

D) **Friction** - force between 2 surfaces that oppose motion

Depends on:

- 1) _____ of each surface
- 2) _____ that holds objects together

Two kinds of friction

f_s 1) **Static Friction** - force of friction that must be overcome to move an object at _____.

f_k 2) **Kinetic Friction** - force of friction that opposes a _____ object.

Kinetic friction is _____ than static friction f_k _____ f_s

Friction Equations

To find static friction: **$f_s = \mu_s F_n$** To find kinetic friction: **$f_k = \mu_k F_n$**

f_s = force of _____ friction

f_k = force of _____ friction

F_n = _____ force (The upward resisting force)

μ_s = coefficient of _____ friction - "the _____ number"

μ_k = coefficient of _____ friction - "the _____ number"

1. Relates to _____ of surfaces in contact
2. Calculated experimentally

FRICION force - vector always drawn _____ **1.**

Friction

Applied Force

*** At **constant velocity**: F applied _____

***** **When object is moving on a horizontal surface:** $F_n = \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$

On a horizontal surface:

$$f_s = \underline{\hspace{2cm}} \quad f_k = \underline{\hspace{2cm}}$$

Question 1

If an object is moving on a horizontal surface and you **doubled the weight force** on the object, how would that change the **kinetic friction** force?

Answer - (Hint: **weight force = normal force** on **horizontal surface.**) $\underline{\hspace{2cm}}$

Question 2

On a horizontal surface

Static Friction equation

Kinetic friction equation

$$f_s = F_n U_s = \underline{\hspace{2cm}}$$

$$f_k = F_n \times U_k = \underline{\hspace{2cm}}$$

Look at the equations above.

- 1) What would happen to the kinetic friction (f_k) if:
- U_k (the roughness number) were halved?

Answer -

- You doubled the weight force (F)? Answer - $\underline{\hspace{2cm}}$

- you turned the block on its' side?

FRictional PROBLEMS

***** Remember $F_n = \text{Weight} = mg$ when the object is on horizontal surface

EX) A 5kg Steel block is resting on a ***horizontal table***. The coefficient of static friction (U_s) is 0.75 and the U_k is 0.57.

- What is the minimum force is needed to **start** this block moving (f_s) ?
- What is the frictional force on this object as it **moves**?
- What force must be applied to the object to keep it moving at **constant velocity**?

(Hint: $F_{\text{net}} = 0$) Answer _____

Momentum - the property of moving object has that makes it _____.

Momentum = _____ x _____

p
(kg · m/s) = _____

- a) _____ quantity
 b) p has same direction as _____
 c) units - kg×m/s

1) Relationship between force and momentum

When a **Force** acts on a body it changes its' _____

Showing the mathematical relationship

$$p = m \times v$$

$$F = m \times a$$

$$= \underline{\hspace{2cm}}$$

$$F = \underline{\hspace{2cm}}$$

$F = \underline{\hspace{1cm}}$ Force is the time rate of change in _____

Cross multiply and you get = _____

The change in momentum that an unbalanced force produces on an object depends on

_____ the force acts on a body.

2) Impulse $F \times t = J$

Combining all the equations

Write on your test immediately before answering questions

ex1) A 5kg mass has its velocity change from 8 m/s east to 2 m/s east. Find the objects change in momentum

ex 2) A 5kg mass moving with a velocity of 8 m/s east has an impulse applied to it causing its velocity to change to 20 m/s East.

Find the Impulse:

Find the force if the impulse was applied for 3 sec.

ex 3) How long would it take for a net upward force of 100N, to increase the speed of a 50kg from 100 m/s to 150 m/s.

ex4) A 1.0kg ball traveling @ 4 m/s strikes a wall and bounces straight back @ 2m/s.

Find _____

(a) = = _____

(b) What is impulse applied to the wall?