordinate q then the generalized momentum associated with that coordinate \tilde{p}_q is at most a linear function of time.
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Problem 3: The Point Grey Pendulum

A rod is fixed at a 45° angle to the floor and ceiling of a room. A mass M is constrained to slide along the rod without friction and is attached to a spring with equilibrium length ℓ_s and spring constant k . A pendulum of mass m and length ℓ_p is hung from the mass M .

- (a) Assuming the pendulum is constrained to move within the plane containing the rod, choose an appropriate set of generalized coordinates and write down the Lagrangian in this case.
 - (b) Assuming the pendulum is constrained to perpendicular to the plane containing the rod, choose an appropriate set of generalized coordinates and write down the Lagrangian in this case.
 - (c) Write down the quadratic Lagrangian close to the stable equilibrium point of the system for both case (a) and (b) above. Which configuration has a simpler description when the pendulum is near equilibrium and why?
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