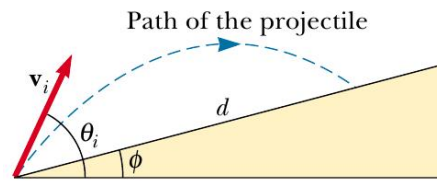


3. A projectile is fired up an inclined plane with an initial speed v_i at an angle θ_i as shown.
 (a) Show that

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

- (b) Find θ_i when d is maximum. What is the maximum value of d ?



4. Given a vector \mathbf{v} in 2-dimensional plane written in terms of the orthonormal basis in polar coordinates

$$\mathbf{v} = 5t\mathbf{e}_r + 2t^2\mathbf{e}_\theta,$$

Find the derivative of \mathbf{v} with respect to t .

5. A bus starts from rest and moves with constant acceleration. First observed that the velocity is 10 ms^{-1} , then it becomes 30 ms^{-1} after 20 s. (a) Calculate the average velocity and the constant acceleration over the time interval. (b) Calculate the position of the bus at 6 s after the first observation. (c) Find the time required for the bus to reach 300 m from rest. (d) Find the velocity of the bus at 250 m from rest.

6. The velocity of a particle moving along the x axis varies in time according to the expression $v_x = (35 - 2t^2) \text{ ms}^{-1}$, where t is in seconds. (a) Find the average acceleration in the time interval $t = 0$ to $t = 2$ s along the direction 15° from the x -axis. (b) Determine the acceleration at $t = 2$ s. (c) What is the acceleration along the y -axis?
7. Please use dimensional analysis to find the expression of the angular momentum L of a particle with mass m in uniform circular motion at an angular speed ω with radius r .