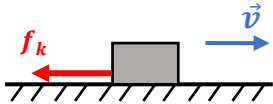


CONCEPT: STATIC FRICTION

- **Static Friction** is another type of friction similar to kinetic friction.

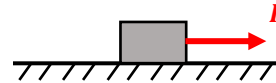
KINETIC FRICTION



- When $v \neq 0$
- Tries to stop objects already moving
- Direction: opposite of motion ($\vec{v}$)

$$f_k = \mu_k N$$

STATIC FRICTION



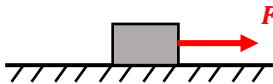
- When $v = 0$
- Tries to _____ an object from starting to move
- Direction: _____ to where the object would move without friction.

$$f_{s, \text{max}} = \mu_s N$$

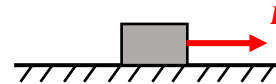
μ_s = coeff. of static friction; μ_s always $\geq \mu_k$

EXAMPLE: A 5.1kg block is at rest on the floor. The coefficients of static & kinetic friction are 0.6 and 0.3, respectively. Determine the magnitude of the friction force on the block when you push it with a force of:

a) $F = 20\text{N}$

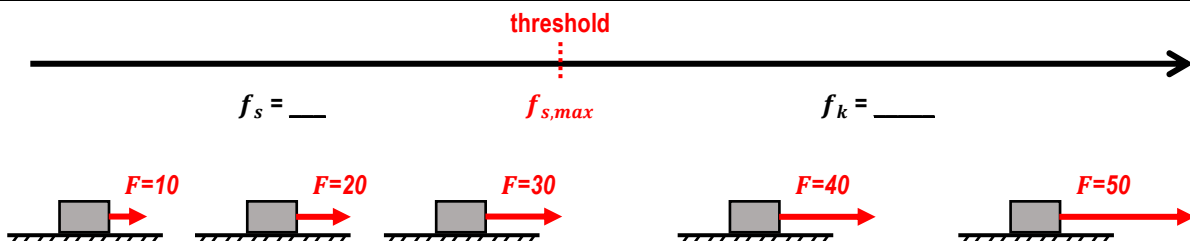


b) $F = 40\text{N}$



- $\mu_s N$ is a threshold: the force you must overcome to get an object moving, so $\mu_s N$ is the _____ value of f_s : $f_{s, \text{max}} = \mu_s N$
- This is **NOT** always the actual friction acting on an object. To determine if f_s vs. f_k , compare F to $f_{s, \text{max}}$:

IS F STRONG ENOUGH TO GET OBJECT MOVING?		
	NO ($F < f_{s, \text{max}}$)	YES ($F \geq f_{s, \text{max}}$)
Object...	[STAYS AT REST STARTS MOVING]	[STAYS AT REST STARTS MOVING]
Friction is...	[STATIC (f_s) KINETIC (f_k)]	[STATIC (f_s) KINETIC (f_k)]



PROBLEM: A 5.1 kg block is at rest on the floor. The coefficients of static & kinetic friction are $\mu_s = 0.7$ and $\mu_k = 0.5$. Calculate the force needed to **get the block moving**, and the force needed to **keep** it moving at **constant speed**.

- A) $F = 0.014 \text{ N}$; $F = 0.01 \text{ N}$
- B) $F = 3.57 \text{ N}$; $F = 2.55 \text{ N}$
- C) $F = 35$; $F = 25$
- D) Impossible to tell

FRICTION
1) Draw FBD
2) Determine if $f = f_s$ or f_k from text or: If ΣF_s on axis of motion $> f_{s,\max}$, $f = f_k$
3) Write $\Sigma F = ma$
4) Solve

- Remember: $\mu_s \geq \mu_k$! It's always harder to [GET | KEEP] something moving than it is to [GET | KEEP] it moving.

PROBLEM: A 15 kg block is initially at rest on a horizontal surface. The coefficient of static friction between the block and the surface is $\mu_s = 0.7$. How hard must you push *down* on the block to keep a 300 N horizontal force from moving it?

- A) 147 N
- B) 210 N
- C) 282 N
- D) 429 N

FRICTION
1) Draw FBD
2) Determine if $f = f_s$ or f_k from text or: If ΣF_s on axis of motion $> f_{s,\max}$, $f = f_k$
3) Write $\Sigma F = ma$
4) Solve

PROBLEM: A 36N force is needed to start a 7.0 kg box moving across the floor. If the 36.0 N force continues, the box accelerates at 0.70 m/s². What are the coefficients of static and kinetic friction?

- A) $\mu_s=0.52$ and $\mu_k=0.64$
- B) $\mu_s=0.64$ and $\mu_k=0.64$
- C) $\mu_s=0.52$ and $\mu_k=0.45$
- D) $\mu_s=0.45$ and $\mu_k=0.32$

FRICTION
1) Draw FBD 2) Determine if $f = f_s$ or f_k from text or: If ΣF_s on axis of motion $> f_{s,max}$, $f = f_k$ 3) Write $\Sigma F = ma$ 4) Solve