Announcements

- Homework 5 due on Monday!
- Compday 5 on Monday dealing with 2D oscillators
- Start reading Chapter 7 for next Wednesday
- Midterm will be handed out a week from today
  - You'll have a week to get it done and turned back in
- Responses: `rembold-class.ddns.net`

Today's Objectives

- Understand what the Calculus of Variations is
- Come to terms with how functions are denoted in this syntax
- Be able to identify and utilize the Euler-Lagrange equation
- Understand how to find and interpret a solution to the Euler-Lagrange equation

Q1

The “Calculus of Variations” is primarily concerned with:

A) Determining the “equilibrium points” of small displacements from a minimum

B) Determining the slopes of small displacements from a minimum

C) Determining the “equilibrium points” of integrals

D) Determining the slopes of integrals

Q2

Suppose your vehicle's speed varies as:

$$\|\vec{\boldsymbol{v}}\| = 5xy$$

Which integral would encapsulate the total time it would take you to drive along a certain path $y(x)$ between two points?

A) $\displaystyle\int_{x_1}^{x_2} \frac{\sqrt{1+y'(x)^2}}{5xy(x)}\,dx$

B) $\displaystyle\int_{x_1}^{x_2} \frac{\sqrt{1+25x^2}}{5xy(x)}\,dx$

C) $\displaystyle\int_{x_1}^{x_2} 5xy(x)\sqrt{1+y'(x)^2}\,dx$

D) $\displaystyle\int_{x_1}^{x_2} \sqrt{1+25x^2}\,dx$

MECHANICS

A new sort of maximum

Q3

The Euler-Lagrange equation is best described as:

A) An expression that must hold true for a particular integral to exist

B) A differential equation whose solution maximizes a particular integral

C) A differential equation whose solution minimizes a particular integral

D) None of the above

MECHANICS

A new sort of maximum

Q4

Many times, you need to know the length ds of a short segment of a curve on a surface. What would ds look like for a short line segment in polar coordinates? Where we are writing r as a function of ϕ.

A) $\sqrt{r(\phi)^2 r'(\phi)^2 + 1}\, d\phi$

B) $\sqrt{\sin(\phi) r'(\phi)^2 + r(\phi)^2}\, d\phi$

C) $\sqrt{r'(\phi)^2 + 1}\, d\phi$

D) $\sqrt{r'(\phi)^2 + r(\phi)^2}\, d\phi$

Q5

What general function would make the integral below stationary?

$$S = \int_0^P \left(y'^2 + yy' - y^2\right) dx$$

A) $Ae^x + Be^{-x}$

B) $A\cos(x - \delta)$

C) Ae^x

D) None of the above