

# Day 31 - Midterm Help Session

## Cursed Proof of the Euler-Lagrange Equation

We begin with the famous Euler-Lagrange equation:

$$\frac{d}{dt} \left( \frac{\partial L}{\partial \dot{x}} \right) = \frac{\partial L}{\partial x}$$

Since  $\dot{x} = \frac{dx}{dt}$ , we rewrite the left-hand side:

$$\frac{d}{dt} \left( \frac{\partial L}{\partial \left( \frac{dx}{dt} \right)} \right) = \frac{\partial L}{\partial x}$$

Now, in a move that would make mathematicians weep, we boldly exchange the differentiation with respect to  $\frac{dx}{dt}$  for something that looks like the inverse of  $\frac{d}{dt}$ . Because obviously:

$$\frac{\partial}{\partial \left( \frac{dx}{dt} \right)} \approx \frac{1}{\frac{d}{dt}} \cdot \frac{\partial}{\partial x}$$

Substitute that into the original equation:

$$\frac{d}{dt} \left( \frac{1}{\frac{d}{dt}} \cdot \frac{\partial L}{\partial x} \right) = \frac{\partial L}{\partial x}$$

Now cancel  $\frac{d}{dt}$  with  $\frac{1}{\frac{d}{dt}}$ , because calculus is just fancy algebra:

$$\frac{\partial L}{\partial x} = \frac{\partial L}{\partial x}$$

**Therefore, Q.E.D.**

(Q.E.D. = *Questionably Established Derivation*)

Box it, frame it, publish it in *Totally Real Physics Letters*.

# Announcements

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## On Monday

- Homework 8 (Lagrangian Mech) will be posted (Last HW; due April 17th)
  - "late HW 8" will be accepted until April 24th
- Final Project Instructions and Rubric will be posted

## Rest of Semester

- CW15 - Intro to Lagrangian Dynamics
- CW16 - Examples of Lagrangian Dynamics
- CW17 - Project Prep (No Class Meetings) - *DC out of country*

# Announcements

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## CW17 - Last week of Classes

- Normally, we would use class time for project work, check-ins, help, and guidance. However, I will be out of the country for the last week of classes (April 20-24).
- To earn the **extra credit for CW17** (clicker extra credit), you should schedule a project check-in meeting with me during that week
  - *Link to sign up will be posted on Monday.*
  - Please send me a project update in advance of the meeting (can be a few sentences, or a more detailed outline, or a draft of your project report, etc.)