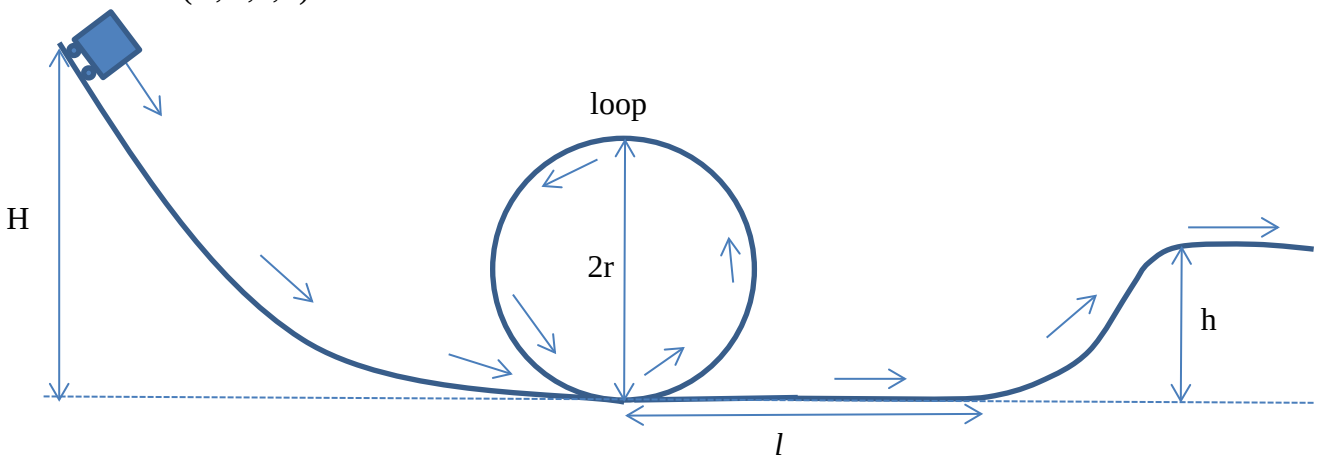
2014-2015 EE Ph.D. Qualifying Exam
Question area: *Engineering Physics*
Examiner: *Jelena Vuckovic*

Clearly state any assumptions you make while solving the problems. Good luck!

1. Rollercoaster design

You are asked to design a rollercoaster shaped as in the figure below. How would you choose the dimensions (H, h, *l*, r) relative to each other?



2. Reflection and refraction

Plane wave is incident from a medium with permittivity and permeability ε_1, μ_1 ($\varepsilon_1>0$, $\mu_1>0$) onto a boundary with a medium described with ε_2, μ_2. The angle of incidence is θ_i, as shown in the figure. What happens with a reflected and a refracted wave in following situations?

- $\varepsilon_2>0$, $\mu_2>0$
- $\varepsilon_2<0$, $\mu_2<0$
- $\varepsilon_2=-\varepsilon_1$, $\mu_2=-\mu_1$
- $\varepsilon_2<0$, $\mu_2>0$