4.2. A test apparatus for measuring the frictional characteristics of materials is shown in Fig. 4.23. A mass is released on an inclined plane and the terminal velocity is measured and used to estimate the friction between the material sample and the surface of the plane.

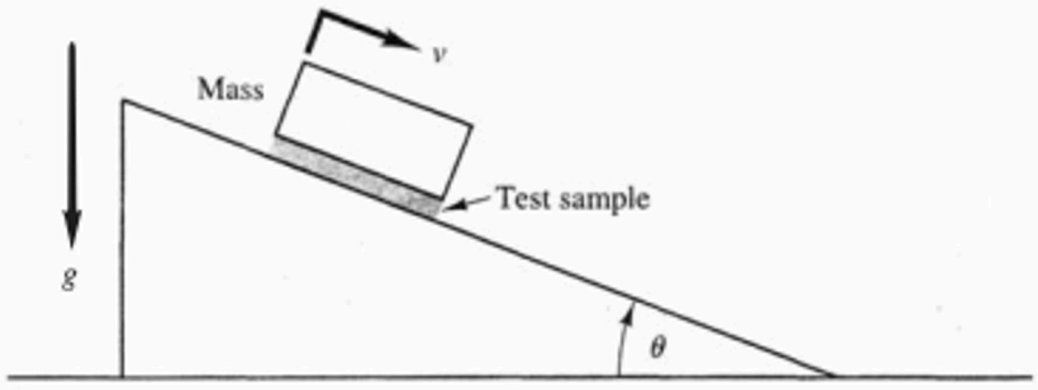


Figure 4.23: An inclined plane for measuring friction.

(a) Draw a sketch identifying (i) major system elements, (ii) the forces acting, and (iii) a velocity reference direction. How is the effect of gravity represented in your sketch?

(b) Construct the system linear graph.

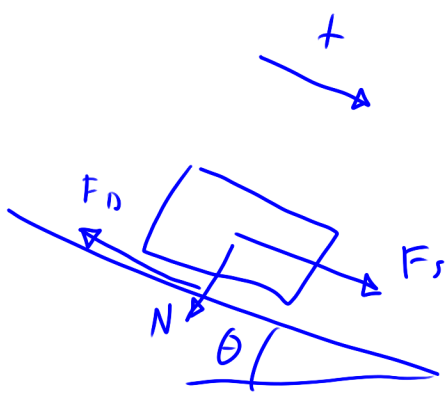
(c) How is the system influenced by changes in the angle of inclination, θ? How is the system influenced by changes in the frictional properties of the sample?

(d) If the frictional effects are modeled as linear, derive an expression for the terminal velocity of the mass element.

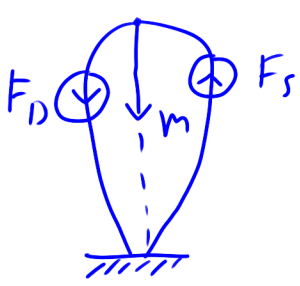
a. F_s m F_D

$F_s = m g \sin(\theta)$

$N = m g \cos(\theta)$



b.



c. if θ increased F_s increased

N decreased

F_D also likely decreased

if sample has lower friction

F_D would be lower

d. $F_D = BV$ at terminal velocity $\frac{dv}{dt} = 0$

since $F = ma$ $F_D = F_s$

$BV = m g \sin(\theta)$

$V = \frac{mg}{B} \sin(\theta)$