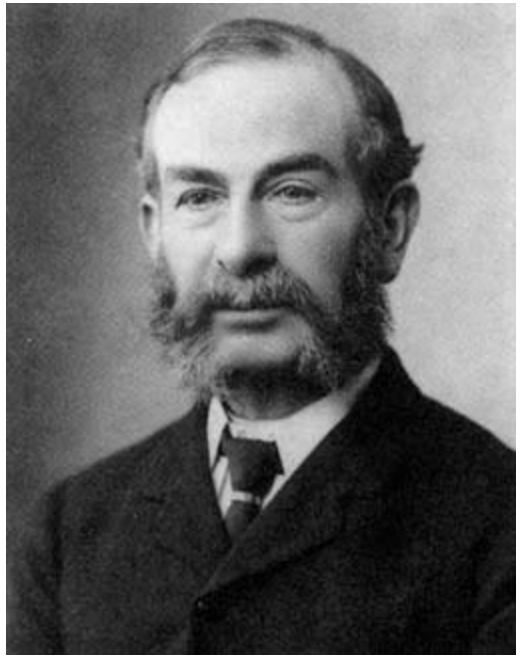
Day 37 - Help Session

Routhian Mechanics



Announcements

- Homework 8 is "Late" 24 Apr
  - Last Exercise 0: Reflect Learning Outcomes
- Final Project is posted
  - Video Presentations due 27 Apr
  - Computational Essay due 1 May
  - Rubric for both are posted
- No class (20 Apr - 24 Apr) - DC out of country
  - Make appointment for project help (clicker extra credit)

Announcements

Rest of Semester Schedule

- CW16 - Examples of Lagrangian Dynamics (HW8)
- CW17 - Project Prep (DC out of country)
- CW18 - Final Project Due
  - Video Presentations due 27 Apr
  - Computational Essay due 1 May

NO IN-CLASS FINAL EXAM

Clicker Question 36-5a

Consider a bead sliding on a parabolic bowl described by the constraint $z = c\rho^2$ where ρ is the distance from the vertical axis. The Lagrangian for this system in Cartesian coordinates is:

$$\mathcal{L} = \frac{1}{2}m(\dot{x}^2 + \dot{y}^2 + \dot{z}^2) - mgz$$

Don't use the constraint, what are the equations of motion for this system? Do they seem correct?

> Click anything to indicate you are ready to see the answer.

Clicker Question 36-5b

For the constraint for the bead in a parabolic bowl ($z = c\rho^2$), what are the units of c?

1. $[L^2]$
2. $[L^{-2}]$
3. $[L]$
4. $[L^{-1}]$
5. Something else

Clicker Question 36-5c

Now use the constraint to write the Lagrangian for the bead in a parabolic bowl in cylindrical coordinates, (ρ, ϕ, z). What is the Lagrangian for this system?

1. $\mathcal{L} = \frac{1}{2}m(\dot{\rho}^2 + \rho^2\dot{\phi}^2 + 4c^2\rho^2) - mgc\rho^2$
2. $\mathcal{L} = \frac{1}{2}m(\dot{\rho}^2 + \rho^2\dot{\phi}^2 + 4c^2\rho^2) - mgc\rho^2$
3. $\mathcal{L} = \frac{1}{2}m(\dot{\rho}^2 + \rho^2\dot{\phi}^2 + 4c^2\rho^2\dot{\rho}^4) - mgc\rho^2$
4. $\mathcal{L} = \frac{1}{2}m(\dot{\rho}^2 + \rho^2\dot{\phi}^2 + 4c^2\rho^2\dot{\rho}^2) - mgc\rho^2$
5. Something else

> Hint: $v^2(\rho, \phi, z) = \dot{\rho}^2 + \rho^2\dot{\phi}^2 + \dot{z}^2$

Clicker Question 36-5d

For the bead in a parabolic bowl, there is a generic Lagrangian:

$$\mathcal{L}(\rho, \dot{\rho}, \phi, \dot{\phi}, z, \dot{z}, t)$$

How many coordinates are there, truly? **here, each variable is a coordinate**

A. 2

B. 3

C. 4

D. 5

E. None of these

Which coordinates are independent?

Clicker Question 36-5e

The Lagrangian for the bead in a parabola does not depend on which of the following?

1. ρ
2. ϕ
3. z
4. More than one of these
5. None of these

> When a coordinate does not appear in the Lagrangian, it is called a **cyclic** or **ignorable** coordinate. This means that the generalized momentum associated with that coordinate is conserved.