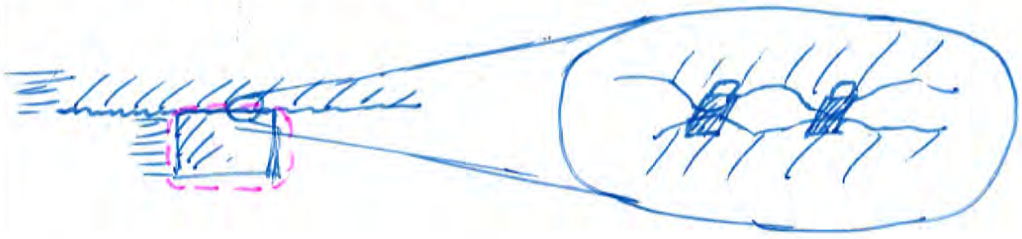
D5

Title Static friction force exerted by a stuck surface

Ingredients

Sketch



At/Through: t

Owner: System; Contact region between system & surface

Quantity: Normal force; Static friction force; Coefficient of static friction

Variable: $\vec{F}_{N,SURF\to SYS}$; $\vec{f}_{s,SURF\to SYS}$; $\mu_{s,SURF\to SYS}$

Giver: Flat surface stuck to system.

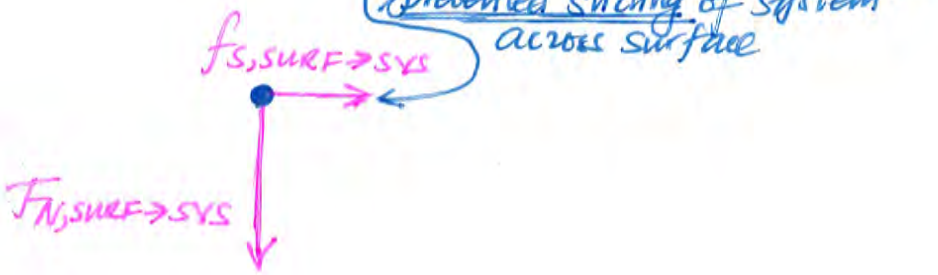
Recipe

Diagram the relationship

$F_{N,SURF\to SYS}$ and $\mu_{s,SURF\to SYS}$ → Greatest value of $f_{s,SURF\to SYS}$

Graphically present quantities

Force diagram



Mathematical relationship

$f_{s,SURF\to SYS} \leq \mu_{s,SURF\to SYS} F_{N,SURF\to SYS}$

Direction of $\vec{f}_{s,SURF\to SYS}$ = Opposes prevented sliding.

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Title: Static friction force exerted by a stuck surface

The top half of this sheet consists of an "**Ingredients**" section with a row labeled "Sketch", a row labeled "At/Through", a row labeled "Owner", a row labeled "Quantity", a row labeled "Variable", and a row labeled "Giver."

Sketch: Block, underneath and in contact with a rough horizontal planar surface. Whooshies trailing to the left behind both the block and the surface indicate that the block and surface are moving together toward the right. The block is surrounded by a dashed system bubble. A magnified view of a small portion of the region of contact between the block and the surface shows that at the molecular scale, both are bumpy and in contact only where a bump of the block and a bump of the surface meet. Otherwise, there are gaps. The locations where bumps meet are marked by icons of padlocks indicating molecular-level adhesions (not necessarily indicating interactions mediated by chemical bonds, but possibly interactions mediated by intermolecular forces). The padlocks are sheared with their tops toward the right, indicating that the surface is trying to drag the block toward the right and that the block is trying to fall behind toward the left.

Remaining rows of Ingredients section are used for a flowchart illustrating the following:
At time t, there are two Owners: the System and the Contact region between the system and surface. The System receives the Quantity Normal force, denoted by Variable F-vector-sub-N,SURF-on-sys, given by Giver Flat surface stuck to system. The System also receives the Quantity Static friction force, denoted by Variable lowercase f-vector-sub-S,SURF-on-sys, also from Giver Flat surface stuck to system. The Contact region between system and surface owns the Quantity Coefficient of static friction, denoted mu-sub-S,SURF+sys.

The bottom half of this sheet consists of a "**Recipe**" section with a row labeled "Diagram the relationship", a row labeled "Graphically present quantities", and a row labeled "Mathematical relationship".

Diagram the relationship
Flowchart arrows show that the magnitude of the normal force F-sub-N,SURF-on-sys contributes to the Greatest value of the static-friction-force strength lowercase f-sub-S,SURF-on-sys and that coefficient of static friction mu-sub-S,SURF+sys also contributes to the Greatest value of the static-friction-force strength lowercase f-sub-S,SURF-on-sys.

Graphically present quantities
Title: Force diagram
Dot represents system. Normal-force arrow originates from dot, points down the page, and is labeled F-sub-N,SURF-on-sys. Static-friction-force arrow originates from dot, points toward right, and is labeled lowercase f-sub-S,SURF-on-sys. Direction of static-friction-force arrow is emphasized by a caption that reads, "directed opposite direction of prevented sliding of system across surface", with an arrow pointing from the caption to the tip of the static-friction-force arrow.

Mathematical relationship
Lowercase f-sub-S,SURF-on-sys is less than or equal to mu-sub-S,SURF+sys times F-sub-N,SURF-on-sys
Direction of lowercase f-vector-sub-S,SURF-on-sys = Opposes prevented sliding