Available: 11:59 am on July 12, 2024

Due: 11:59 am on July 15, 2024

Problem A: Underground highspeed train

Many years ago, a physicist proposed a crazy idea of building an underground highspeed train connecting two cities and use the gravity of earth to drive the train. Suppose we are planning on implementing this idea and building a train connecting Shanghai, China and Los Angeles, USA. The idea is to drill a STRAIGHT tunnel through the earth directly connecting these two cities. How long would it take for the passengers to safely travel from Shanghai to LA? What is the max speed of the train? What devices would you add to the train and why?

Problem B: Tennis serve

You are playing an important tennis game against someone on a clay court in France and are preparing for the serve. What is the best strategy to serve? Suppose you are a 1.8m tall man and the maximum speed you can give the tennis ball is 251km/h WITHOUT spinning the ball.

Rules[1]

1. **The Team:** Each team may consist of a maximum of three students. Each student may participate on only one team.

2. **The Problems:** Two problems will be available. Teams may submit a solution to only one of the two problems posed.

3. **Solution Papers:** All teams must prepare a formal paper, written in English, in which they explain their work. The first part of the paper should contain only four items, (1) the author names, (2) the problem selected (”A” or ”B”), (3) the title of the paper, and (4) an abstract, no longer than 300 words in length, which will be an abstract providing key details of the work performed, answers to the questions posed, final numbers, results and conclusions. The body of the paper, which follows the first part, may be of any length necessary to report the team’s work. During the project, teams may use books, journals, computers, the Internet, programs that they write, or any other nonliving resources, but they may not consult with any people outside of their team. No contribution may be made by any other individuals other than the three students. Although the problems will be intended for a theoretical analysis, teams are permitted to conduct relevant experiments and present any resulting data in their paper. Each paper must include a list of references used, as well as make in-text citations to these resources. Papers may use existing algorithms and computational tools (including not only freely available tools, but also tools within systems like Matlab or Mathematica), as long as these are correctly referenced, cited, and the methods are

[1]Cited from the university physics competition web. `http://www.uphysicsc.com/contestrules.html`.

clearly explained within the paper. Papers may include equations, graphs, figures, and tables. Any computer programs written may be included as an appendix to the paper, however all algorithms, methods and results must be explained in the main text of the paper to receive consideration during judging. Each paper must include at minimum (1) a restatement and clarification of the problem as interpreted by the team, (2) an explanation of all assumptions and approximations made, (3) justification for all work performed, as well as (4) a discussion of the strengths and weaknesses of the approach taken.

4. **Submit Solutions:** Papers should be submitted as pdf files. Each team must submit their paper on Canvas before the deadline.

5. **Grading Policy:** Papers will be graded by Professor directly. No detailed rubric will be provided.

LaTeX Template

The teaching team will provide the LaTeX template for the paper, which is created based on *RevTeX 4.2 Template* provided by *American Physical Society (APS)*.