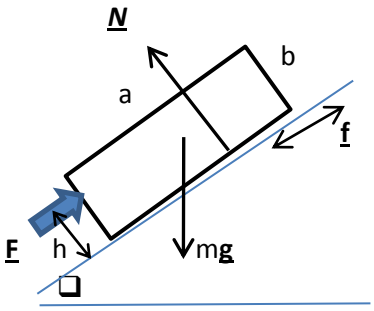
Statics Problem - Investigation of Slipping vs Tipping.



The fig. above shows a uniformly dense rectangular brick of length a, height b resting on a rough inclined plane of angle ❑.
The interface between surface and brick has associated coefficients of friction $❍_s$, $❍_k$. A force **F** is applied as indicated.

a) For F = 0, and varying ❑, obtain an expression for the angle at which the brick will first start sliding down the plane.

b) Assuming ❑ is such that the brick does NOT slide down the inclined plane obtain expressions for F that i) causes the brick to start sliding up the plane and ii) causes the brick to tip.

c) Plot a graph of f vs F as F is gradually increased from 0 to the value that causes sliding.

d) Obtain a constraint on h such that the brick will tip before it slides.

e) Suppose that instead of a brick of uniform density, we have a rectangular tank containing water. How will your answers to the above be affected?

(Note: static friction force has magnitude $f \leq ❍_s N$)

Based on what you already know (or seek out in texts or online) about static and kinetic friction and also the application of Newton's 1st law to both static equilibrium for translation and rotation, carry out the theoretical investigation in this file.

Make all your analysis - including any assumptions - comprehensible to my engineering or physics colleagues.