Exam 2 Corrections

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Problem 1

a

The action integral is

$$S = \int_{t_1}^{t_2} L dt.$$

Which is the integral from time 1 to time 2 over the Lagrangian with respect to time. So this is the integral over time along the path of the system between points t_1 and t_2. The action integral is stationary if the integral is zero, that is $\delta S = 0$.

b

The Lagrangian equation of motion describes the motion of a particle by the second order differential equation. The Hamiltonian is the particle of motion in a coupled system with two first order ode's. There is also the fact that the Hamiltonian is the total energy of the system and is unique. Finally, Lagrangian formalism is configuration space while the Hamilton is in Phase space.

Problem 2

a

If dH/dt is zero then the Hamiltonian is a const of motion. If $\partial H/\partial t$ has no no explicit time dependence then the parial derivative is zero. The Hamiltonian in this problem has dH/dt = 0 so the Hamiltonian is zero.

b

The only time a system is not equal to its total energy is if the system is holonomic or monogenic. Furthermore, if the coordinates do not explicitly depend on time then the Hamiltonian is not equal to its total energy. Since r is dependent on time since it increases over time, then the system is not equal to its total energy.

Problem 3

The stable points are my circles on the exam and the unstable points are the x's.

Problem 4

a

Since θ is our cyclic coordinate that makes

$$\dot{\theta}r^2m = const$$

c

To find if this is stable we have to take the derivative of v_{eff} with respect to r twice. We then get that k is

$$k = m\dot{\theta}^2$$

d

Needed to label $-\dot{p_r}$ and $\dot{p_\theta}$.

Problem 5

The θ component of this is not zero. Therefore, when we use our Lagrangian multipliers the final tension force is

$$Q_T = -mgcos\theta - mr\dot{\theta}^2$$