

Projectile Motion on an Incline (10 Points)

Problem Statement

Consider a projectile launched up an inclined plane, where the plane is inclined at an angle ϕ and the projectile is fired with initial speed v_i at an angle θ_i above the horizontal ($\theta_i > \phi$).

- (a) Establish a suitable coordinate system and derive the equation of the projectile's trajectory in this coordinate system. (4 points)
- (b) In the chosen coordinate system, write down the equation representing the inclined plane. (1 point)
- (c) Determine the condition under which the projectile intersects the inclined plane. Provide an equation that describes this condition. (1 point)
- (d) By performing the necessary algebraic manipulations, show that the projectile travels a distance d up the incline, given by:

$$d = \frac{2 v_i^2 \cos(\theta_i) \sin(\theta_i - \phi)}{g \cos^2(\phi)}.$$

(1 points)

- (e) If the initial speed v_i is held constant and θ_i is varied, at which angle θ_i is the distance d maximized? (3 points)

Deadline: February 27, 2025.