Friction Force Lab (F_k *and* F_s *and* $maxF_s$) - Partial Write-up

PURPOSE

One purpose of this lab is to study kinetic friction forces, F_k , and the kinetic coefficient of friction, μ_k . Factors which might affect the friction force are the weight of the moving object (or normal force, N), the surface area (A) of the object, the object's speed (v), and the roughness of the two surfaces being rubbed together, with the coefficient of friction (μ_k) a measure of this roughness or stickiness.

A second purpose of this lab is to study static friction forces, F_s , and $maxF_s=\mu_s N$. Here μ_s is also a measure of the surface roughness.

EXPERIMENTAL DESIGN

Materials: Three blocks, a large spring scale (preferably in newtons), and string strong enough to pull the blocks. (Include an illustration of the physical set-up.)

Procedure: (I) One block was weighed and pulled, lying flat, across a selected surface (eg., concrete outside, desk top or counter if the block doesn't scratch the surface, a wood surface, or the floor) It is pulled at a constant speed. A second block was placed on top of the first block and the two blocks were pulled across the surface at the same speed. Finally a third block was added to the first two, and the three blocks were also pulled across the surface at the same speed. The three kinetic friction forces required were recorded with respect to the normal force(N) between the blocks and the surface.

The dimensions of a block were measured and the surface area of the flat and edge faces was calculated. Using the string to attach the spring scale, one block was pulled at a constant speed across the surface once on its edge face and once lying flat. The force required for each of these two cases was recorded to determine if surface area(A) affected F_k.

One block was pulled, lying flat, across the same surface at three different speeds (labeled very slow, slow, and medium). The three required forces were recorded to determine if speed (v) affected F_k.

(II) One, two, and three blocks were "tugged at" as they remained motionless on the same surface. The static friction forces were recorded until the block just slipped. This is the only time F_s equals $maxF_s$. (F_s is always less than or equal to $maxF_x$.)

DATA

(Include here tables of measurements, graphs, calculations, and answers to questions asked in the lab instructions.)

RESULTS AND CONCLUSIONS

The pulling force and hence friction force did vary directly with the weight or normal force. The kinetic coefficient of friction was the constant of proportionality or the slope of the linear relationship. $F_k = \mu_k N$

The force required to pull one block at a constant speed did <u>not</u> vary with the surface area of the face on which it was pulled. Hence, kinetic friction force does not vary with surface area.

The pulling force did <u>not</u> vary with the speed of the block. Hence kinetic friction force is independent of speed.

$F_s \le maxF_s=\mu_s N$. Notice that $maxF_s$ is only known when the object just begins to move (motion "impends"). This is the only instance where $F_s = maxF_s$.

Another result from comparing F_k and $maxF_s$ was that $\mu_k \le \mu_s$.