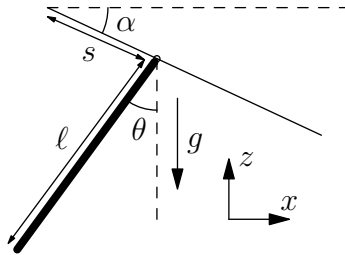


J10M.1 - Rod on a Rail (M93M.2)

Problem



A uniform rod of length ℓ and mass m moves in the x - z plane. One end of the rod is suspended from a straight rail that slopes downwards with an angle α relative to the horizontal; the connection point is free to move along the rail without friction, and the rod is able to swing freely in the x - z plane. Uniform gravity acts downwards.

- Construct the Lagrangian of this system in terms of generalized coordinates s (the distance the connection point has moved along the rail) and θ (the angle the rod makes with the vertical direction).
- Using your Lagrangian, find a solution to the equation of motion where the rod moves with fixed θ as s increases.
- Explain how your solution is consistent with (and can be derived from) the equivalence principle.