Final Exam Corrections

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Problem 1

b.

The Euler-Lagrange equation is derived by using the least action principle.

c.

It is not acceleration it is our conjugate momentum. Conjugate momentum is our generalized momentum that is solved from our generalized velocity variables.

d.

If

$$\frac{\partial H}{\partial t} = \frac{dH}{dt}$$

then it means that H depends only on t. Now, if $\partial H/\partial t = 0$ it means that H has no explicit time dependence. Therefore, the system is invariant with time Δt. p is constant when H does not explicitly contain conjugate coordinate q when the system is invariant with displacement Δq.

e.

The generating functions are used to find the differential equations for the function. The generating functions take p and q and transform them to P and Q. This is however, not always the case, with the generating functions we are always able to get P, p, Q, and q.

Problem 3

a.

Missed a dot in my $\dot{x} = \dot{X} + \dot{x}$.

b.

Taking the time derivative for $mA\omega sin(\omega t)$ the chain rule is applied. This results in another ω. This means that $B = A\omega^2$.

Problem 4

Leaving off where

$$m\ddot{x} + mg = \lambda$$

and

$$I\ddot{\theta}/R = \lambda$$

we can eliminate θ. This now leaves us with $\ddot{\theta} = \ddot{x}/R$ which is

$$m\ddot{x} + mg = \lambda$$

and

$$I\ddot{x}/R^2 = \lambda.$$

If we combine these expressions we get

$$\ddot{x} = \frac{mg}{m + I/R^2}$$

Problem 5

Given that the generating function is $F_3(p, Q)$, the function has to be in terms of p and Q. Q is gave as $Q = -1/q$, P is also gave as $P = pq^2$. Knowing that $P = \partial F_3/\partial Q$ we find that F_3 is

$$pq^2 = \frac{-\partial F_3}{\partial Q_i} \rightarrow \int \frac{p}{Q^2} dQ = F_3 \rightarrow \boxed{F_3 = -\frac{p}{Q}}$$