FRICTION

FRICTION

- a force between two surfaces that opposes motion
  - acts opposite the direction of motion
- static – object is stationary (trying to move)
- kinetic – object is moving

- F_f does not depend on velocity or surface area

COEFFICIENT OF FRICTION

- Coefficient of Friction – the ratio of the magnitude of the force of friction between 2 surfaces to the magnitude of the normal force between the surfaces

$$\mu = \frac{F_f}{F_N}$$

NORMAL FORCE

- Equal to the weight of the object
- $F_N = mg$

$g = 9.8\ m/s^2$

FRICTION

$F_f = \mu F_N$

F_f=force of friction (N)
μ=coefficient of friction
F_N=normal force (N)

COEFFICIENT OF STATIC FRICTION

- static – stationary (not moving)
- Coefficient of Static Friction:
  - the ratio of the magnitude of the maximum force of static friction to the magnitude of the normal force

$$\mu_s = \frac{F_s}{F_N}$$

COEFFICIENT OF KINETIC FRICTION

- kinetic – moving
- Coefficient of Kinetic Friction:
  - the ratio of the magnitude of the force of kinetic friction to the magnitude of the normal force

$$\mu_k = \frac{F_k}{F_N}$$

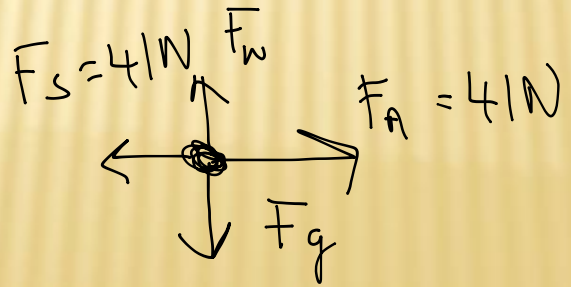
WHERE DO YOU WANT FRICTION…

- as low as possible?

- as high as possible?

EXAMPLE #1

- In the horizontal starting area for a bobsled race, 4 athletes, with a combined mass of 295 kg, need a horizontal force of 41 N [forward] to get the 315 kg sled moving. Calculate the coefficient of static friction.



$F_s = 41\ N$

$F_N = ? \longrightarrow mg$

$\mu_s = ?$

Given: $F_s = 41\ N$

$m = 315\ kg$

Required: μ_s

Analysis: $F_N = mg$

$$\mu_s = \frac{F_s}{F_N}$$

Steps: $F_N = (315\ kg)(9.8\ m/s^2)$

$F_N = 3087\ N$

$$\mu_s = \frac{41\ N}{3087\ N}$$

$\mu_s = 0.013$

EXAMPLE #2

- A truck's brakes are applied so hard that the truck goes into a skid on a dry asphalt road. The truck and its contents have a mass of 4.2×10^3 kg, calculate the force of kinetic friction on the truck.

Use $\mu_k = 0.65$

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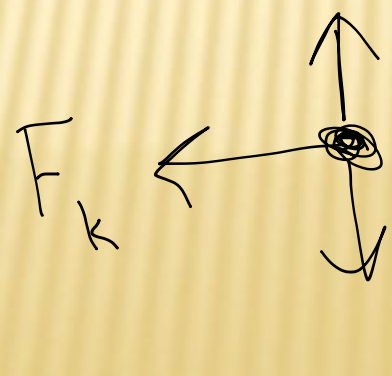

Given: $m = 4.2 \times 10^3$

$\mu_k = \frac{F_k}{F_N}$

$F_k = \mu_k F_N$

$$F_N = mg$$
$$= (4.2 \times 10^3 \text{ kg})\left(9.8 \frac{m}{s^2}\right)$$
$$F_N = 41160 \text{ N}$$

$$F_K = \mu_k F_N$$
$$= 0.65(41160 \text{ N})$$
$$F_K = 26754 \text{ N}$$

$$\therefore F_K = 27000 \text{ N}$$

EXAMPLE #3

A loaded 4-man bobsled with a mass of 615kg experiences a frictional force of 66N as it slides down the track. Calculate the coefficient of friction.

HOMEWORK

Pg 171 # 1-3

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