Theoretische Physik I: Klassische Mechanik - Präsenzübung

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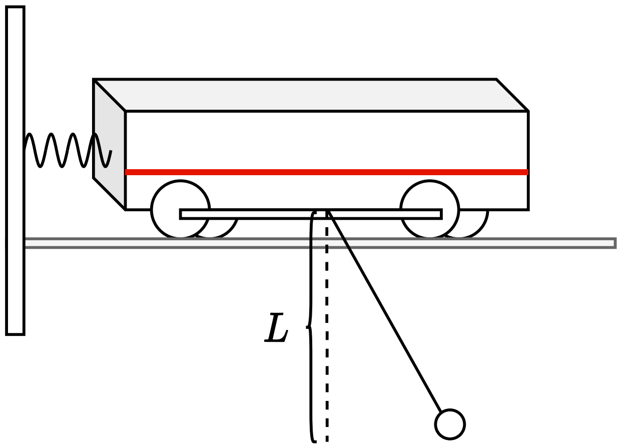
Übungsblatt 4

Aufgabe 4.1: A model train

A model train is on a horizontal track, a bridge above a high ravine. It can roll horizontally without friction on its track, but it is attached to a spring. The train has mass M and the spring has constant K and minimal-energy point x_0. Also, there is a pendulum of length L and mass m hanging below the train.



4.1a)

What coordinates should you use to describe the system?

4.1b)

What is the Lagrangian?

4.1c)

What are the equations of motion?

Aufgabe 4.2: Important rocket calculations

Consider a not very powerful rocket. It launches from 35 degrees north, flies straight up with enough initial speed to reach 100km, and comes down under the influence of gravity. Since 100km is much smaller than 6370km, you can make the approximation that the acceleration from gravity is constant.

4.2a)

Neglecting the rotation of the Earth and making any simplifying approximation, how long does it take for the rocket to complete its flight (from takeoff to landing), assuming that it takes off with its full speed and is in free fall for the entire flight?

4.2b)

Next consider the Earth's rotation and the Coriolis effect. What is the -initial- extra acceleration due to the Coriolis effect, and in what direction does it push?

4.2c)

If the Earth did not turn, the rocket would land right where it took off. Because of the Coriolis effect, it lands somewhat to the side of its initial launch point. How far to the side does it land? Make any simplifying approximation which you find helpful.