Indian Institute of Technology Guwahati

Tutorial-1 | PH131: Modern Physics | Due on :07 October 2025

1. A block of mass m is released at O as shown in figure 1 on a slope at time t=0. The slope exerts sliding friction of co-efficient μ. Obtain an expression on the block's position (x, y) as a function of time and the time taken by the block to reach the bottom. Use the coordinate axes OXY and O′X′Y′ and show that expressions obtained in the two coordinate systems are basically same.

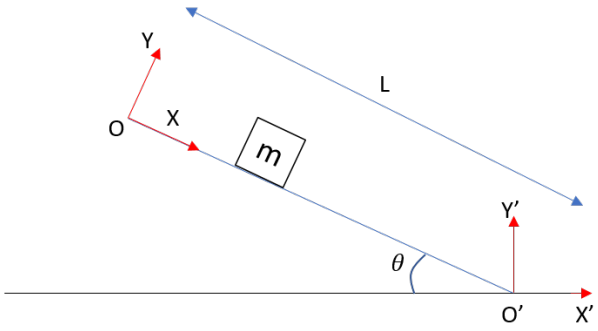

Figure 1:

2. A policeman is chasing a robber with both travelling in cars at the same speed v and are separated by distance L. The policeman wishes to shoot at the robber with gun whose muzzle velocity is u_0. At what angle θ with respect to the horizontal should he aim the gun. Solve the problem once from the the frame of reference of the policeman and then from the frame of reference attached to the ground. Is the angle of the gun same as the bullet's initial velocity.

3. In the Michelson-Morley experiment part we have used the approximation $(1-x)^n \approx (1-nx)$ once using n=-1 and then using n=-1/2. Make a table for the values of $(1-x)^n$ and $(1-nx)$ using n=-1, and -1/2 and x=0.5, 0.1, 0.01 and 0.001 and hence find the percentage by which the approximation fails in each case.

4. In the initial version the arm length of the Michaelson's interferometer used in their experiment was about 50 cm. Considering the wavelength of light to be 590 nm, obtain the expression for number of fringes shifted as recorded by the observer when the interferometer is rotated by 90 degree. Assume that the speed of earth relative to ether is 3×10^4 m/s.